THE

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THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

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CONTENTS

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Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge

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Paper to be presented before the Annual General and General Professional Meeting of The Engineering Institute of Canada at Ottawa, February 12th, 13th, and 14th, 1930

Introduction

The new South Shore bridge at Montreal is the outcome of an insistent demand for a more adequate connection between that city and the numerous important highways south of the St. Lawrence river which have hitherto converged on the well-known Victoria bridge where the roadway accommodation is extremely limited. This demand was reinforced by increasing pressure on the part of the rapidly developing communities on the south shore and public sentiment unanimously supported the Hon. Dr. W. L. McDougald, president of the Montreal Board of Harbour Commissioners, when with courage and foresight he undertook the solution of the problem.

In January, 1925, Messrs. Monsarrat and Pratley, consulting engineers of Montreal, were appointed designing and supervising engineers for the proposed bridge, with J. B. Strauss of Chicago as associate. At the same time an Advisory Board of Engineers was created, representative of the various interests affected, to collaborate in the selection of a site and in the preparation of the plans and specifications. The Advisory Board consisted of Mr. T. W. Harvie, M.E.I.C., general manager of the Montreal Harbour, chairman; Mr. G. H. Duggan, D.Sc., M.E.I.C., president of the Dominion Bridge Company Limited; Dr. H. M. MacKay, M.E.I.C., dean of the Faculty of Engineering, McGill University; Mr. S. A. Baulne, consulting engineer, Montreal; Mr. H. A. Terreault, M.E.I.C., director of public works, City of Montreal; and Mr. Ivan E. Vallee, A.M.E.I.C., chief engineer, Department of Public Works, Quebec. Tenders were called in due course and in October, 1925, the contract for the entire steel superstructure was awarded to the Dominion Bridge Company Limited, of Montreal.

The contract stipulated that the bridge was to be built to plans and specifications as prepared by the engineers and approved by the Advisory Board. The contractor was, however, required to assume the entire responsibility for the construction of the superstructure and reserved the right to submit alternative proposals as regards the design if deemed advisable. In case of disagreement with the engineers, such proposals were to be referred to the Advisory Board whose decision was to be final. It is worthy of note that complete agreement was reached in every instance between the engineers and the contractor.

The general characteristics of the bridge are illustrated by figures Nos. 1 to 5. Figure No. 1 shows its location in relation to the vicinity, the storage yards and the railway connections for transportation of materials. Figure No. 2 is an elevation diagram showing the component parts, principal dimensions and distribution of weight. Figures Nos. 3, 4 and 5 show typical cross-sections illustrating the arrangement of the roadway, tramway tracks, and sidewalks. For convenient reference, the structure was subdivided by the engineers into section 1—south approach; section 2—main span, and section 3—north approach. The steelwork of the pavilion was awarded as a separate contract but will be considered as part of section 1 for present purposes.

The design drawings for the south approach were practically complete at the time the contract was awarded, thus enabling detail drawings to be proceeded with at once. The design of the main span was, however, in an embryonic condition owing to the lack of time previously for proper investigation and it was obvious that considerable time would be required to develop the details, estimate the weights, and complete the calculations. After a number of changes in the general proportions of the main span had been discussed with the engineers and agreement reached, the contractor undertook to fully develop the design of this section of the superstructure, all calculations and details to be checked and approved by the engineers. At this period the alignment of the north approach was unsettled. Difficulties regarding property expropriations finally led to a radical alteration in the original arrangement with the result that it was impossible to complete the design of this section until the spring of 1928.

The methods to be employed in the erection were left for the contractor to determine with the single stipulation

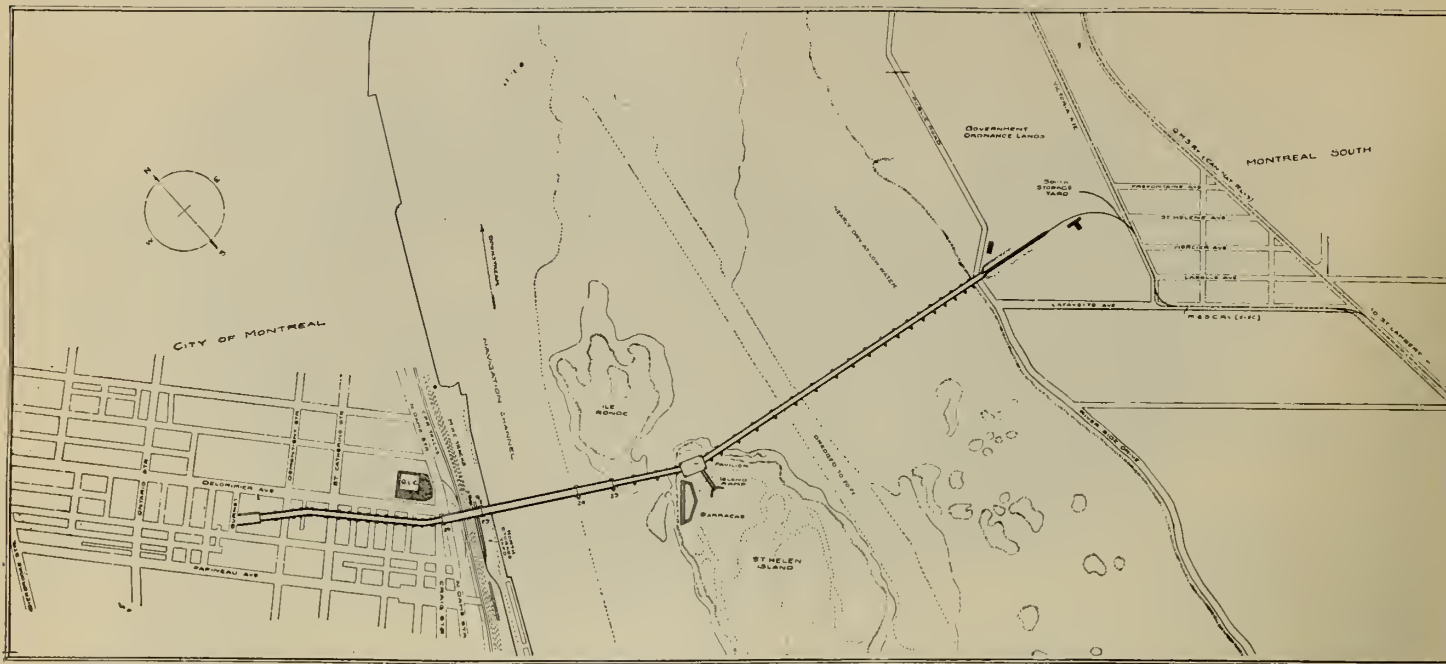


Figure No. 1.—Plan of Bridge and Vicinity.

that the navigation channel must at all times be kept clear of obstruction to shipping. It was therefore requisite that each half of the channel span be erected by cantilevering to the centre of the span, at which point the final connection would be made.

In a project of such magnitude the erection of the superstructure is a problem of outstanding importance and has a pronounced influence on the design and on the entire programme of construction. The order of operations is determined partly by the nature of the structure itself and partly by other controlling factors such as the construction programme to be followed on the substructure and the time necessary to complete final designs and drawings, to obtain the materials from the various mills, and to fabricate the steelwork. Before the designs can be completed erection methods must be decided on, and these in turn

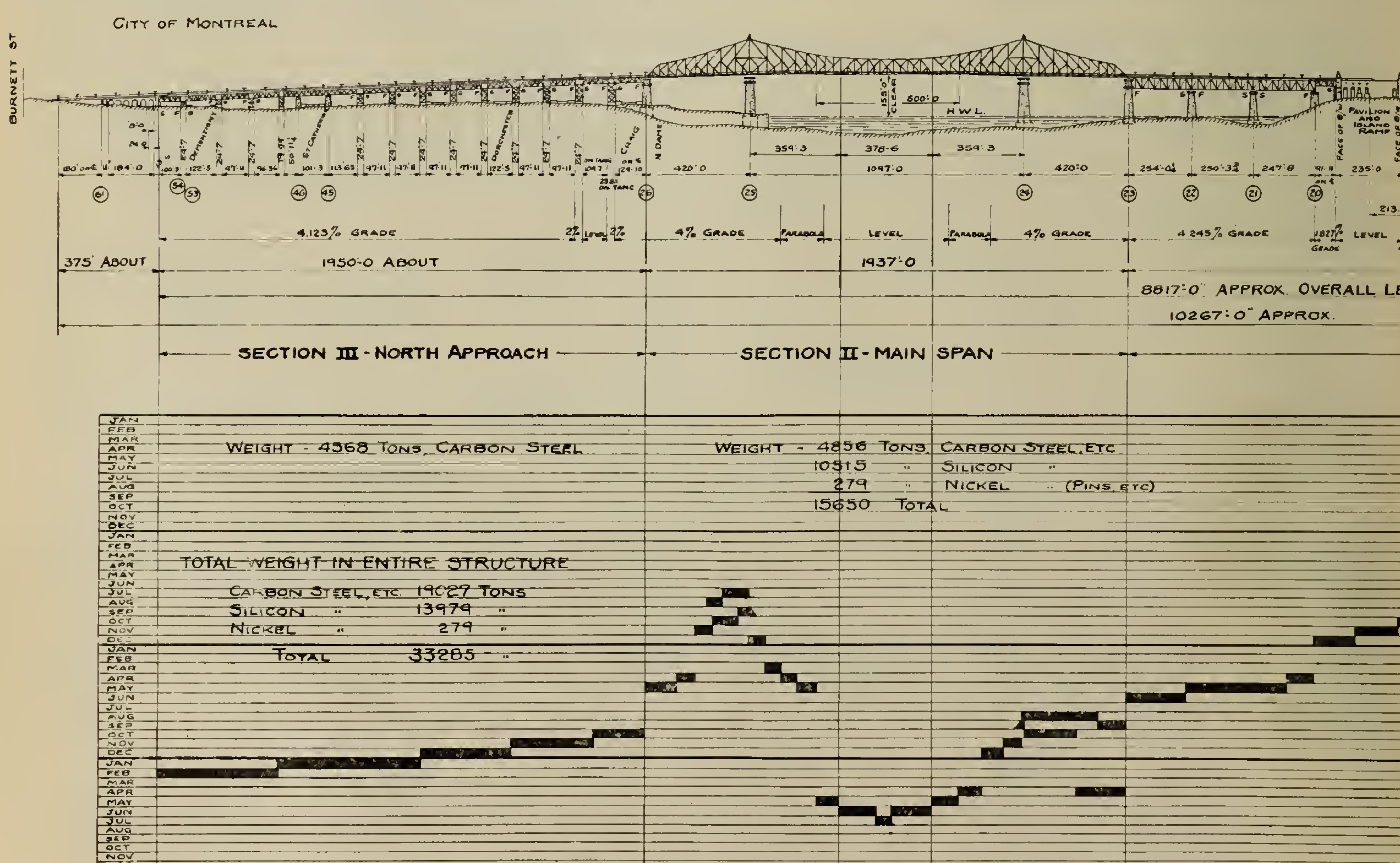


Figure No. 2.—Profile of Bridge

are governed largely by the problems of transportation and handling of materials. Where heavy erection equipment is required the weights must be determined and provision made for them in the design of the structure.

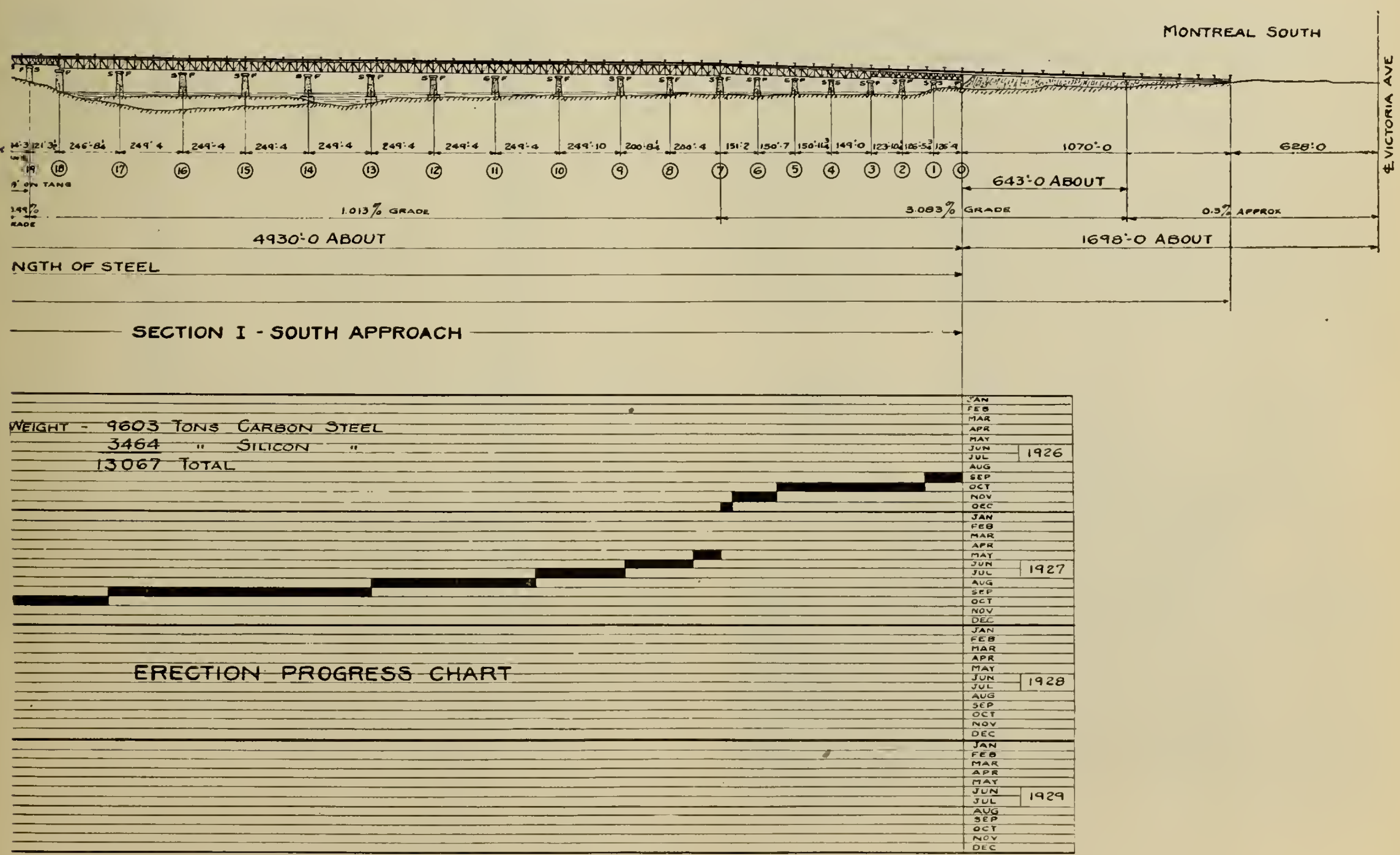
The bridge is designed to carry highway, tramway, and pedestrian traffic only. The floor system was consequently of insufficient strength to permit the use of the derrick cars and locomotive cranes so common on railway bridge erection and it was necessary to develop special equipment. The safe capacity of the floor system and other practical considerations limited the weight of individual members to about 40 tons.

The transportation of materials to the site and to their final location in the structure was one of the first problems attacked. Road transportation was out of the question for the greater proportion of the materials. Water transportation was considered carefully but was abandoned after it was established that satisfactory railway connections could be obtained which would ensure more economical and more flexible handling. On the south shore, a storage yard was established at the lower end of the approach fill leading to the bridge and rail connections made with the Canadian National Railway over the electric lines of the Montreal and Southern Counties Railway. This permitted the cars of material being delivered directly from the shops to sidings installed in the storage yard. On the north shore, it was impossible to make direct rail connections with the floor of the bridge. The harbour tracks however pass under the north anchor arm and the storage yard was established at this point with railway sidings connecting to the harbour tracks.

It is evident that the dividing line of erection was the centre of the channel span. The superstructure to the south had as its base of operations the south storage yard where materials were received, unloaded for storage, and re-handled as required to the bridge over the connecting service tracks. It was necessary that erection be commenced at the south abutment and be carried on in sequence to St. Helen's island and thence to the main span. The superstructure north of the dividing line had as its base of operations the north storage yard under the north anchor arm. Materials were received here at ground level, hoisted to the floor of the bridge as required, and distributed to their destination. Erection naturally commenced on the anchor arm, the north approach being inaccessible until after completion to the anchor pier.

The storage yards were equipped with offices and stores, repair shops and other necessary facilities in addition to the railway sidings. Materials were handled in the yards by locomotive cranes of 30 to 40 tons capacity. On the south side, the motive equipment consisted of a 40-ton standard gauge saddle-tank locomotive and a number of standard gauge 40-ton capacity flat cars; several of the latter were also supplied for use on the north side. It was decided to provide for two standard gauge service tracks throughout the structure on the lines of the future tramway tracks, consisting of 56-lb. rails on 8- by 10-inch B.C. fir bridge ties 10 feet long, every alternate tie being secured by hook bolts to the flanges of the track stringers. The length of haulage and the steep gradient in certain sections made every precaution necessary to avoid delay to the erecting crews.

After every factor affecting erection had been carefully reviewed in collaboration with the engineers, a working programme was adopted which required the erection of the south approach to be commenced at the south abutment in the fall of 1926 or spring of 1927, depending on progress on the substructure; of the north half of the main span in the early summer of 1927; of the south half of this section during the summer of 1928; and of the north approach



and Erection Progress Chart.

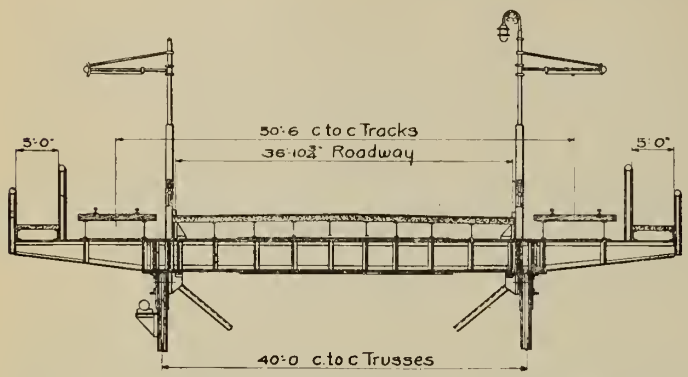


Figure No. 3.—Typical Cross-section of Floor on Approach Spans.

during the fall of 1928. The date stipulated in the contract for completion, exclusive of the field painting was July 1st, 1930. The actual progress of erection is illustrated graphically in figure No. 2 and will be referred to in detail later.

Mention may also be made of the fact that tenders had been invited based on concurrent erection of both halves of the main span, the object in mind being a possible saving in time of construction. However, the greatly increased cost owing to duplication of equipment and other factors led to this scheme not being adopted, particularly as any actual saving in time was somewhat hypothetical.

South Approach and Pavilion — Section 1

The south approach extends in a straight line from the south abutment to the pavilion on St. Helen's island, a distance of approximately 4,000 feet. Changing alignment at this point, it continues to the south end of the main span, a further 900 feet. A ramp 250 feet in length leads from the pavilion to road level on St. Helen's island. The total length is therefore approximately 4,900 feet from south abutment to main span, or slightly less than one mile, including the ramp.

The approach consists principally of a series of deck truss spans carried on masonry and concrete piers, and graduated in length from 122 feet 6 inches to 245 feet, the arrangement being illustrated in figure No. 2. The floor rises on a 3.083 per cent grade for about 1,000 feet, flattens to 1.013 per cent to St. Helen's island, and after a level section over the pavilion, rises sharply on a 4.245 per cent grade to the end of the main span.

The trusses are of conventional Warren type, are spaced at 40-foot centres and vary in depth with the span. The floor system is carried above the trusses by floorbeams which rest on and cantilever over the top chords, as shown in cross-section in figure No. 3. The lateral and bracing systems are of liberal proportions. Short skew spans were necessary at each end of the pavilion to suit the arrangement at that point and the ramp is also somewhat different in design to the main approach. The steelwork of the pavilion is of simple design, the floor of the bridge being carried on the roof of the pavilion by means of heavy girder construction. Throughout the main portion of the approach the floor panels are 24 feet 6 inches in length; this uniformity proving a great advantage during erection.

The steelwork of the approach is of special carbon steel except in the trusses of the 245-foot spans where silicon steel is used with a limiting thickness of ¾ inch. For further particulars on the characteristics of these materials, see Section 2—Main Span.

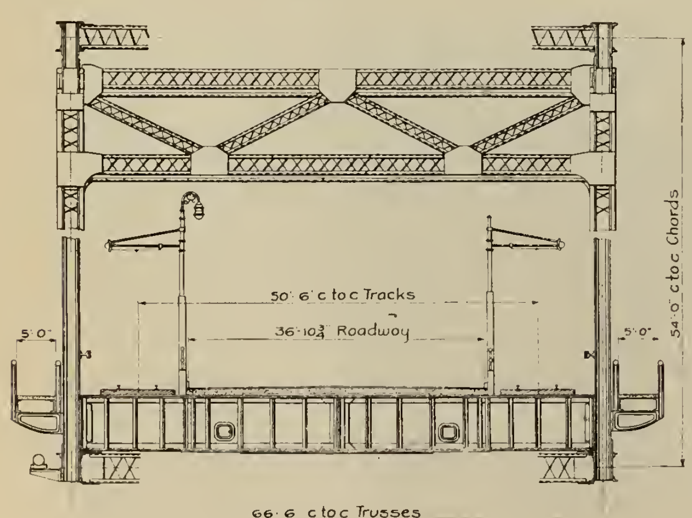


Figure No. 5.—Cross-section of Main Span at Centre.

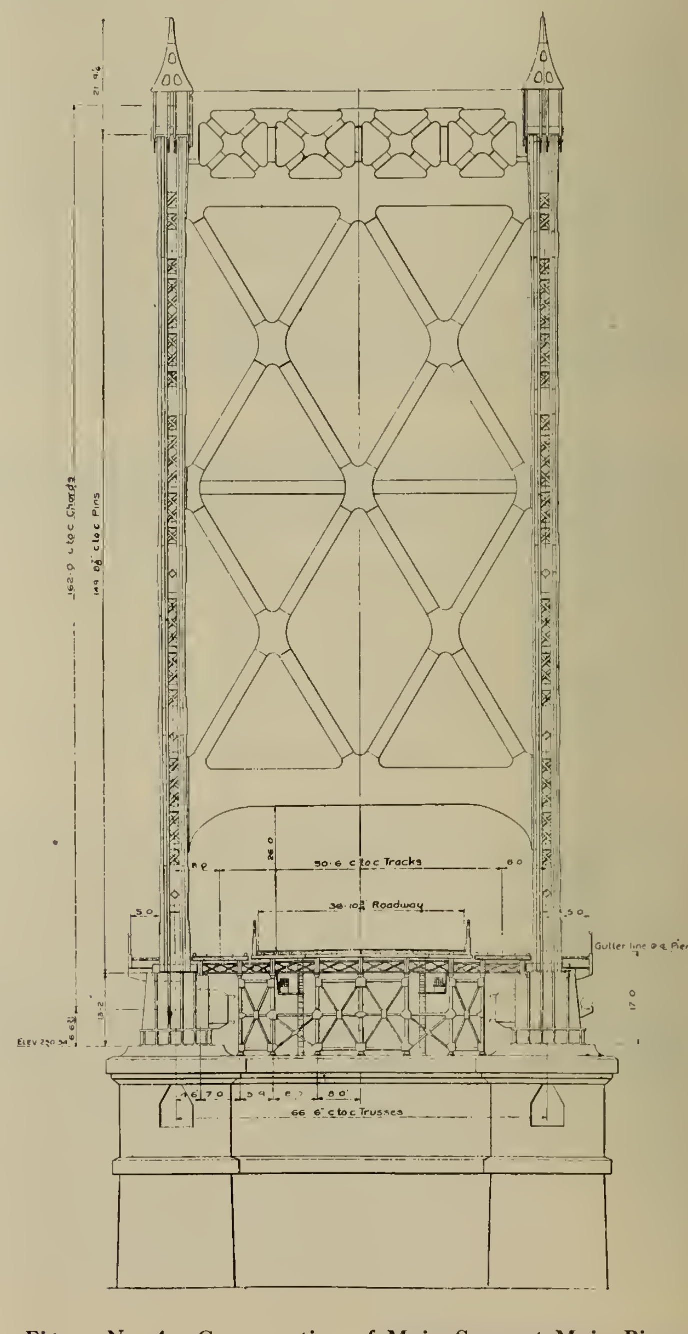


Figure No. 4.—Cross-section of Main Span at Main Piers.

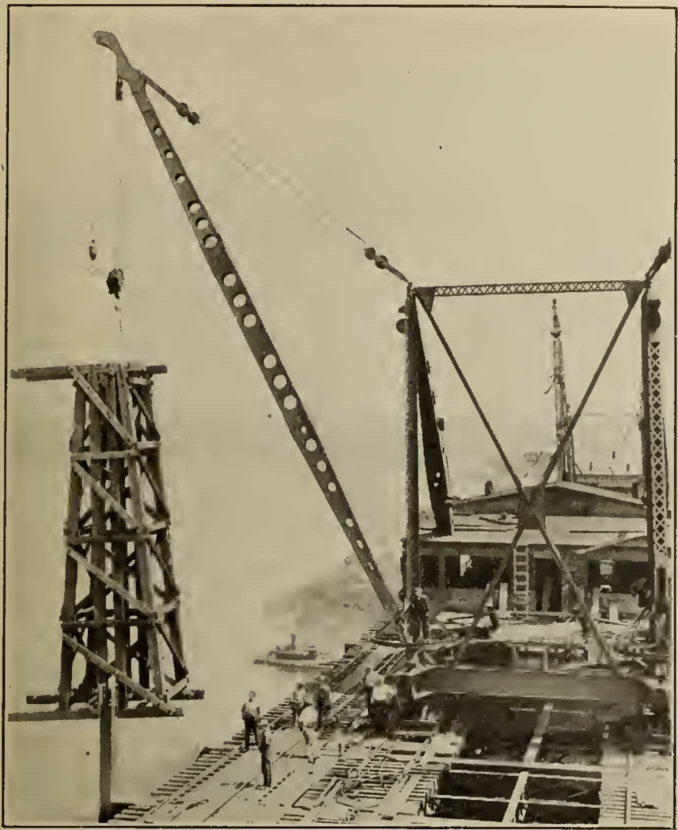


Figure No. 6.—South Approach—Front View of Traveller No. 1 handling Timber Falsework.

Fabrication followed well established practice and presented no unusual difficulties. The main gusset plates were rivetted to the chords, the field connections for the web members being drilled full size to template in the gussets before assembly. The chords were in general spliced in two-panel length of about 50 feet, the splices being arranged for continuous erection of each span from the south end. The chord splices were faced and reamed to template, without assembly of the adjoining members, Lateral, swaybracing and floor connections were punched fullsize. Owing to pressure of work, the fabrication of the roadway and tramway stringers and roadway curbs was sublet to Canadian Vickers Limited of Montreal.

Erection was commenced at the south abutment during September, 1926, and seven spans were completed in that season. Operations were resumed during April, 1927, and the structure was completed during that season to pier 20, one span beyond the pavilion. The remaining spans were erected early in the season of 1928. It had been planned to complete the south approach by the end of 1927, but operations were retarded throughout by the progress on the piers and pavilion substructure with the result that winter ice conditions made it impracticable to proceed further than the point noted.

The superstructure was erected by means of travellers operating on the deck of the bridge, the materials being delivered alongside on either service track as required. The service tracks being 50 feet 6 inches centres, it was necessary to restrict the overall width of the travellers to about 40 feet. The changes in the floor gradient had also to be provided for in the traveller construction.

The principal erection was carried out by the specially designed traveller No. 1, the base of which consisted of a steel frame 25 feet wide by 50 feet long, mounted on four 4-wheel trucks travelling on two tracks of 4 feet 2 inches gauge spaced 25 feet centres. On this base were mounted two steel derricks with masts over the forward trucks and booms 70 feet long, each boom being equipped with main falls of 20 tons capacity and an auxiliary line of 5 tons capacity.

The hoisting lines were of ¾ inch diameter 6-19 special wire rope, using six parts in the main falls and thirteen parts in the boom falls. Power was supplied by two standard 3-drum 8- by 12-inch steam hoisting engines. The masts were fitted with 9-foot diameter bull wheels for swinging purposes operated from independent single-drum swinging engines. An auxiliary derrick was mounted at the centre of the rear end with a 50-foot boom of 5 tons capacity. Somewhat elaborate details were developed to facilitate the movement of the traveller and provide positive anchorage against movement or uplift in the working positions, the convenience of these features amply repaying their expense. The weight of the traveller in full working order was 120 tons. It was designed to permit the safe handling of a weight of 16 tons on either or both booms, at 60-foot forward radius and 40-foot side or rear radius, the capacity increasing at lesser radius to a maximum of 20 tons. The general arrangement of traveller No. 1 is illustrated in figure No. 6.

It was the intention to use this traveller on the erection of the north approach also which would require its operation on a downward 4 per cent grade. The base was therefore so arranged that by altering the blocking on the rear trucks it could be kept level on any floor gradient from 4.25 per cent upward to 4 per cent downward, thus maintaining the derrick masts in proper working position at all times.

The roadway stringers, 20-inch, 65-lb. I-sections, were inadequate to carry the weight of the traveller while being moved. Doubling-up of the stringers under the traveller tracks was first considered but the amount of blocking for stability on such a length of floor led to the decision to provide special track girders for the traveller. Each unit

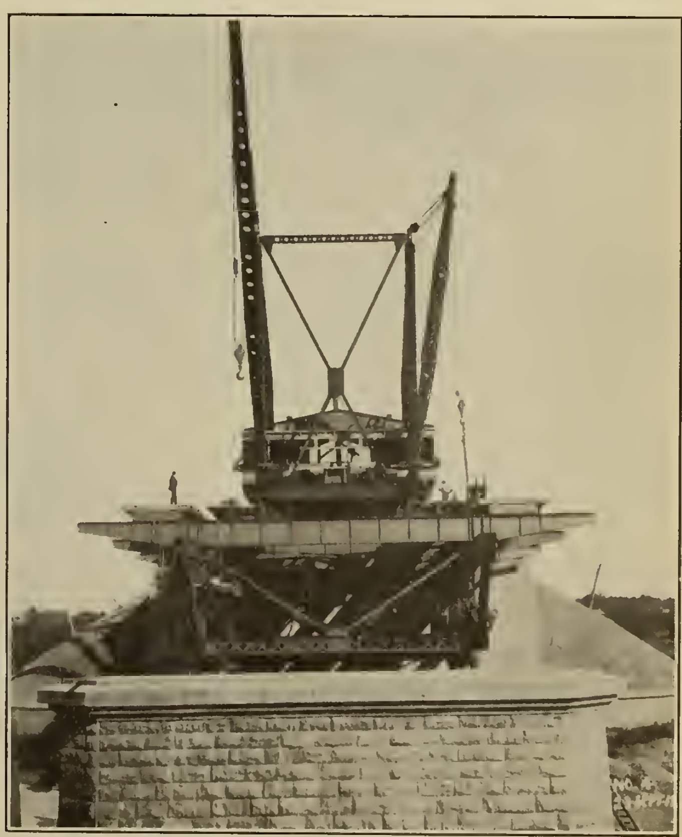


Figure No. 7.—South Approach—Front View of Traveller No. 1 showing Arrangement of Deck.

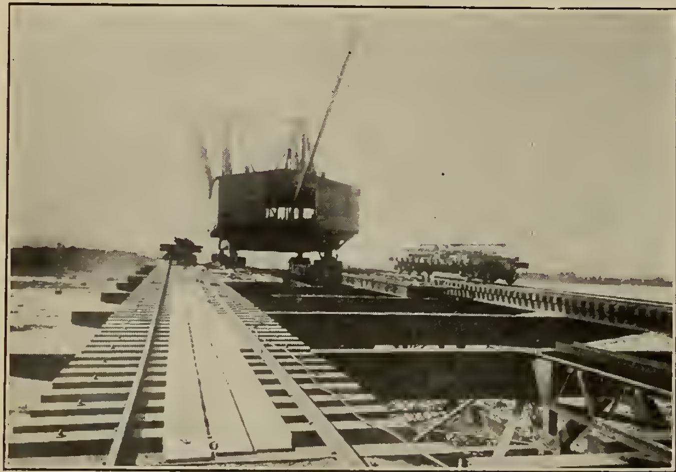


Figure No. 8.—South Approach—Rear View of Traveller No. 1 and Deck.

Figure No. 9.—South Approach—Timber Falsework under Short Spans.

consisted of two 24-inch, 106-lb. I-sections, 24 feet 6 inches long, rigidly braced and stiffened, and with brackets on the outer side. The track rails were clamped directly to the top flanges of the beams and the entire deck of the unit planked over. The track girders were of sufficient strength to carry the truck reactions of the traveller in the working positions, the maximum reaction being 86 tons. Sufficient girders were provided for four panels of floor. As the traveller was moved forward the girders behind were lifted as released by the rear boom, placed on the flat cars and moved forward for use in the next panels. At such few points where the panels were not of standard length special blocking and temporary grouping of the stringers proved sufficient. The general arrangement on the deck is shown in figures Nos. 7 and 8, which show the service tracks with material cars, traveller No. 1 and the temporary track girders.

An auxiliary traveller, No. 2, was also provided, the base of which was of simple timber construction mounted on special double-flanged truck wheels rolling directly on the flanges of the roadway stringers. On this base were placed two standard stiff-leg derricks with 70-foot booms of 12 tons capacity, operated from steam hoisting engines. This traveller was used to place the floor steel behind traveller No. 1, remove falsework, and perform other handling operations as required.

At a later date a third traveller was used to place the fences, curbs, lamp poles and other sundry steelwork of the deck. This traveller consisted of a light Jinniwink derrick mounted on a standard flat car and operated from the service tracks.

The south approach is shown in profile in figure No. 2, the method of erecting the various spans being partly on timber falsework and partly by cantilevering. The use of falsework throughout this section had serious drawbacks as a study of the profile will suggest. In the first place, winter ice conditions prohibited falsework in the river from about December 15th until the following May. Secondly, the river bottom between the south shore and St. Helen's island consists for the most part of irregular shale rock which entirely precluded the driving of piles. Although the water is very shallow throughout the greater part of the season, the depth is sufficient when coupled with the current to render very laborious the fitting of falsework to a good bearing on the bottom. Thirdly, the changes in grade and in the depths of the spans resulted in a constantly changing distance from the underside of the steel to the river bottom necessitating alterations in the height of the

Figure No. 10.—South Approach—Timber Falsework under Span No. 10 (245-foot).

Figure No. 11.—South Approach—Timber Falsework under Span No. 22 (245-foot).

falsework at every panel. Fourthly, the very considerable height of steel above river bottom, particularly beyond St. Helen's island, was unfavourable to the use of falsework on account of the quantity involved and the time required for setting up and dismantling. These various factors led to the decision to erect by cantilevering wherever practicable as being both more economical and more expeditious. In all, three of the four 147-foot spans and ten of the twelve 245-foot spans were erected in this manner.

The falsework, where used, consisted of timber towers framed in the yard of specially imported B.C. fir and shipped forward to the erecting crews as required, the units being as large as handling conditions permitted. Each tower consisted of two bents 8 feet centre to centre; the posts, caps and sills being of 12 by 12 inches, and the bracing 4 by 8 inches with steel scabs at the joints. The towers were erected on previously prepared cribwork footings and were braced together and to the piers sufficiently to ensure stability. The spans were supported on the towers by an arrangement of blocking which permitted jacking when necessary. Typical details of the falsework and the arrangement during erection are shown in figures Nos. 9 and 10. A special arrangement of falsework was necessary under the first 245-foot span beyond the pavilion owing to the ground contours at that point and the depth of water. As illustrated in figure No. 11, a three-bent tower was used near the centre of the span in view of the heavy reaction while cantilevering the forward half of the span.

The erection of the spans on falsework requires no special comment. Sufficient towers had been provided to avoid delay to traveller No. 1 and as each span was completed and jacked on to the piers, the falsework was removed by traveller No. 2 and moved forward for further use as required.

The three forward 147-foot spans were cantilevered, the span immediately behind being used in each instance as an anchor span. The trusses were of sufficient depth that reinforcement for erection stresses was unnecessary. The end top chord sections of the adjoining spans were fabricated as continuous members to avoid heavy temporary connections over the piers while cantilevering beyond. Special temporary shoes were placed between the faced ends of the adjacent bottom chord sections. The span having been erected as a cantilever, was jacked at the forward end to relieve the stresses at the rear. The continuous top chords were then cut by burning, the temporary shoes removed and the span lowered to permanent position on its pier members.

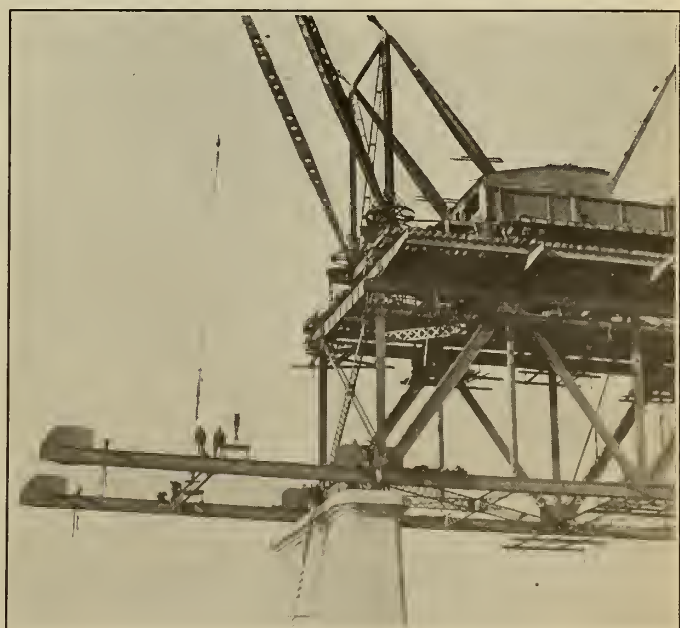


Figure No. 12.—South Approach—Cantilever Erection of 245-foot Span—First Stage.

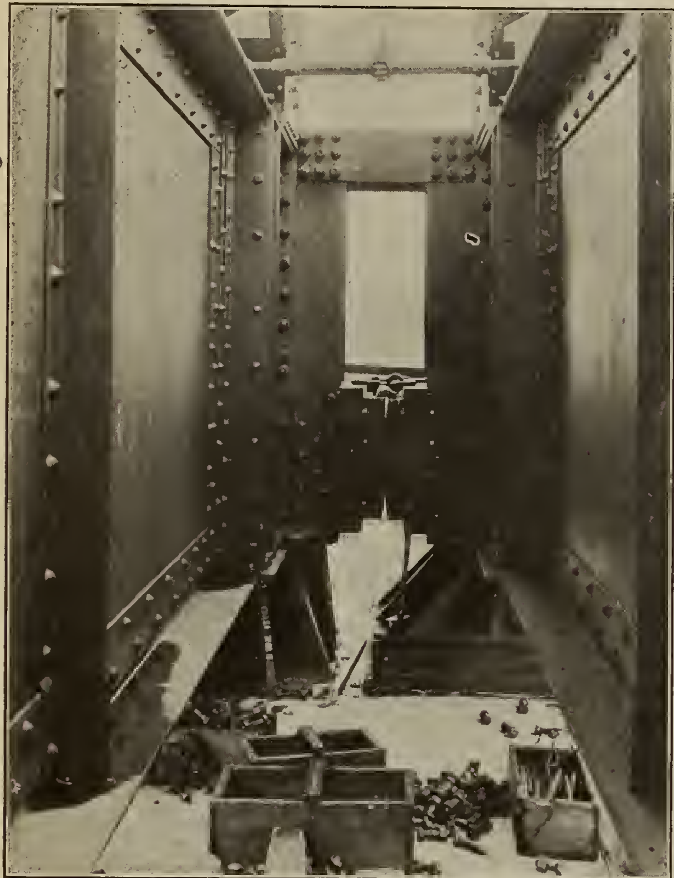


Figure No. 13.—South Approach—Cantilever Erection of 245-foot Span—Special Shoe Details.

Eight of the nine 245-foot spans south of St. Helen's island and two of the three similar spans north were also erected as cantilevers. Special treatment of them was necessary to avoid an excessive amount of erection reinforcement in the chords adjacent to the loaded pier. An overhead harness was specially developed which increased the effective depth of the trusses at the pier from 35 to 70 feet, and reduced the reinforcement required to a small addition in the end bottom chord sections. The general arrangement of the harness is shown in figure No. 18. The tension members consisted of medium heat-treated eyebars having a yield point of 50,000 lbs., and an ultimate strength of 80,000 lbs. per square inch. Silicon steel was used in the posts and the 10 ½-inch pins were of forged nickel steel. The necessary top chord sections of the spans were specially bored in the shops, the pinholes being liberally reinforced. Particular attention was given to all details to ensure ease of handling during the successive use of the harness.

The first operation in the erection of a typical 245-foot span was the placing of the bottom chord sections at the pier. (See figure No. 12.) Temporary shoes were placed between the faced ends of the adjacent chords and connections made at the top of the main gusset plates to sustain the weight of the chords. (See figure No. 13.) Three panels of the span were then cantilevered with temporary connections to the rear span, in the line of the top chord, the temporary bottom chord gusset connections being removed on the completion of the first panel. (See figure No. 14.) This portion of the span was erected with a slight inclination to facilitate the connection of the harness, which was now set up omitting the bracing between the posts for the time being to permit the passage of traveller No. 1. By means of the booms of traveller No. 1, the harness was toggled upwards at the midpoint over the pier to release the temporary top chord connections which were removed, the harness being then slacked off. The general arrange-

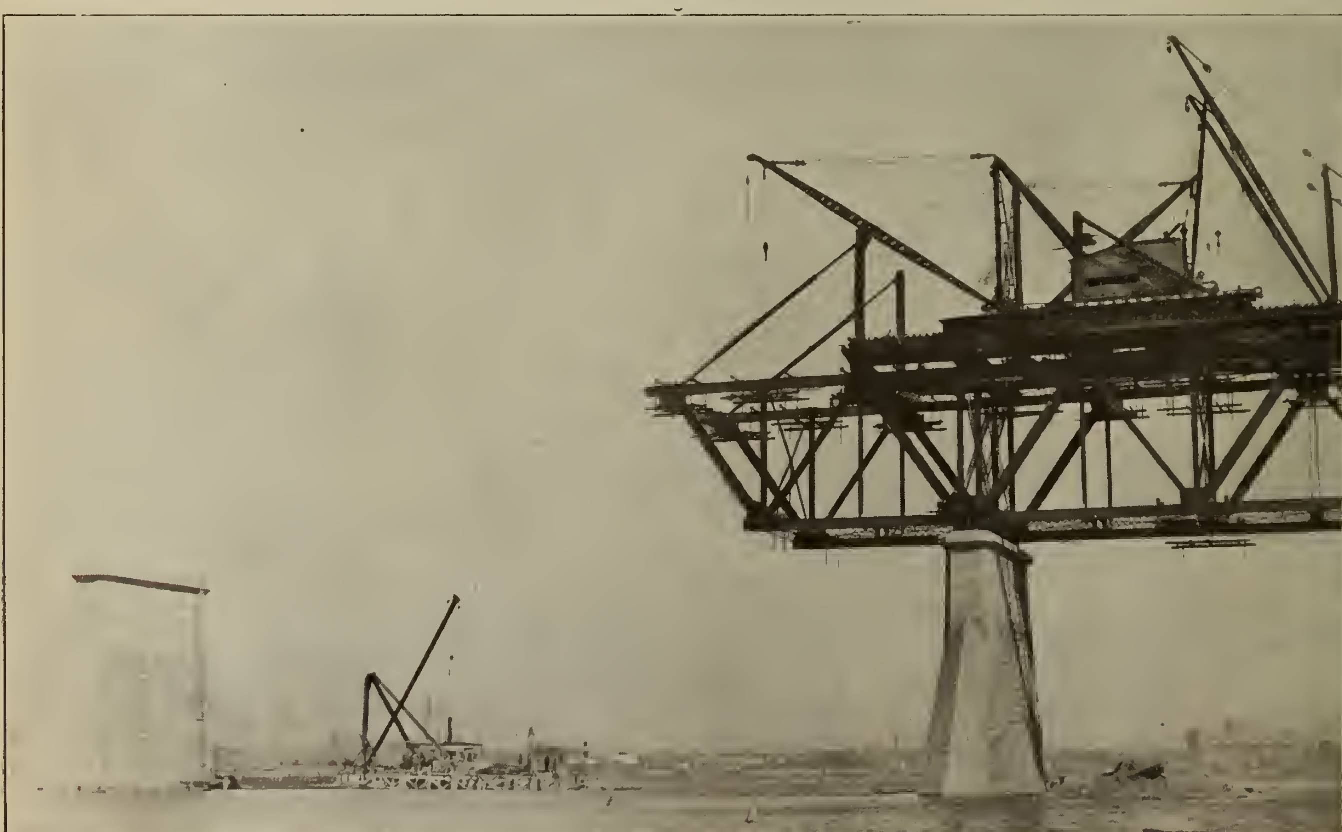


Figure No. 14.—South Approach—Cantilever Erection of 245-foot Spans—Second Stage.

ment during this stage is illustrated by figure No. 15, which shows the harness in its toggled condition. Traveller No. 1, having been moved forward, proceeded with the erection of the span after placing the front harness bracing, while traveller No. 2 placed the rear harness bracing, (see figure No. 16), being afterwards moved to the back end of the rear span as additional anchorage. At this point temporary vertical and lateral connections were also made to the span behind to ensure stability under all conditions. Conditions on the deck at this stage with further details of the harness are shown in figure No. 17. On the completion of the span to the forward pier, (see figure No. 18), the bottom chords were blocked after jacking a small amount, the remaining material being then erected. (See figure No. 19.) Hydraulic jacks of 190 tons capacity having been placed under each end of the jacking girder, the end of the span was raised to release the harness and permit its disconnection. The bottom chord shoes were also removed and the span then lowered by jacking on to the permanent pier members.

The amount of jacking was determined in advance by accurate calculations of the deflections during erection, actual results corresponding closely with the calculated. The length of the harness members was made such as to ensure ample room for the jacks under the jacking girders at the forward pier when cantilevered to that point. The amount of upward jacking to relieve the sag in the cantilevered span and release the harness was about 22 inches, it being necessary to lower the end approximately the same amount while landing on the shoes. The ratio of width to length in the spans resulted in exceptional stiffness even when fully cantilevered, there being virtually no vibration in the structure from either wind or the traveller.

The temporary shoes between the abutting bottom chords at the loaded pier were developed with some care.

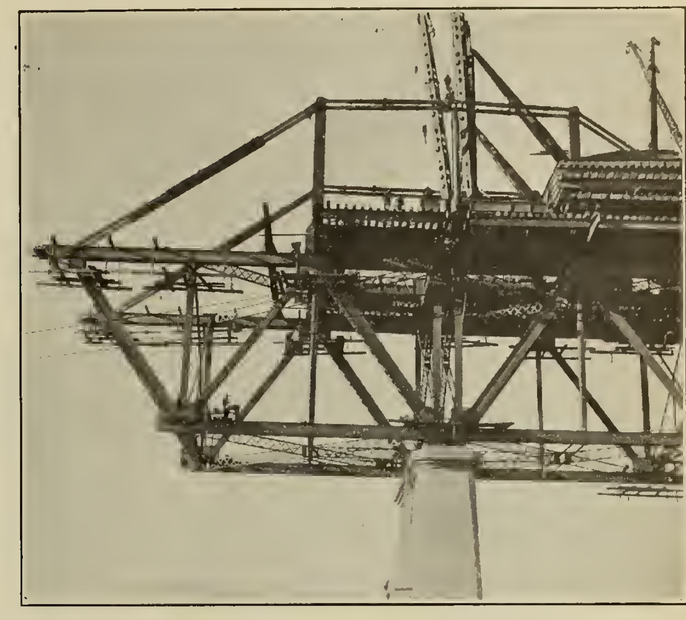


Figure No. 15.—South Approach—Cantilever Erection of 245-foot Spans—Third Stage.

The change in angle of the end chords due to the span deflections was sufficient to produce a definite vertical movement at the contact faces of the shoes. The bearing face of one shoe at each point was, therefore, made convex, (see figure No. 13), to prevent bearing on the edges and facilitate vertical adjustment by sliding during the earlier stages before the load was sufficient to make the shoes seize. The approximate secondary bending stresses in the end chords were calculated and provision made for them by

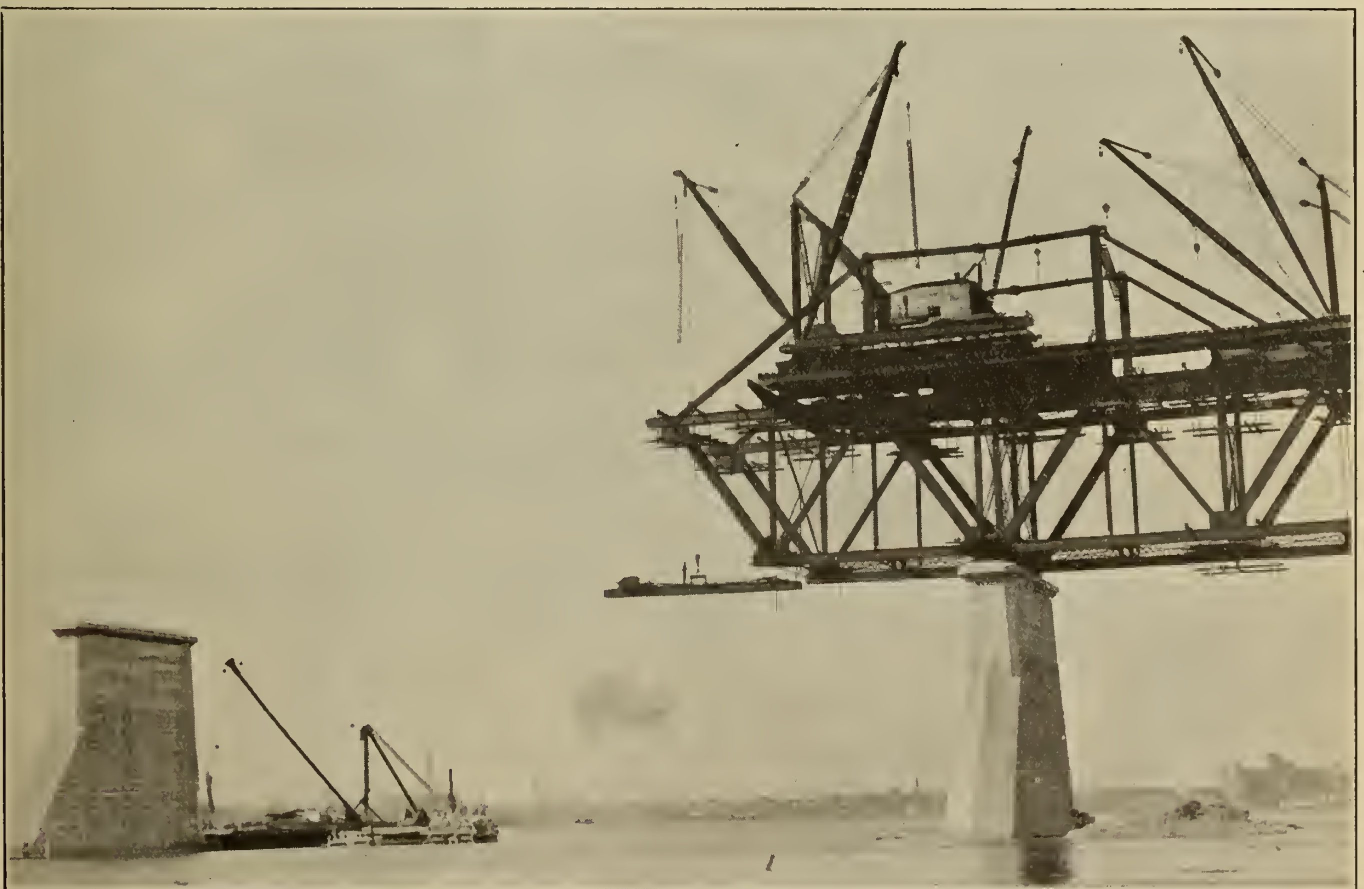


Figure No. 16.—South Approach—Cantilever Erection of 245-foot Spans—Fourth Stage.

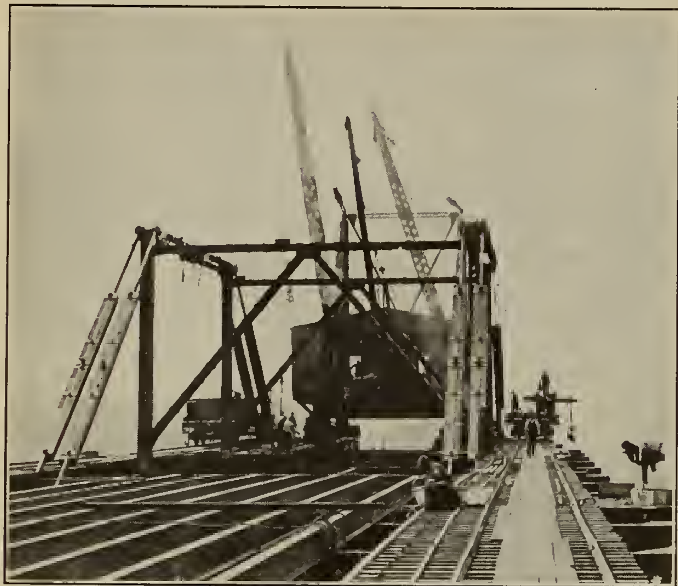


Figure No. 17.—South Approach—Cantilever Erection of 245-foot Spans—Details of Harness.

local reinforcing. The removal of the shoes was simplified by erecting each span slightly behind its ultimate position. As the forward end was lowered on to the disc-like tops of the fixed shoes, the span mechanically centered itself on these shoes by moving forward as a whole, releasing the temporary erection shoes and making their removal easy.

Throughout the approach, the work of traveller No. 1 was restricted to the erection of the main framework thus greatly accelerating its rate of progress. The remaining floor steel was placed by traveller No. 2 as it advanced behind traveller No. 1, the miscellaneous material such as fences, curbs, etc., being left for later erection.

The steelwork of the pavilion was erected with traveller No. 1, the type of construction being illustrated by figure No. 20. The ramp leading from the pavilion to St. Helen's island was erected during the summer of 1928 with auxiliary equipment.

That the equipment devised for the erection of the approach superstructure was well suited to the purpose is best illustrated by the fact that during September, 1927, four 245-foot spans were completely erected, representing a length of 980 feet, and a weight of approximately 2,260 tons. Had it been possible to accelerate sufficiently the progress on the substructure the entire steelwork of the south approach could have been erected during the season of 1927, and no advantage resulted from the commencement of work in 1926. Fortunately it was found possible to so co-ordinate operations on the south half of the main span as greatly to offset the delay on the south approach.

North Approach — Section 3

At the Montreal end, the approach to the main span consists of a viaduct approximately 2,300 feet in length commencing at ground level some distance north of St. Catherine street east, and rising on a 4.123 per cent gradient to near its junction with the main span. Of the total length, 1,950 feet is of steel construction and consists of a series of short deck truss spans supported on steel towers except for masonry piers at St. Catherine street. The original layout involved a viaduct of straight alignment parallel to Delorimier avenue; this was later modified by introducing a reverse curvature, the ultimate arrangement being illustrated by figure No. 21, which shows a view of the deck looking north from the main span.

The viaduct crosses a number of important thoroughfares of which Craig street and St. Catherine street carry tramway traffic. The spans are arranged to suit the street crossings and are for the most part 98 feet and 122 feet 6 inches in length with special construction where necessary, as illustrated in figure No. 2. The floor construction is similar to that of the south approach. The spans are also of similar design to the short spans of the south approach, the trusses being spaced at 40 feet centres as on the south side. The tower bases are 40 feet in width by 24 feet 6 inches in length except where skew construction was necessary,

Figure No. 18.—South Approach—Cantilever Erection of 245-foot Spans—Fifth Stage.

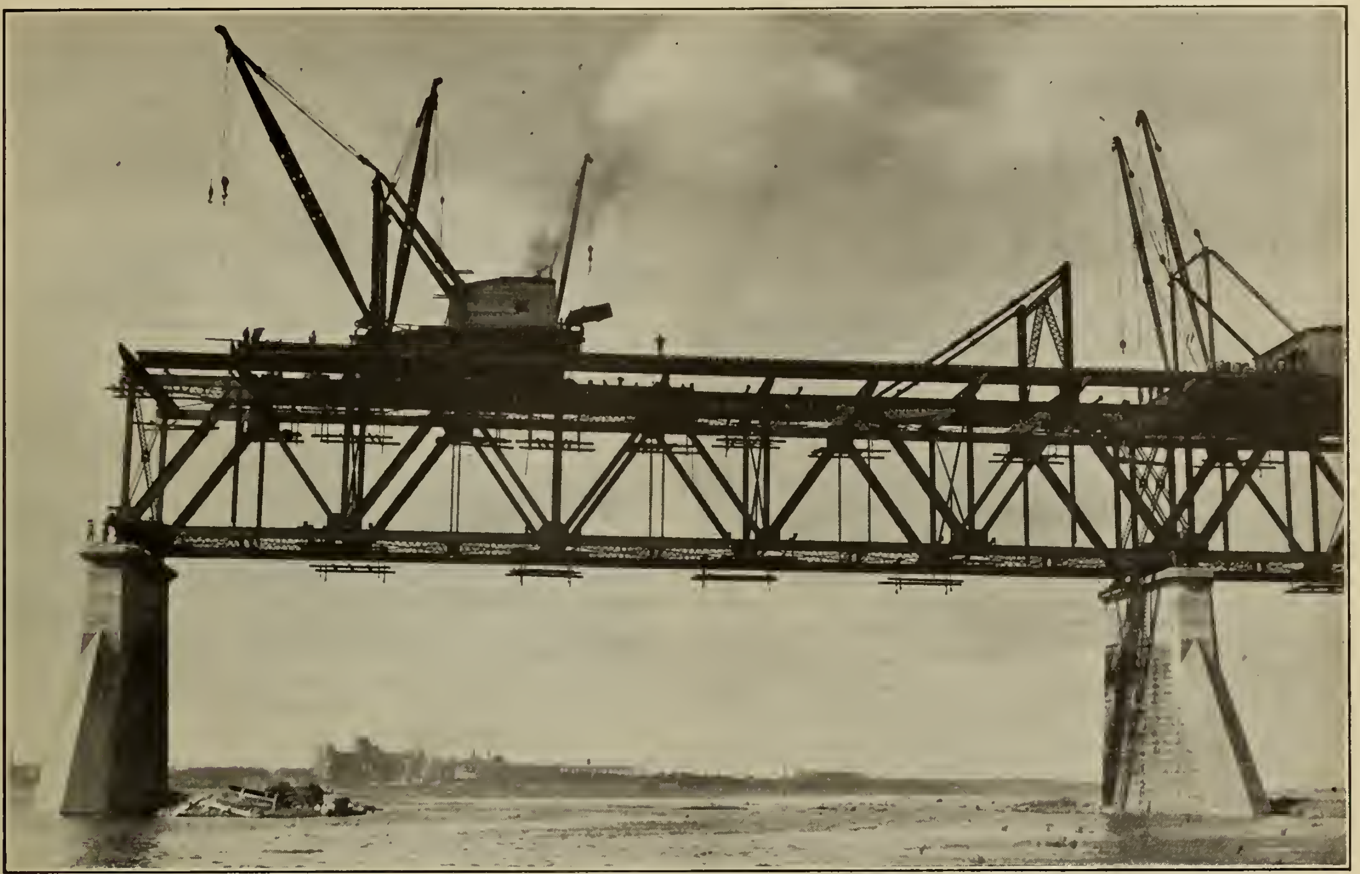


Figure No. 19.—South Approach—Cantilever Erection of 245-foot Spans—Sixth Stage.

the towers themselves consisting of four vertical steel posts with suitable bracing.

Erection commenced at the end adjacent to the main span during October, 1928, and was completed in February, 1929. Traffic was diverted by the authorities at the various streets in turn while construction proceeded overhead, with the exception of St. Catherine street where heavy tramway traffic throughout the day prohibited interference. The materials were received in the north storage yard by rail, hoisted to the floor of the bridge and distributed by flat cars on the service tracks to the point required. These cars were operated by cables leading to steam winches on the deck near the north main pier.

The first span of the approach crosses Craig street. It was erected by traveller No. 3 which had been used on the erection of the north anchor arm earlier in the season and a description of which is given elsewhere. The span was supported near its midpoint by a timber tower of similar construction to those used in the south approach falsework. (See figure No. 22.) With the traveller standing at this point, it was possible to erect the near bent of the steel tower which was sufficiently rigid to permit the span being blocked thereon. (See figure No. 23.) The traveller, having been moved forward, completed the erection of the tower after which the span was jacked clear of the falsework and landed on the tower. A portion of the next span was then erected and traveller No. 1, previously used on the south approach, was set up for the erection of the remaining spans. With the exception of the span over St. Catherine street, the remainder of the structure was erected in the manner outlined above, the timber towers being shortened progressively to suit the grade. Special arrangement of the floor was necessary temporarily where the alignment changed; elsewhere the traveller was carried on the same track girders used on the south side.

At St. Catherine street the method of erection was modified owing to the impracticability of placing falsework in the middle of the street. This span, 98 feet in length, was erected as a cantilever using a simplified harness similar in principle to that used on the erection of the 245-foot spans of the south approach and made up of some of its parts. (See figure No. 24.) In this manner, the span was erected quickly without interference with the tramway traffic below.

Traveller No. 1 placed the roadway stringers and curbs during the erection of each span; it also removed the falsework tower as soon as released. This dispensed with any need for an auxiliary traveller on the north approach; for convenience however, the fences, etc., were placed later by equipment similar to that employed on the south approach.

Main Span—Section 2

General Design

The main span of the bridge is a symmetrical cantilever having an overall length of 1,937 feet. (See figure No. 2.) The centre span is 1,097 feet centre to centre of main piers which provides a clear navigation channel of 1,000 feet, the pier on the north wharf being set back about 50 feet from the face of the dock wall. The north anchor pier is located near the intersection of Craig and Notre Dame streets and clears each thoroughfare, the resultant length of the anchor arms, which were made alike, being 420 feet. The navigation clearance in the channel is 155 feet at mean high water level on a central length of 500 feet as stipulated by the authorities. The roadway is level on this section and descends each way on a gradient of 4 per cent, the arrangement of the deck being illustrated by figures Nos. 4 and 5.

The trusses of the anchor and cantilever arms are of the K-design so successfully introduced in the Quebec bridge

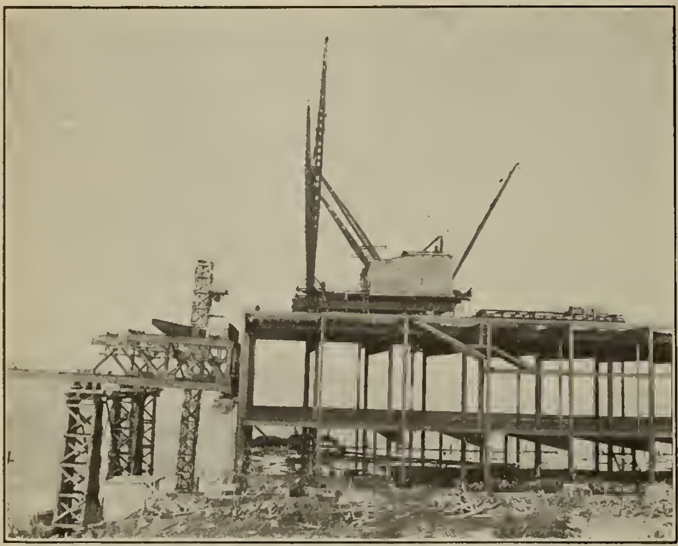


Figure No. 20.—Pavilion on St. Helen's Island.

and are spaced at 66 feet 6 inches centres to suit the floor requirements. They are 162 feet in depth at the main piers, reducing to 50 feet at the end of the anchor arm, and to 54 feet at the centre of the span. Special pains were taken to obtain the most pleasing outline consistent with economical proportions, the top chord curvatures being carried through into the suspended span for the sake of appearance. To permit a harmonious treatment of the web members, a varying length of panel was adopted for the main arms, the longer panels being subdivided for the sake of economical construction. A tapering effect was introduced in the top and bottom chords of the main arms, and the bracing at the main posts and end portals laid out with special regard to appearance.

The tender plans called for a suspended span 312 feet in length as lending itself to ease of erection. In the interest of economy and appearance, however, the contractor suggested and undertook the erection of a longer span, the length finally adopted being 378 feet 6 inches. The ultimate arrangement of the members in this portion of the span was governed largely by erection considerations.

The present description of the design and details of the span must of necessity be limited to sufficient for an understanding of the problems of fabrication and erection. The trusses are in parallel planes throughout and are of rivetted construction, with pin connections at points where free articulation is desirable. The truss members consist for the most part of two built-up webs in planes parallel to the axis of the bridge, connected by suitable lacing systems and squared-up by transverse diaphragms at intervals. The distance between webs is 42½ inches in the anchor and cantilever arms except in the case of the main post where it is 47½ inches, and is 26 inches in the suspended span. The gusset plates of the upper and lower connections are built into the top and bottom chords respectively; those at the midpoints into the lower diagonals.

Figure No. 21.—North Approach from Top of Main Span.

Figure No. 22.—North Approach—Typical Method of Erection—First Stage.

The trusses are supported at the main piers on shoes of special design, consisting in each case of a cast-steel base in three sections on which is mounted a structural member built up of four massive webs with inter-connecting diaphragms. (See figures Nos. 44 and 69.) The base rests on a bush-hammered surface on the pier concrete, layers of heavy canvas being laid on this surface and coated with red lead just prior to the placing of the castings in position. The base is connected to the pier by anchor bolts which were set in advance to template, and to the upper shoe section by rivets and turned bolts. All truss members converging on the shoes are pin-connected, important advantages being facility of erection and easement of secondary bending stress by rotation on the pins. The bottom chord and shoe connections consist of 20-inch diameter pins in split bushings of 30 inches external diameter. For the main post, the pins are 24 inches and the split bushings 36 inches diameter; for the diagonals, the pins are 16 inches diameter, no bushings being required. All bored holes are semi-circular; single plates were, however, extended on the bottom chords and on the inner webs of the shoes to fully engage the pin bushings, thus providing a positive connection during the early stages of erection. The base castings of the shoes weighed 17 tons each; the upper sections were divided longitudinally in halves for shipment, each unit weighing about 39 tons.

Each main post consists of six sections, the location of the splices being determined by weights and to suit the members connecting to the posts. The sections are built up of two webs 84 inches wide and 47½ inches apart, with a continuous middle diaphragm and a plane of lacing on either flange. (See figure No. 25.) The upper post sections which support the links are provided with wing plates on either side, bored to engage the pins which connect the upper diagonals to the links. (See figure No. 26.) The weight of each post section was approximately 40 tons.

In order to avoid heavy secondary bending stresses at the top of the main post during erection and in the completed structure, links are provided similar in principle to those used in the Quebec bridge. (See figures Nos. 27 and 28.) Each link is built up of four massive webs with inter-connecting diaphragms, and is carried on top of the main post on a pin with split bushings of the same size and type as at the base of the post. The converging truss members are pin-connected, the size of the pins being 21 inches for the top chords and 13 inches for the upper diagonals. The wing plates on the upper post sections provide interlocking connections with the links which ensure stability under all conditions, any unbalanced loading being readily compensated by the bending resistance of the posts. The construction also proved most convenient during erection. The links are surmounted by ornamental finials of simple plate construction with cast iron caps. The links were divided longitudinally in halves for shipment, each unit weighing about 25 tons.

The bottom chords of the anchor and cantilever arms are spliced at all main panel points, and at the mid-panel point where necessary on account of weight. The sections are built up of two webs 42½ inches apart and tapering in depth from 60 inches at the shoes to 39 inches at the anchor pier and 42 inches at *CLO* on the cantilever arm. (See figure No. 37.) In the heavier members the webs are connected by continuous coverplates on the top flanges and lacing on the bottom; elsewhere, by lacing on both flanges. (See figure No. 29.) The main gusset plates are spliced into the webs, the chord joints being located in each case at the edge of the gusset plates. All joints are of the butt-type but spliced in addition for practically the full value of the material. The various sections varied in weight up to a maximum of about 40 tons.

The top chords are spliced at all main panel points and were also divided longitudinally in halves for shipment where necessary on account of weight. The sections are built up of two webs 42½ inches apart and vary in depth from 62 inches at the main post to 40 inches at the ends of the arms. The depth is constant throughout each panel, but is made to reduce about 3 inches in each successive

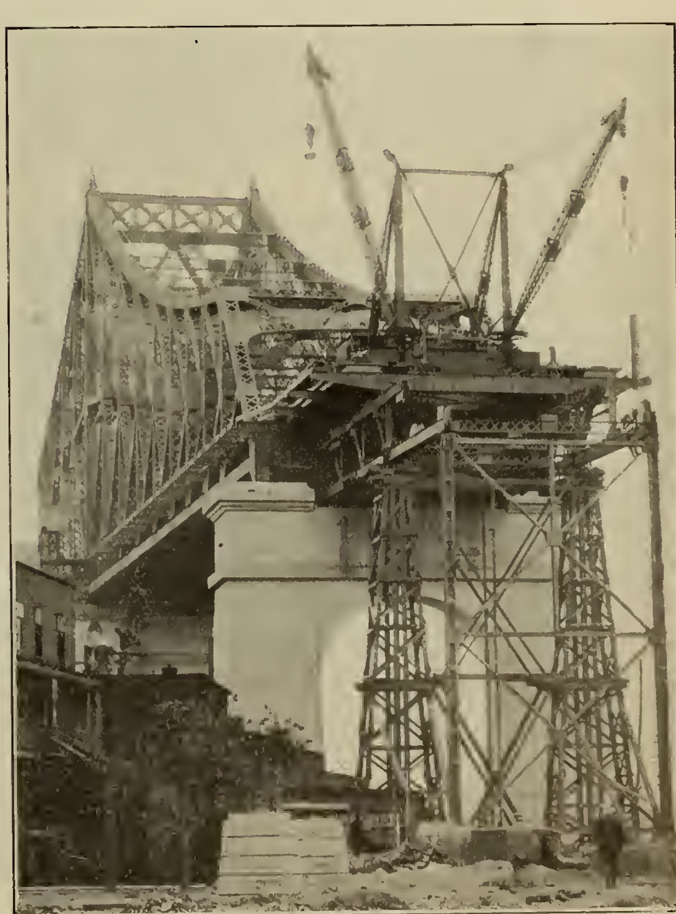


Figure No. 23.—North Approach—Typical Method of Erection—Second Stage.

panel by a novel treatment at the main gusset plates which are spliced into the webs. The webs are connected by lacing on each flange. The splices are of the lap-type and are located immediately beyond the gusset plates. (See figure No. 30.) The various sections varied in weight, those adjoining the main post being about 84 feet long and weighing 45 tons per web.

The order of erection naturally led to all chord splices in the main arms being located a short distance beyond the respective panel points on the side remote from the main pier.

The web members of the trusses are of simple design with splices in the longer diagonals. The gusset plates at the mid-points were rivetted to the lower diagonals and required somewhat careful treatment in design on account of their size. Secondary members are introduced over the main pier, that on the anchor arm side bracing the main post and carrying load from the floor sub-panel concentrations while that on the cantilever arm side is redundant and for appearance only, with a sliding connection at one end.

The anchor arms are connected at the anchor piers to anchorage grillages built into the body of each pier. Each grillage consists of a 4-web structural detail engaging the mass of the pier. The connection is by means of structural members 50 feet long, pin connected at either end to the anchor arm and anchorage grillage respectively, the pinholes being bushed for pins 12 inches in diameter. The members are of rigid construction as it is theoretically possible that a small reversal of the uplift reaction may occur under certain extreme conditions of loading. They were, also, designed to support the anchor arms during erection until that stage was reached where a permanent uplift resulted from the weight in the channel span.

The suspended span swings from the ends of the cantilever arm on structural hangers about 60 feet long, pin connected at either end, the pinholes being bushed for pins 17 inches in diameter. This span was of conventional design except for some special features referred to in the section dealing with the erection of the suspended span.

The bracing of the suspended span consists of top and bottom laterals in the plane of the chords, and swaybracing on the main diagonals above the roadway clearance line. Transverse forces are delivered at each end to the main bottom lateral systems which extend throughout the cantilever and anchor arms in the plane of the bottom chords and are connected to anchorages in the anchor piers. At the latter points and at one end of the suspended span the lateral connections are specially designed to permit the longitudinal movements which result from temperature changes and varying deflections. Top laterals are omitted in the cantilever and anchor arms, the upper structure being braced by planes of swaybracing as deep as permitted by the roadway clearance requirements. In general this bracing extends between the upper verticals, following the lower diagonals below the midpoint. The swaybracing between the main posts is of massive proportions, being designed both for rigidity and appearance.

The floor system is raised above the plane of the bottom chords and laterals and is carried on floorbeams 6 feet 8 inches in depth which frame into the lower verticals immediately above the bottom chords or into the sub-verticals at the mid-panel points. The tramway tracks are supported on built stringers, rigidly braced under each track. The roadway slab rests on 10-inch I-beams about 4 feet apart, laid transversely on five lines of built stringers which are braced together at intervals by cross frames. These longitudinal tramway and roadway stringers frame into the floorbeams, being connected to the stiffeners, with special brackets at expansion points. The sidewalk stringers are outside the trusses and are carried on brackets.

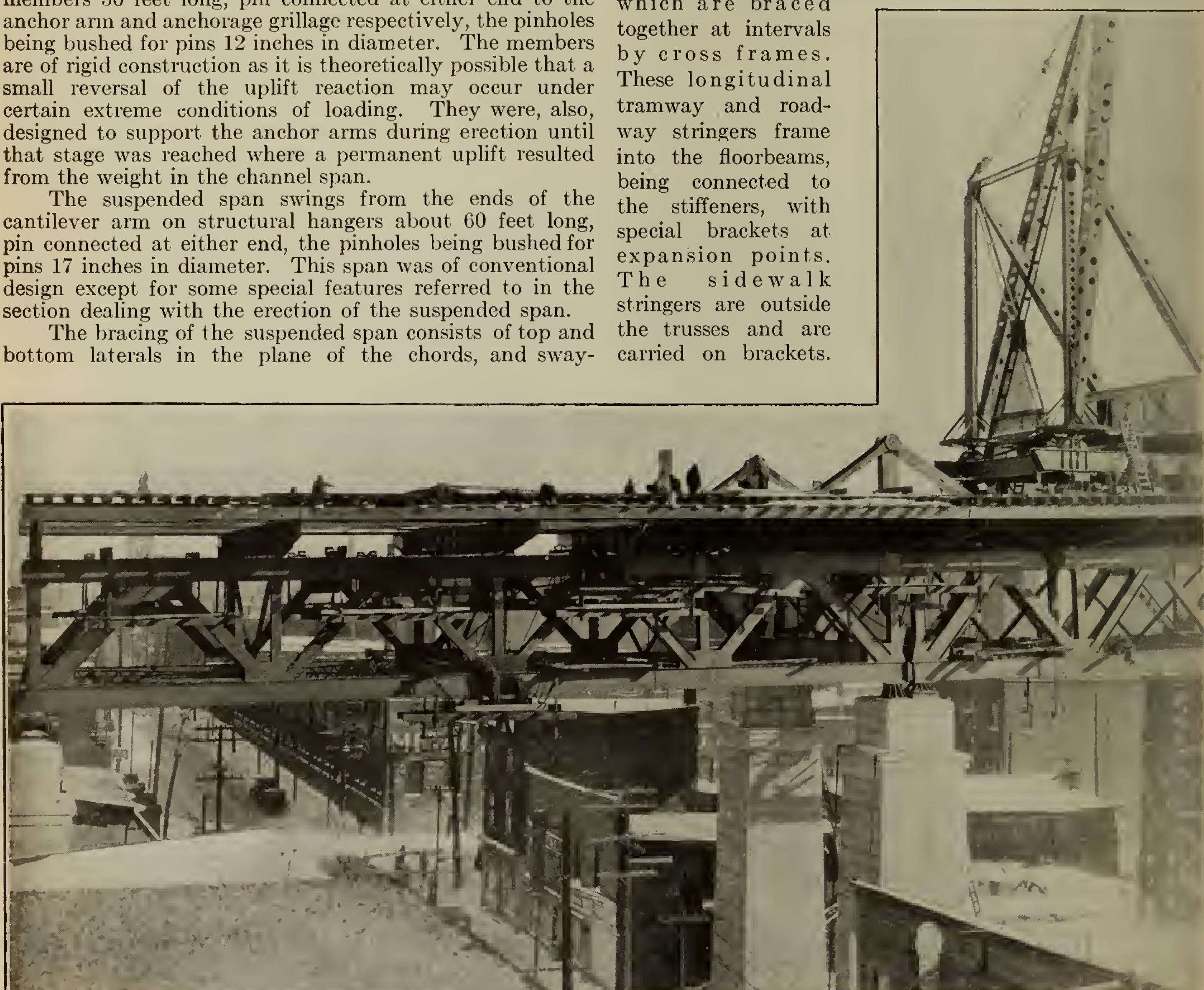


Figure No. 24.—North Approach—Cantilever Erection of Span over St. Catherine Street.

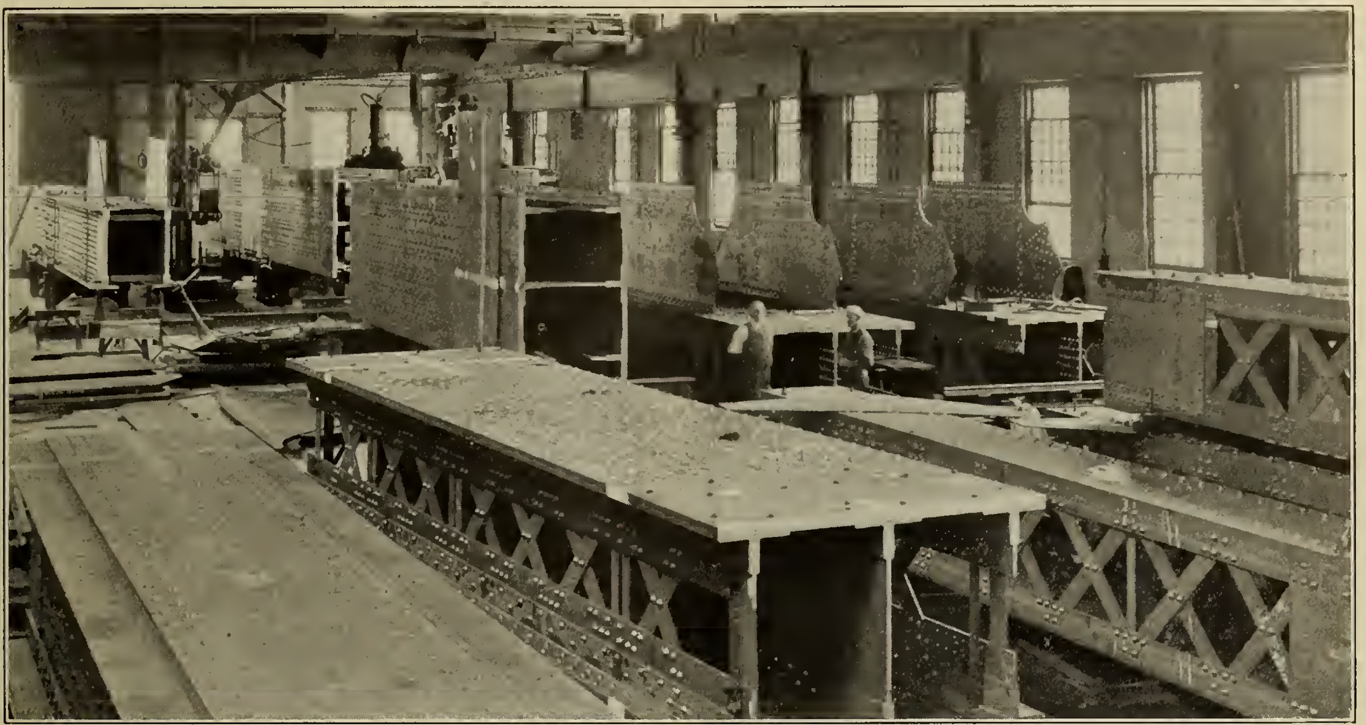


Figure No. 25.—Fabrication of Main Span—Main Post, Intermediate Sections.

The floorbeams at the ends of the anchor arms are of special double-web construction, flush on the underside with the bottom chords and with the stringers resting on their upper flanges. The bottom lateral systems frame into these floorbeams which connect to the transverse anchorages with provision for longitudinal movement. Special provision was made in these floorbeams for jacking loads during erection. The floor system is carried at the main piers on steel trestles of simple construction. At the junction of the cantilever arms and suspended span the construction consists of a pair of floorbeams 7 feet apart at *CLO* and *SLO* respectively. (See figure No. 37.) These floorbeams are flush on the underside with the bottom chords and support the stringers on their top flanges. The bottom lateral systems frame into these floorbeams and between them are inserted the special details which constitute the connections between the lateral systems, with provision for longitudinal movement at one end of the suspended span.

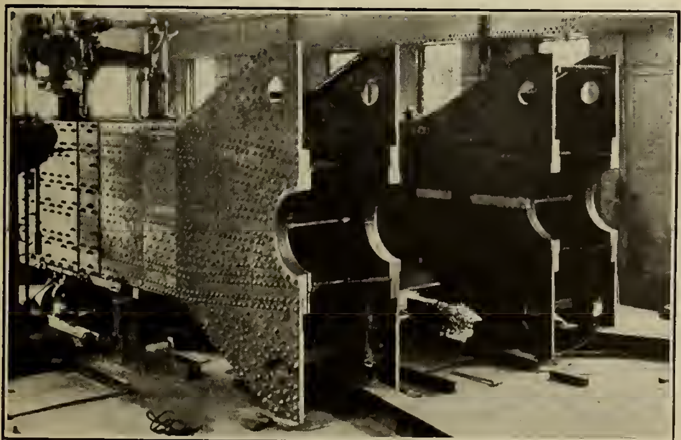


Figure No. 26.—Fabrication of Main Span—Main Post, Top Sections.

The double floorbeam construction at the junction of the cantilever arm and suspended span was dictated by the method adopted for the erection of the latter, which made it necessary to brace very securely the ends of the cantilever arm bottom chords immediately adjacent to the suspended span. The independent floorbeam at *CLO*, (see figure No. 37), being connected to the bottom lateral systems, provided the requisite support in the horizontal plane, that in the vertical plane being provided by the introduction of subdiagonals between *CMI* and *CLO*.

Figure No. 27.—Assembly at Top of Main Post.

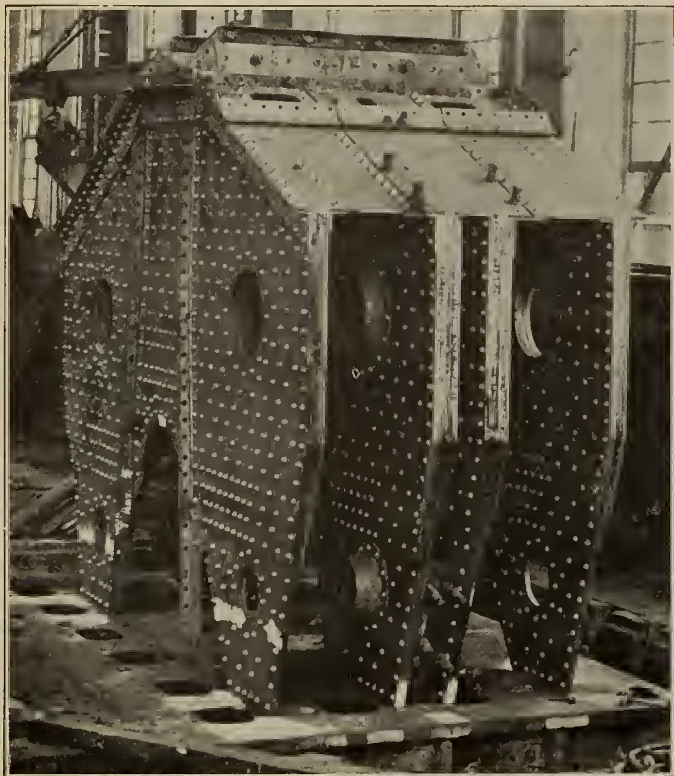


Figure No. 28.—Fabrication of Main Span—Main Post Link.

Silicon steel is used in all the main truss members; in the flanges of the floorbeams and of a number of the longitudinal stringers; and in the main material of most of the bottom lateral system. Elsewhere the structural material is of special carbon steel. The pins and bushings are of forged nickel steel, bronze liners being used in the bushing at points where pronounced movement occurs.

All material used in the superstructure was in accordance with the "Specification for Steel Superstructure" prepared by the engineers and attached to the contract. The material was subjected to mill inspection at the point of manufacture by the engineers and no shipments were permitted before such inspection and acceptance. The

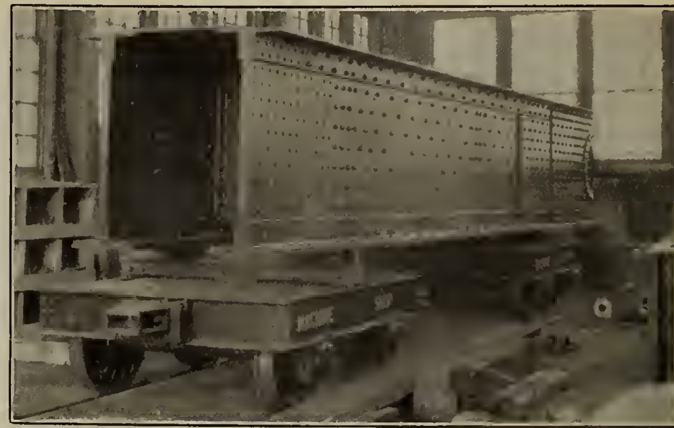


Figure No. 29.—Fabrication of Main Span—Main Bottom Chord Section—Boring of Member.

principal physical requirements for the structural steels were as follows:—

	Special Carbon Steel lbs. per sq. in.	Silicon Steel lbs. per sq. in.	Rivet Steel lbs. per sq. in.
Ultimate tensile strength..	60,000-70,000	80,000-95,000	48,000-56,000
Minimum yield point.....	36,000	45,000	28,000
Minimum elongation in 8 ins.............		1,500,000 ÷ ultimate	
Minimum reduction in area..............	42 per cent	35 per cent	50 per cent

The permissible normal unit stresses used in the design of the superstructure were as follows:—

	Special Carbon Steel lbs. per sq. in.	Silicon Steel lbs. per sq. in.
Tension on net section........	18,000	23,500
Compression on gross section..	$17,000 - 70\frac{L}{R}$	$22,000 - 100\frac{L}{R}$
with maximum..	15,000	19,000
Shear on webs...............	11,000	13,000
Pin bearing..................	20,000	26,000

Rivets, shop driven......shear 12,000, bearing 24,000
Rivets, field driven......shear 11,000, bearing 22,000
Pins, nickel steel..............bending 35,000
Steel castings..................bending 16,000

An increase of 25 per cent was permitted in the above normal unit stresses during erection, for the combined effect of the weight of the structure, the weight of erection

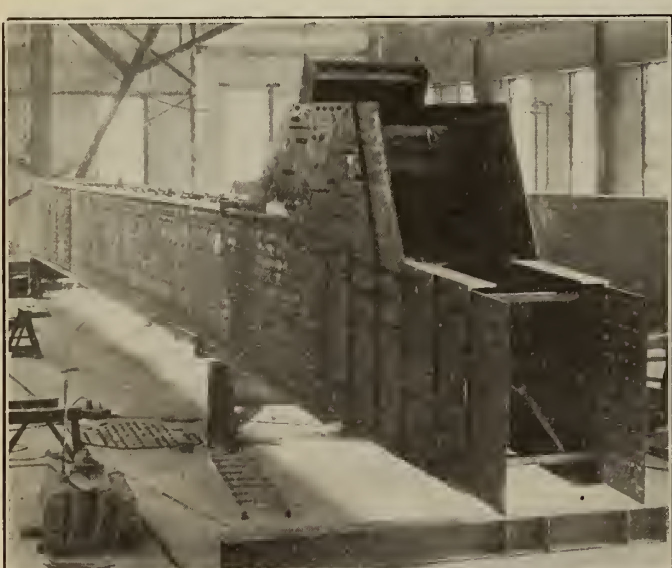


Figure No. 30.—Fabrication of Main Span—Main Top Chord Section—Assembled in Inverted Position for Reaming of Detail.

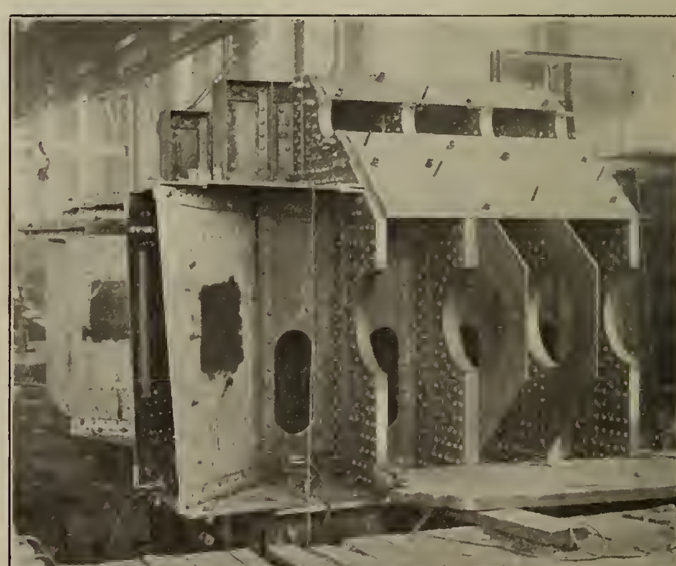


Figure No. 31.—Fabrication of Main Span—Main Shoe during Assembly.

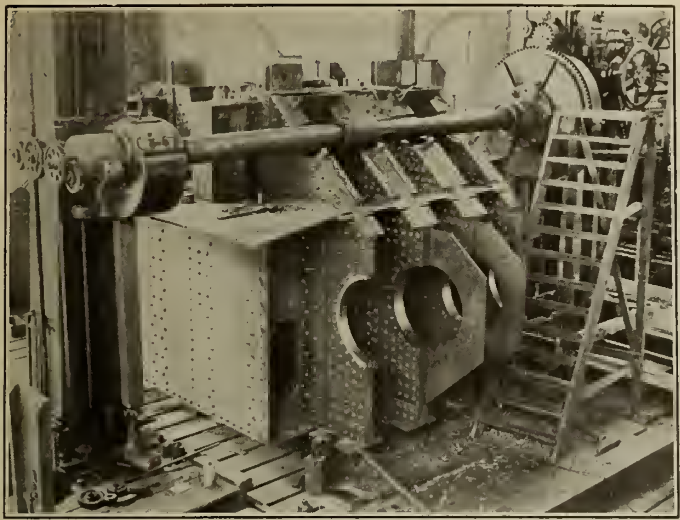


Figure No. 32.—Fabrication of Main Span—Main Shoe during Boring of Pinholes.

travellers and other equipment, and a wind load of 30 lbs. per square foot on exposed surfaces. In general the erection stresses were kept considerably under the above permissible limit, both in the superstructure and in the erection travellers and falsework.

Thickness of material was limited in general to ¾ inch particularly in tension members and main gusset connections, multiple thicknesses being used where necessitated by the area of material required.

The design of the various members was the result of prolonged study, every effort being made to obtain the best proportions and disposition of material for efficiency and economy.

Fabrication

The base castings of the shoes, which were supplied by Canadian Steel Foundries, Limited, were planed top and bottom, and on the adjoining faces; the outstanding lugs on these faces were also drilled for the turned bolts with which they were connected. The individual webs of the upper shoe sections were first assembled and rivetted as units, and the lower edges planed to provide perfect bearing on the base castings. Each entire shoe was then assembled complete with bottom lateral connection plates in place on a specially prepared base, the connections between the webs reamed, and the rivetting completed except in the field connections. (See figure No. 31.) The connections to the base castings were marked from the upper sections and drilled after their removal. Owing to their size, it was necessary to have the upper sections bored at the plant of the Dominion Engineering Works, Limited, on equipment previously used for the Quebec bridge. Each upper shoe was completely re-assembled on the table of the boring machine and the five holes bored, after which the shoe was taken apart for shipment. (See figure No. 32.)

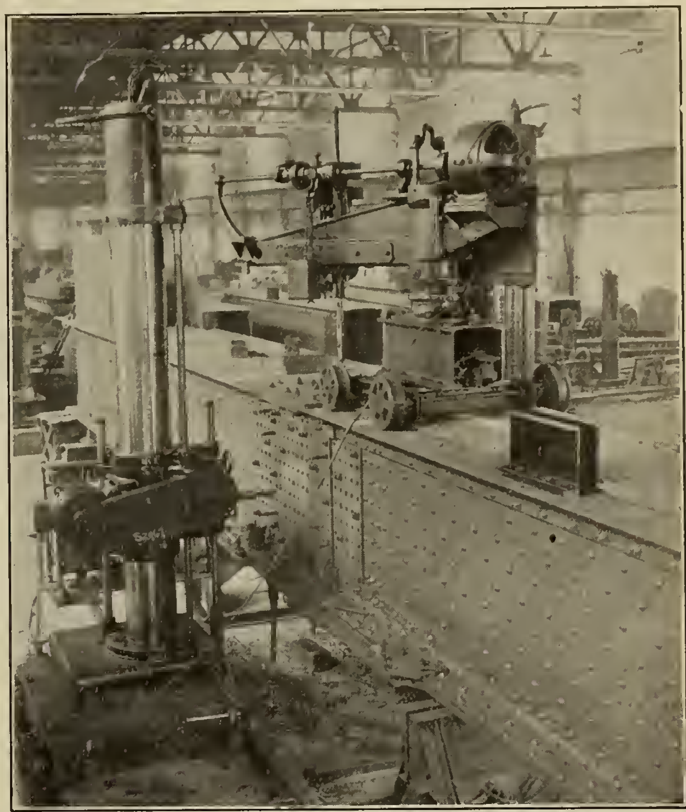


Figure No. 34.—Fabrication of Main Span—Bottom Chord Sections—Assembly of Field Splice.

The links were fabricated in the same general manner as the shoes and were bored on the same machine.

The tapered web-plates of the bottom chords were received from the mills as rectangular plates and their edges planed to the required taper in the shops. The material for the various sections was sub-drilled or subpunched depending on the thickness, after which each web was assembled as a unit, reamed and rivetted. In the case

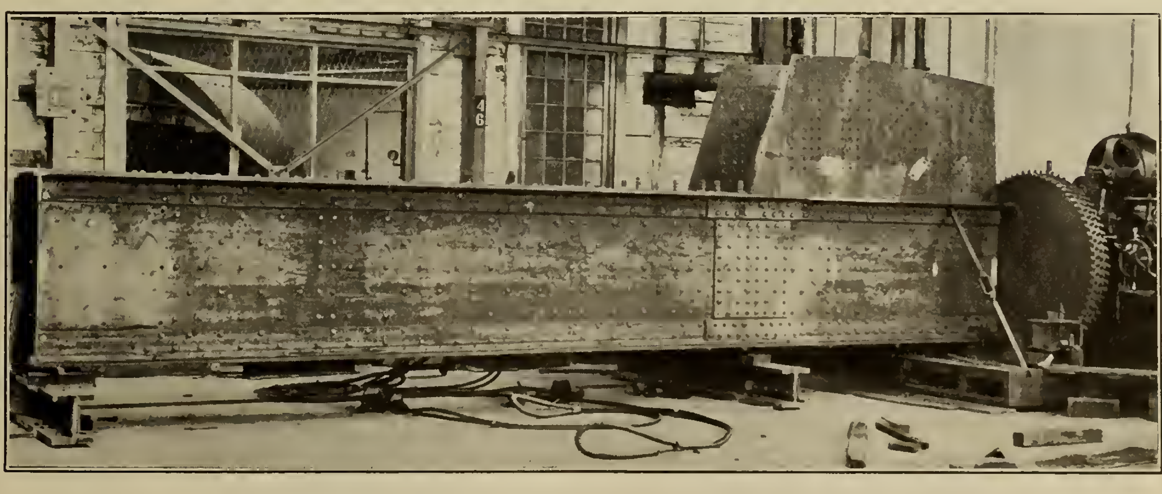


Figure No. 33.—Fabrication of Main Span—Bottom Chord Section—Facing End on Rotary Planer.

of the main gusset plates, the connections for the adjoining truss members were drilled full size before their assembly in the chord sections. The two webs comprising a section were next assembled with their intervening coverplates, lacing and diaphragms which were rivetted after the necessary reaming. The ends of the section were then planed on a rotary planer. (See figure No. 33.) The section was now assembled with the section adjoining at the end towards the shoe. The faces were drawn to close contact and, with the splice material in place, the joint was fully drilled and matchmarked. (See figure No. 34.) The contact at the joints was carefully inspected with feelers before placing the splice plates and a joint was not accepted until 90 per cent of the face was in contact and the remainder would not admit a feeler over four thousandths inch thick. In the drilling, the exterior splice material, in which the holes were drilled full size, before assembly, was used as a template, the ends of the member and the other splice material being left blank except for occasional holes provided for bolting purposes. The successive chord sections were treated in similar manner.

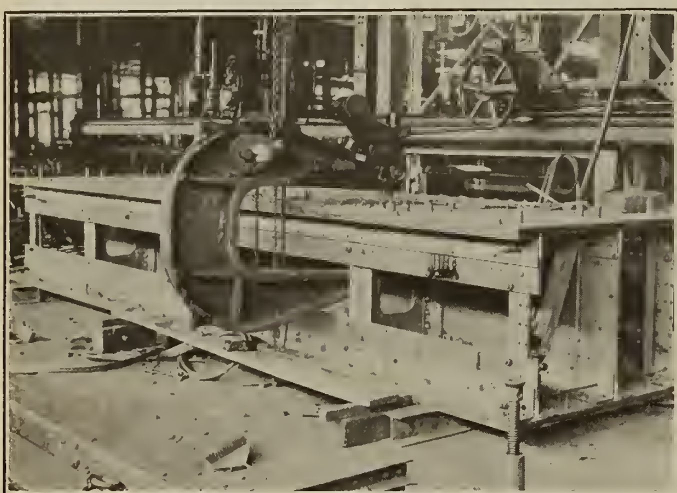


Figure No. 35.—Fabrication of Main Span—Main Post Section—Assembly and Rivetting.

The main post sections were fabricated by the same general methods as employed on the bottom chords, all adjoining sections being assembled in pairs for drilling and matchmarking. (See figure No. 35.)

The top chords, as previously mentioned, were fabricated partly as complete sections and partly as single webs, two of which were required for the ultimate members. In the former case the treatment was similar to that for the bottom chords except for the omission of the end facing. In the latter case the individual webs were assembled, reamed and rivetted. The flange angles were formed in easy curves at the panel points to suit the change in the chord depth and inclination in the adjacent panels, and special arrangement of the other material was also necessary at these points to ensure adequate strength at all planes. The two webs of a section were next assembled on the skids with the intervening detail in place, all of which was reamed, matchmarked, and removed. (See figure No. 30.) Each web was then assembled with the corresponding web of the section adjoining at the end towards the main post, the alignment and length being carefully checked. After all splice material had been placed, the joint was drilled and matchmarked. (See figure No. 36.)

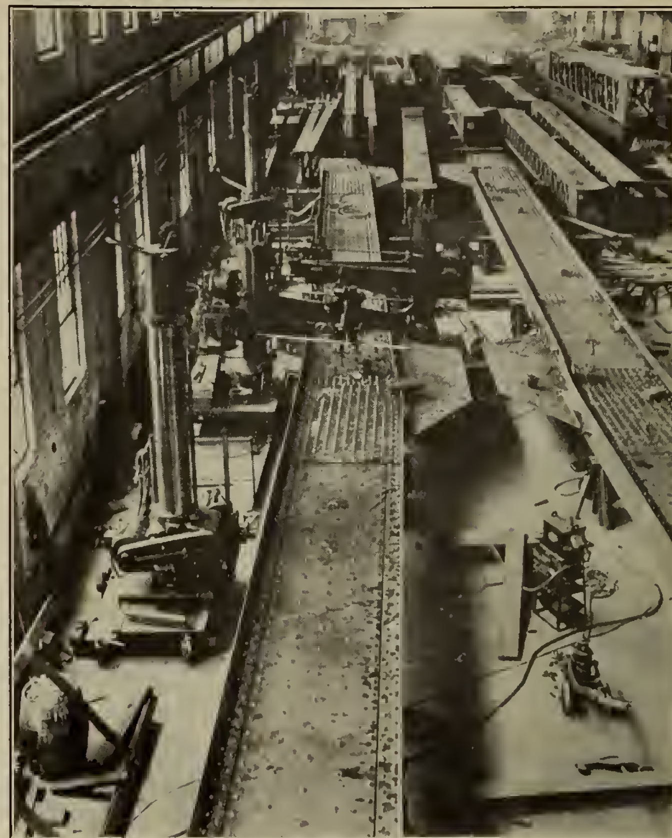


Figure No. 36.—Fabrication of Main Span—Top Chord Webs—Assembly of Field Splice.

The fabrication of the web members was simple in nature, the end connections being, in general, reamed or drilled full size to template. The lateral and swaybracing connections were also reamed to template.

The shop lengths of the members were derived from the camber requirements as laid down in the specifications, all measurements being made with standardized steel tape supported at close intervals.

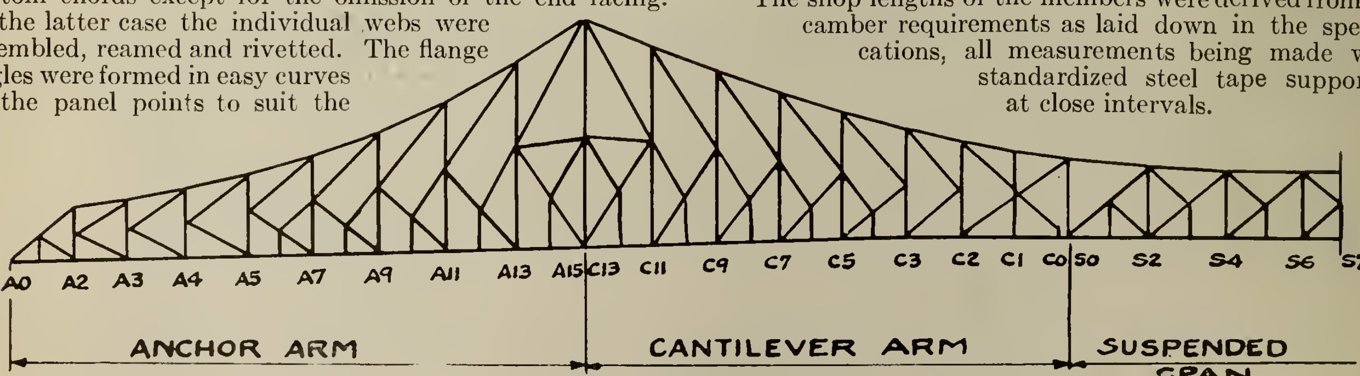


Figure No. 37.—Diagram showing Designation of Panel Points of Main Span.

"*L*" denotes bottom chord intersection, thus—*AL7*, etc.
"*U*" denotes top chord intersection, thus—*AU7*, etc.
"*M*" denotes middle web intersection, thus—*AM7*, etc.
Prefix "*N*" denotes North Side, thus—*NAL7*, etc.
Prefix "*S*" denotes South Side, thus—*SAL7*, etc.

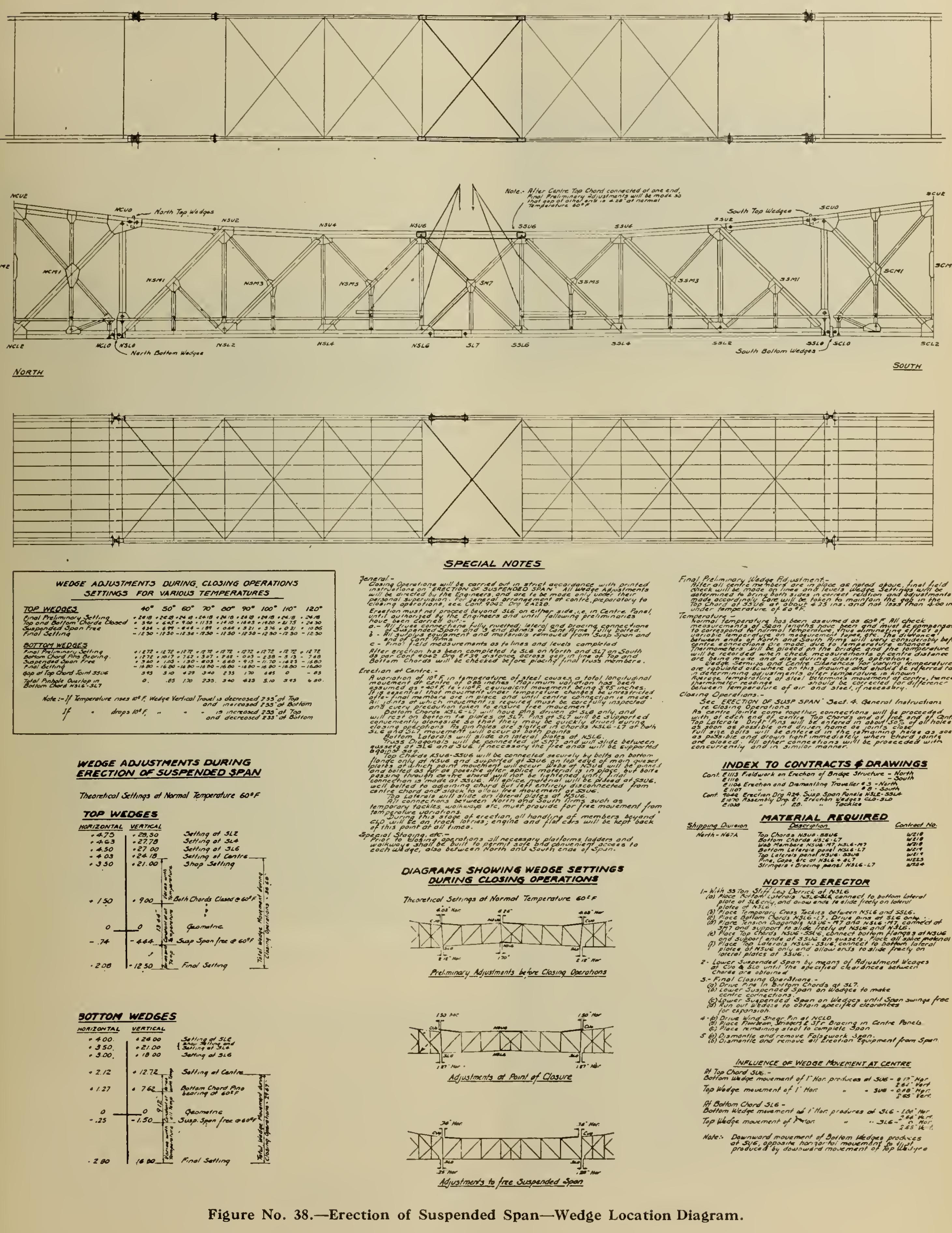


Figure No. 38.—Erection of Suspended Span—Wedge Location Diagram.

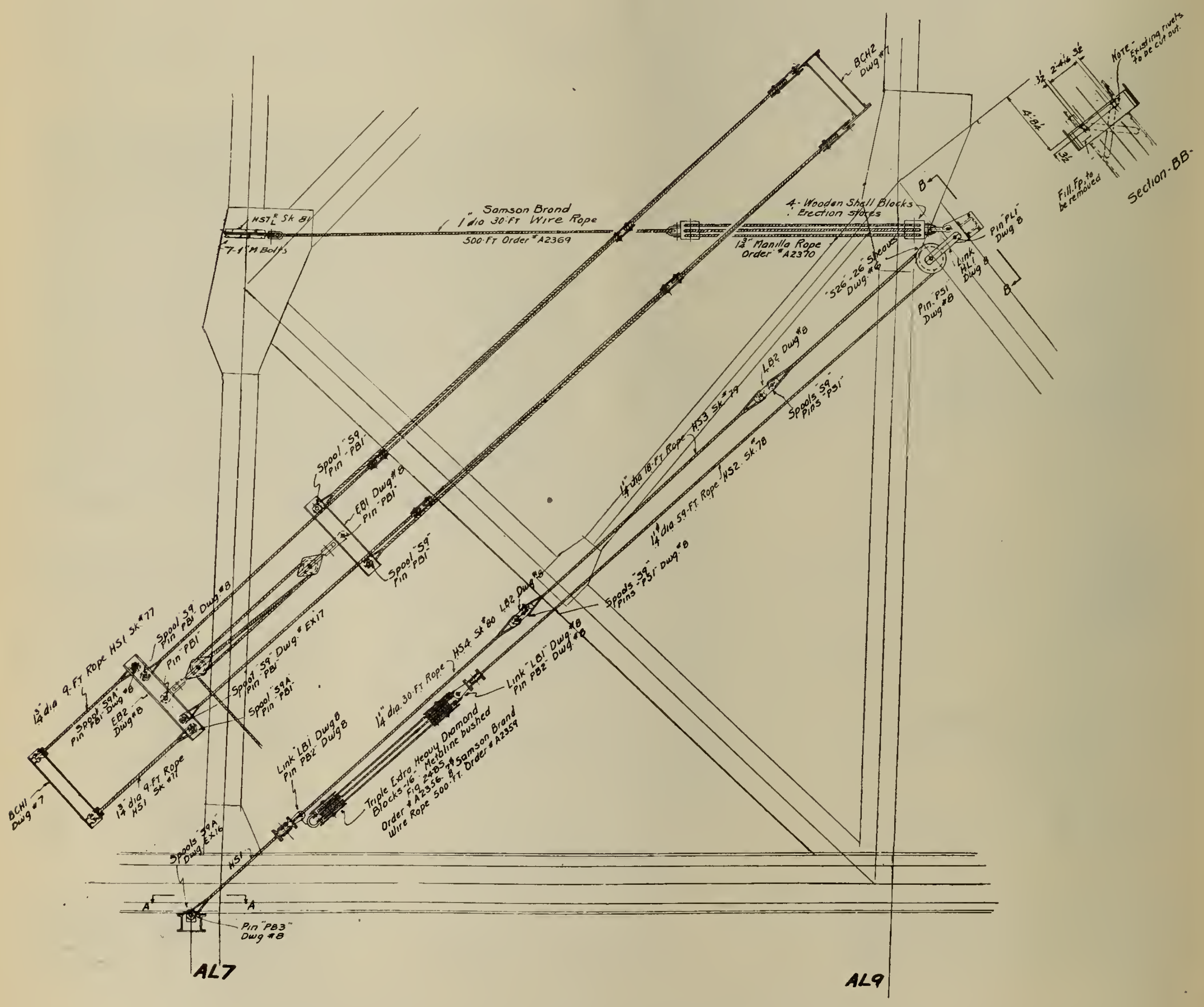


Figure No. 39.—Adjustable Tackles used during Erection of Main Span.

The forgings for the pins and bushings were supplied in a semi-finished state by Canada Foundries and Forgings, Limited, and finish-machined in the shops of the contractor.

The standard of workmanship was in accordance with established practice on construction of such importance. Sheared edges of material over ⅝ inch in thickness were planed to remove incipient cracks, this including virtually all silicon steel. Punching was permitted in silicon steel up to ⅝ inch and in carbon steel up to ¾ inch in thickness, material over these limits being drilled. In general, the individual pieces were sub-punched or sub-drilled ⅛ to ¼ inch small and reamed to size after the assembly of the members. The rivets varied in size up to 1⅛ inch diameter, according to the thickness of the material in contact. The

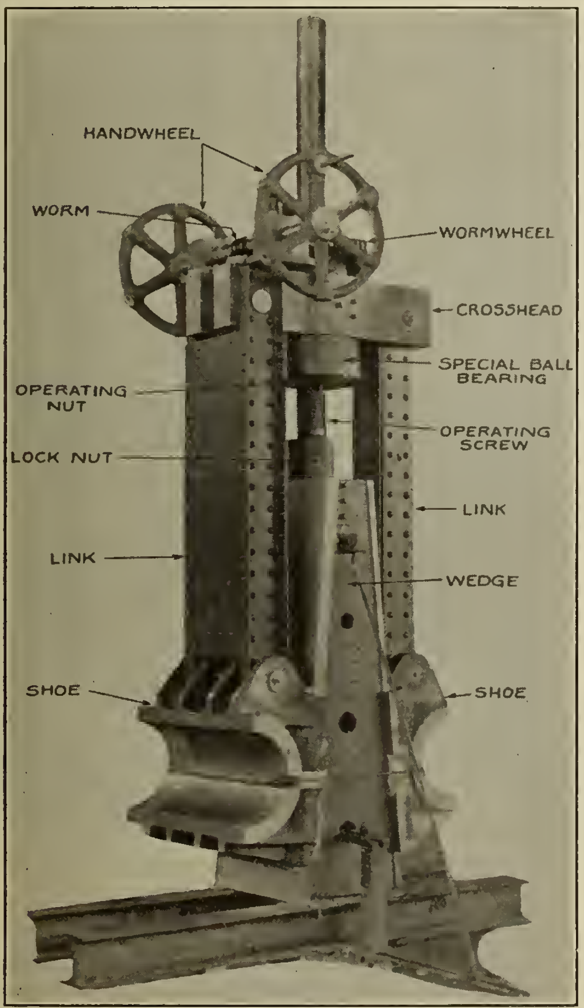


Figure No. 40.—Wedge Mechanisms used in Erection of Suspended Span.

minimum size for the important truss members was, however, 1 inch diameter to permit the use of ¾-inch bolts in the unreamed holes during assembly. Bolts of "Mayari" steel were used during the assembly of the heavier members, to facilitate the drawing together of the material.

It is fitting to note that the field experience proved the quality of the fabrication to have been of the highest order, reflecting most creditably on those associated with the preparation of the detail drawings and with actual fabrication in the shops.

The special carbon steel did not differ sufficiently from the commonly used grades of structural steel to create special problems in fabrication beyond slightly greater

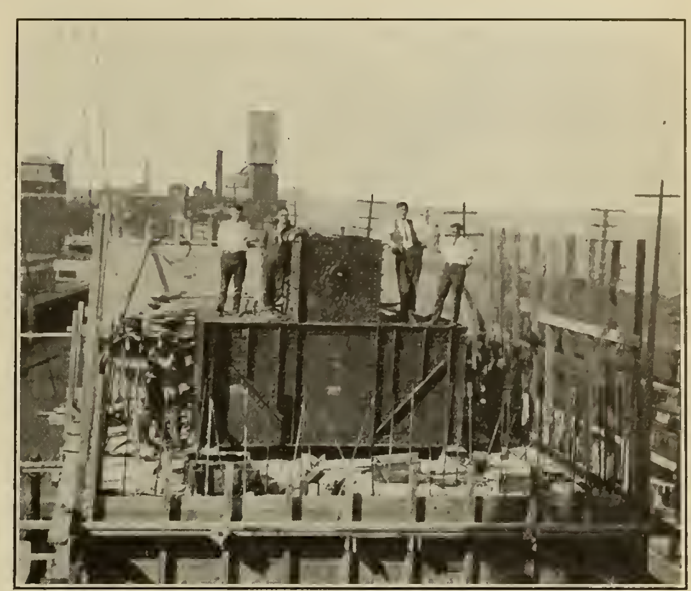


Figure No. 41.—Main Span, North Side—Setting of Anchorage Grillage at Anchor Pier.

demands on the machines and some increase in genera wear and tear.

In the case of the silicon steel, however, quite different characteristics appear, as a comparison of its strength with that of medium structural steel will at once suggest. Particular care is necessary at the mills during manufacture, there being a pronounced tendency towards segregation in

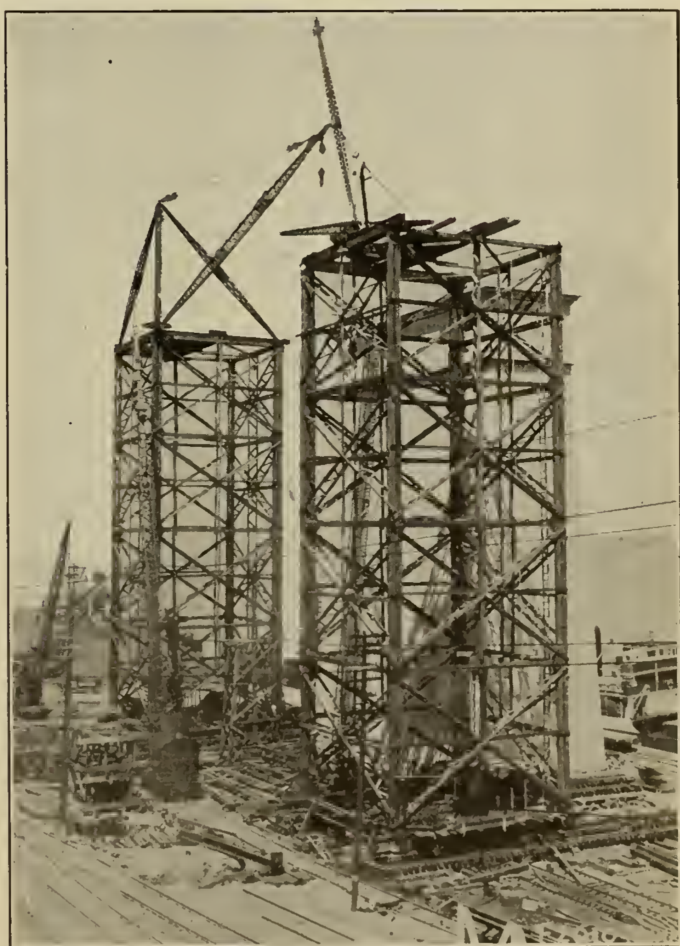


Figure No. 42.—Main Span, North Side—Travellers Nos. 5 and 6 during Assembly.

Figure No. 43.—Main Span, North Side—Setting Main Shoe Castings on Main Pier.

the ingots which requires careful and extensive cropping. Experience proves the importance of extremely thorough inspection at the mills as a much larger percentage of rejections may be expected than in the ordinary grades of steel. Fortunately, in this instance the mill inspection was exceptionally rigid and thorough. Rigid inspection was maintained at all stages of fabrication, the proportion of material rejected at the fabricators plant for native defects being comparatively small.

The most common defects appearing during fabrication were in the form of occasional hard spots and pipes, the latter being revealed during the punching, shearing or facing of the material.

As may be inferred from the relative strength of silicon steel, its fabrication demands heavy and powerful equipment, particularly as the thickness increases. In shearing and punching, the metal literally breaks with a sharp report quite different to the similar operation with ordinary grades and with a much more crystalline fracture. To obtain satisfactory results, operations must be slowed up, cutting and punching tools carefully selected, and the settings of shear blades and punches regulated in the light of actual experience. Wear and tear on tools and equipment is, of course, greatly increased. With proper precautions and an expert organization, however, the material is quite workable.

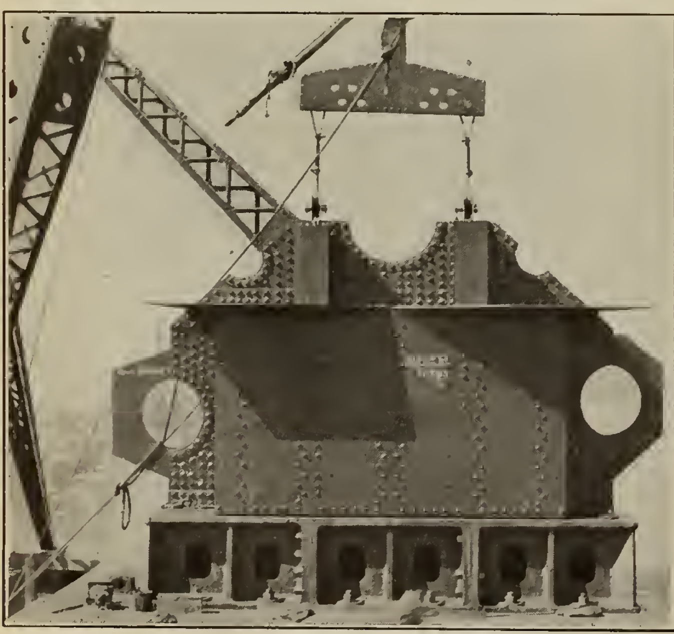


Figure No. 44.—Main Span, North Side—Setting Main Shoe on Main Pier.

Based on experience, the unit fabricating cost for silicon steel is from 25 to 35 per cent greater than for ordinary structural steel, depending on the nature of the work, any advantage from lighter material being offset by the added cost of the operations as outlined above.

All material which could be supplied by Canadian mills was obtained from them, the balance being obtained from United States mills. The silicon steel was manufactured by the United States Steel Corporation with the exception of a quantity of the lighter sections manufactured by the Algoma Steel Corporation Limited.

Erection

The problems connected with the erection of the main span were unique, differing considerably on the north and south sides of the channel. Tentative erection plans were developed during the preparation of the tender but, after the award of the contract, were subjected to prolonged study. The methods finally adopted adhered closely to the preliminary plans, greater confidence being naturally felt after the comparison with alternative methods.

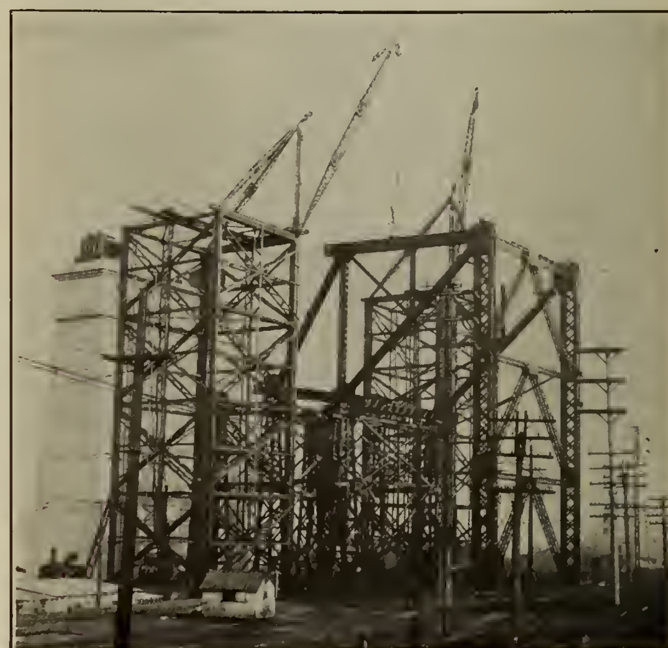


Figure No. 45.—Main Span, North Side—Erection of Falsework Span and Tower—First Stage.

As previously stressed, the erection of the south half of the main span was dependent on the completion of the south approach. The adopted programme required operations to commence on the north half early in 1927 and on the south half during 1928, after the transfer to this side of considerable equipment to be used in the first instance on the north side.

Method of Erection for Anchor Arms

The first outstanding problem was the method of erection to be employed on the respective anchor arms, ground conditions being entirely different in the two cases. The north anchor arm spans the main railway tracks of the harbour and Canadian Pacific Railway; a large building used at that time as a brewery warehouse; and Notre

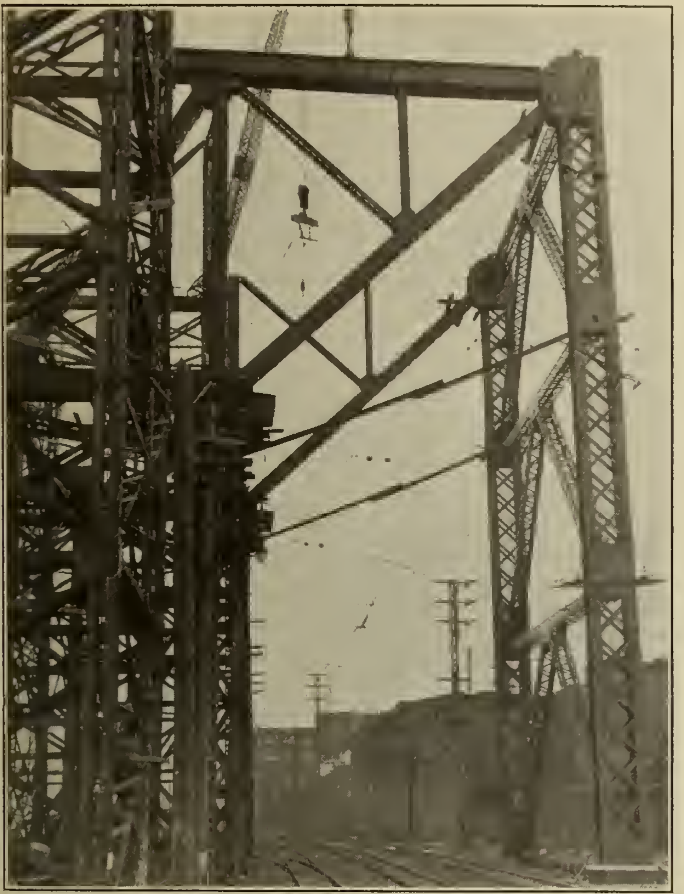


Figure No. 46.—Main Span, North Side—Arrangement of Falsework Tower.

Dame street, a busy thoroughfare with tramway tracks. The only ground available for construction purposes was a strip about 100 feet wide between the main pier and the railway tracks. The existing conditions entirely prohibited the use of falsework under the greater portion of the anchor arm.

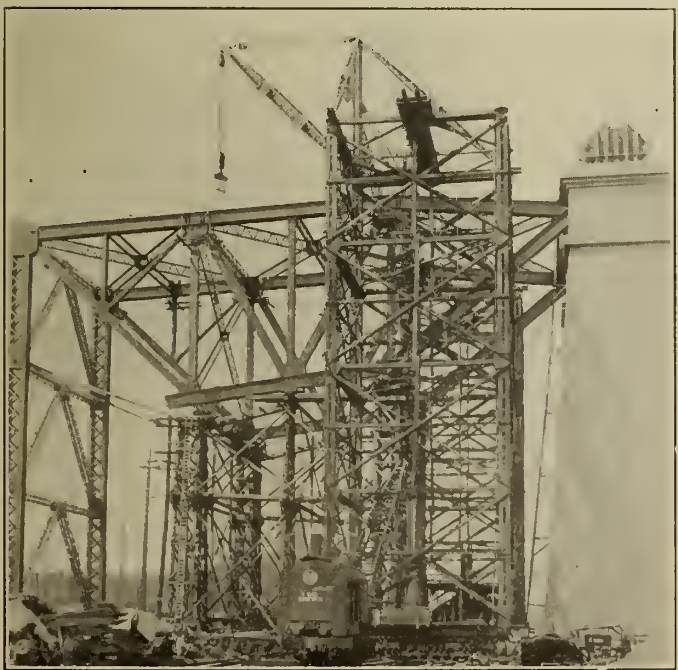


Figure No. 47.—Main Span, North Side—Erection of Falsework Tower and Span—Final Stage.

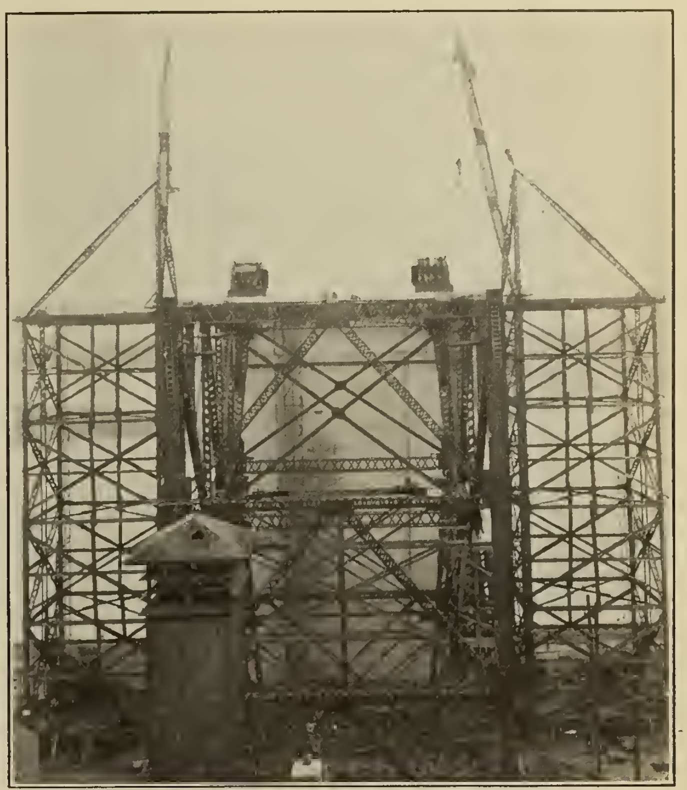


Figure No. 48.—Main Span, North Side—General Arrangement of Falsework and Travellers Nos. 5 and 6.

The south anchor arm is over the river but clear of the navigation channel, the current being approximately 7 miles per hour. Under mean summer conditions, the water is about 3 feet in depth at the south anchor pier, increasing gradually to about 12 feet at midspan, and then deepening rapidly to about 40 feet at the main pier. The river bottom in this section consists of a shallow layer of hardpan over irregular rock. The river usually freezes at this point in early January and is subject to intermittent ice shoves during the winter. The break-up occurs during late March or early April, causing ice jams in the vicinity which often build up to a height exceeding 30 feet at the site and overrun the dock walls. Tremendous pressure is exerted as these jams slowly break-up, reform, and finally move

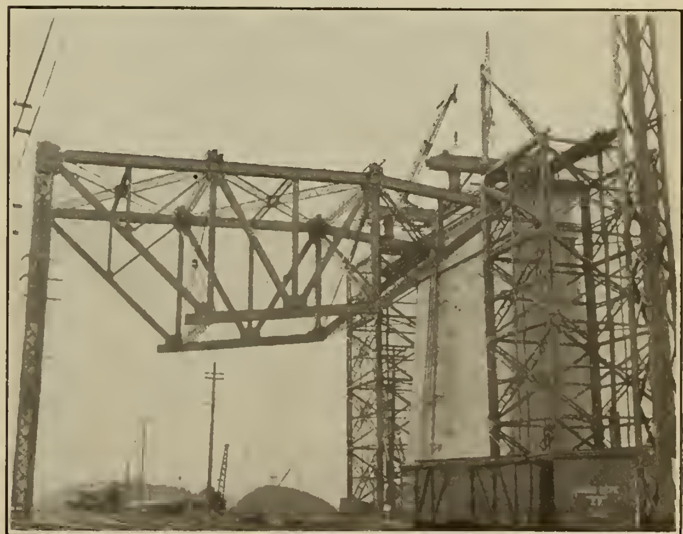


Figure No. 49.—Main Span, North Side—Placing Bottom Chord Sections of Anchor Arm—First Stage.

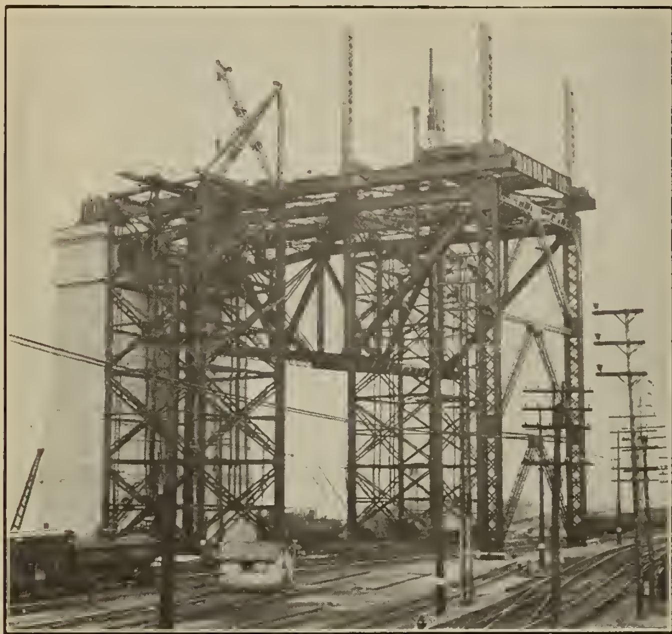


Figure No. 50.—Main Span, North Side—Erection of Bottom Chords and Floor System on Falsework Span.

down the river. The water level rises with great rapidity during this period, drops to more normal conditions after the ice movement is completed, and gradually falls a further 6 or 7 feet after May, commencing to rise again in the late autumn. It was obvious that no falsework could endure the ice movement unless supported above it on massive foundations.

Figure No. 51.—Main Span, North Side—Erection of Traveller No. 4 on Anchor Arm—First Stage.

It was apparent that on the north anchor arm, falsework was practicable under the three panels adjacent to the main pier only, it being necessary, therefore, to erect the remainder as a cantilever. These conditions required that a main point of support be established at *AL9*, three panels north of the main pier. (See figure No. 37.) A re-arrangement of the harbour tracks under the anchor arm made possible the location and construction of suitable foundations, and a steel tower was therefore determined on for this point as providing in conjunction with the main pier a satisfactory base for the support of the superstructure.

In the case of the south anchor arm, methods were first examined which might make possible its complete erection in a self-supporting condition in one season, thus avoiding the ice problem. It was the final consensus of opinion, however, that the prospect of such an accomplishment was too slight to justify the hazard, particularly as the work would be in serious jeopardy should labour troubles arise. The use of massive foundations for falsework was also discarded as lacking economy and it was decided to provide a temporary span the full length of the anchor arm, supported at each end directly by the piers.

As a further step, it was decided to make use of a portion of this span on the north side between the main pier and the steel tower at *AL9*. The resultant advantages were more positive support for the anchor arm during the early stages of erection and much less interference with handling operations on the ground where space was only too limited.

At first sight the falsework construction may appear elaborate and expensive. It must be borne in mind, however, that a disaster at this location would have had far-reaching results of the gravest nature and that the memory of the Quebec bridge was still fresh. Quite apart from the inevitable loss of life and property in case of a disaster, there also existed the contingency of the entire blocking of the main harbour for several months with incalculable loss to the entire country. The contractor

Figure No. 52.—Main Span, North Side—Erection of Traveller No. 4 on Anchor Arm—Second Stage.

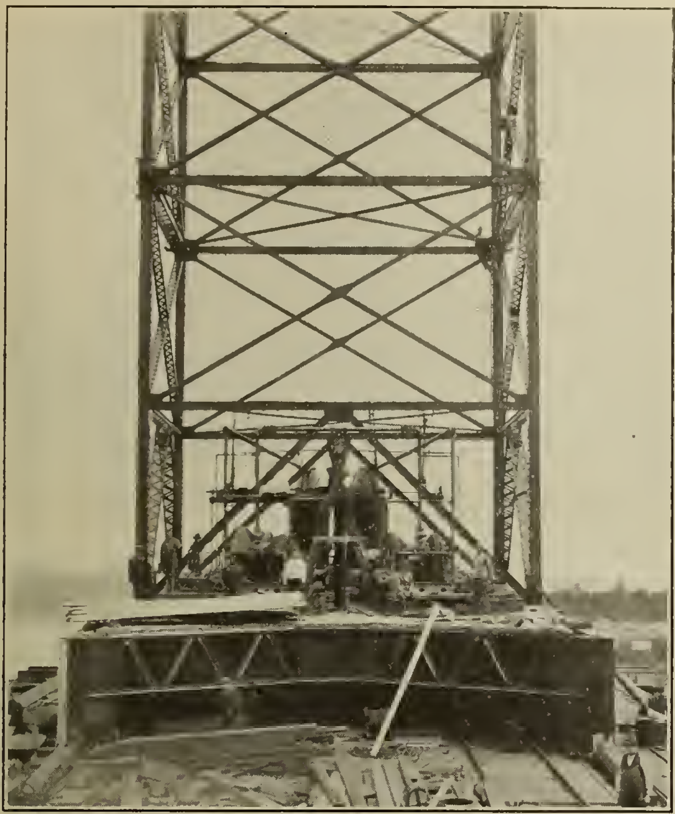


Figure No. 53.—Main Span, North Side—Rear View of Base—Traveller No. 4.

unhesitatingly accepted safety as the paramount consideration and spared no expense to achieve it.

Conditions Governing Erection Equipment

The second major problem was the type of handling equipment to be employed in the erection of the various parts of the structure. The weight of the members varied up to a maximum of 45 tons, but the greater proportion of the pieces to be handled were comparatively light. It was, therefore, important to provide speedy handling equipment for the lighter material, combined with the capacity for the heavier pieces.

At the main piers the trusses are 162 feet in depth, the height of the highest point above the floor being about 160 feet, exclusive of the light ornamental finials. This height diminishes rapidly panel by panel on either side of the main post, the greater portion of the span length being within the reach of equipment of reasonable proportions operating on the deck.

After a comparison of various methods for the erection of the high portions adjacent to the main piers, it was decided to adhere to the original plan of a tower traveller, operating between the trusses on the deck. In the plan of operations finally developed, the tower traveller erected these high portions, consisting of four panels of each anchor arm and five panels of each cantilever arm, the remainder of the structure being erected with deck travellers.

The peculiar conditions under the north anchor arm presented some difficulty. The distance from the ground to the top of the main pier is 134 feet, and to the floor at this point 150 feet, these heights precluding erection at floor level from the ground. After consideration of many schemes, it was decided to erect on the ground outside each truss a moveable timber tower carrying on its top a heavy derrick. These derricks erected the falsework span and tower; placed the shoes, bottom chords, laterals and floor system from the main pier to *AL9*; assisted in erecting the tower traveller on the deck; and throughout the first season handled all materials from the ground to the deck of the bridge. This arrangement permitted the erection of the temporary span on comparatively light timber falsework, and eliminated the need of pile footings.

The distance between the trusses of the span made possible a convenient arrangement of traveller and service tracks, the latter being laid on the lines of the tramway stringers at 50 feet 6 inches centres. For the former, two standard gauge tracks at 24 feet centres were adopted, carried in each case on two lines of longitudinal roadway stringers which were reinforced where necessary for the traveller loads. The traveller tracks consisted of 85-lb. rails carried on 8- by 10-inch ties 10 feet long, spaced as necessary for the loads to be carried. By restricting the overall width of the travellers to within 40 feet, the service tracks were at all times clear enabling material to be placed alongside each traveller as required, within the convenient reach of the booms.

The number and disposition of travellers was influenced by various factors and by the desire for as rapid construction as possible. The necessity has already been shown for the erection of a portion of the north anchor arm by cantilevering. It would have been possible to complete this anchor arm with the tower traveller, afterwards erecting the cantilever arm with the same equipment; this method, however, involved extremely heavy reactions on the tower at *AL9*, seriously stressed certain portions of the arm and lengthened operations considerably. A first alternative was concurrent erection of the cantilever arm with a tower traveller duplicating that on the anchor arm. A second and more attractive alternative was the method adopted, in which the tower traveller erected its allotment of the

Figure No. 54.—Main Span, North Side—Erecting First Sections of Main Post.

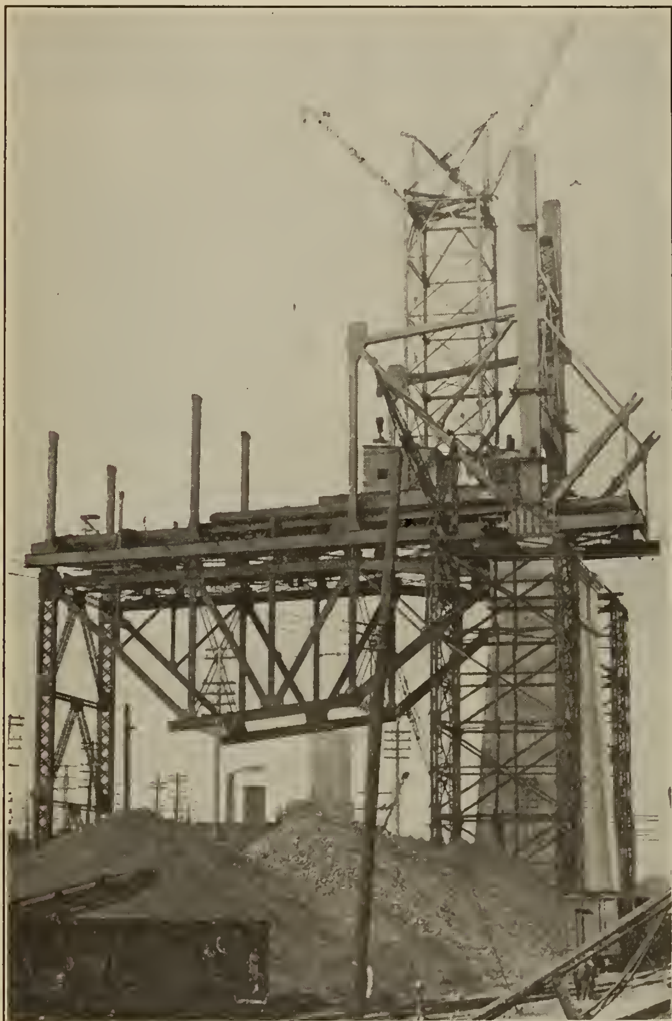


Figure No. 55.—Main Span, North Side—Erection proceeding on Main Posts and Adjacent Structure.

anchor arm, was then transferred to the cantilever arm and proceeded with its erection concurrently with the completion of the anchor arm by a deck traveller. As the weight and general arrangement of the tower traveller prohibited its use on the central portion of the channel span, a further utility was thus found for the less cumbersome deck traveller.

Rapid construction also required that erection be commenced on the south anchor arm before the equipment on the north side could be released, and the materials to be handled were entirely beyond the capacity of the equipment used on the south approach. The early stages on the south side being much more conveniently served by a deck traveller, that on the north side was duplicated for the south and operations planned on the basis that the single tower traveller would erect the similar sections of the superstructure on both sides. By erecting the cantilever arm concurrently with the rear portion of the anchor arm on the south side as on the north, operations were accelerated and a more economical design for the falsework span made possible.

Two deck travellers being thus available, concurrent erection towards the centre from both sides was provided for, as the work approached the final stage.

Closure of the Suspended Span

The final and outstanding problem was the connection of the two cantilever arms over the centre of the channel, or what may be briefly termed the "closure of the suspended span."

This central section of the channel span functions in the completed structure as a simple span suspended between the ends of two cantilever arms. The members *CUOSU2* and *CL2SLO*, (see figure No. 38), are subordinate, the former being entirely redundant and the latter affected only by wind and traction influences. During erection, however, each half of the suspended span became temporarily a prolongation of the corresponding cantilever arm, the stresses in its chords being of a reverse nature to those in the completed structuie. The sub-chords referred to above became integral parts of the top and bottom chord systems and were subjected to heavy erection stresses which governed their design.

The closure consisted of the bringing together of the arms at the centre of the span, the making of all connections at that point, and the subsequent transitiou of the suspended span from the cantilever to the simple span condition under fully controlled adjustment, during which process the stresses in the structure assumed their final nature, those in the sub-chords disappearing entirely.

Early consideration was given to the truss design of the suspended span to determine that arrangement of panels which would give the most favourable conditions at the centre while making the closure. The design as finally adopted contains seven main panels of which the central panel is bisected by the centre of the span. The members involved in the closure are indicated in figure No. 38 and consist of top chords and laterals *NSU6-SSU6*, bottom chords and laterals *NSL6-SL7*, and sub-diagonals *NS6-S7*. The top chords *NSU6-SSU6* were designed with butt joints at the panel points, the ends being chamfered slightly at each flange to ensure the bearing being taken on the central portion of the webs. The bottom chords *NSL6-SL7* were pin-connected at either end, the holes being slotted 3 inches back of the pins to provide ample clearance for the driving

Figure No. 56.—Main Span, North Side—Erection of Anchor Arm being completed to Tower at *AL9*.

Figure No. 57.—Main Span, North Side—Erection commenced on Cantilever Arm. Progress as at December 14th, 1927.

Figure No. 59.—Main Span, North Side—Erection proceeding on Cantilever Arm. Progress as at March 16th, 1928.

of the pins before the closure of the connections and for movement during the closure operations after the pins were in place. The arrangement of the members proved exceedingly flexible and prevented minor discrepancies of alignment in either plane from being bothersome, as these were readily corrected as soon as contact at the joints had been established.

In the cantilevered condition, the weight of the suspended span and erection equipment produced much heavier stresses in the anchor and cantilever arms proper than was the case after the change to the simple span condition, the stresses in the chords at the outer end of the cantilever arms being up to their safe capacity. The deflections of the arms at this time were sufficient to render impossible the placing and connecting of the final members at the centre without compensating adjustments. Expansion and contraction in the structure, due to temperature changes, also produced a continually varying condition at the centre between the two arms and it was important that the centre joints should not close prematurely under temperature expansion as the resultant arch action in the suspended span with consequent thrust against the main piers would have been objectionable if not serious under extreme conditions. It was, therefore, necessary that each half of the suspended span be erected in such a manner that adequate clearances would exist between the ends of the two arms before attempting the closure which implied providing for longitudinal adjustment in the planes of the top and bottom chords. This required that adjustable devices be provided in each plane capable of being operated under a load of approximately 800 tons on each and, after the consideration of many types, wedge mechanisms were finally adopted for each plane as the means whereby all the adjustments incidental to the closure would be made.

The wedge mechanisms were located in the sub-chords at each end of the suspended span in the positions most convenient for operating; those in the bottom plane being adjacent to *SLO* and in the top plane to *CUO*, as shown in figure No. 38. Manual operation was provided for as being most dependable and subject to perfect control. It was also considered both unnecessary and impracticable to design the wedge mechanisms for operation against their maximum load and they were, therefore, designed for slacking off only under full load. This necessitated an initial setting of the wedge mechanisms when first placed

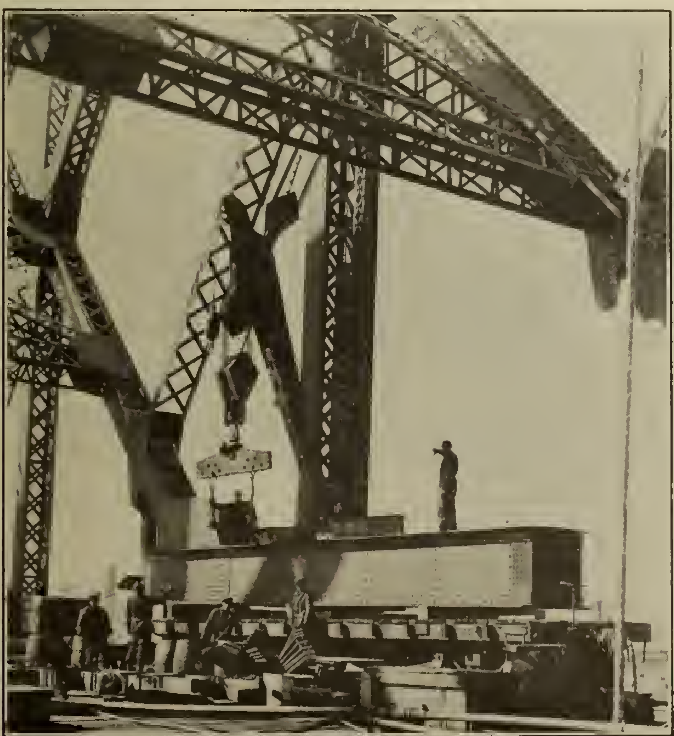


Figure No. 58.—Main Span, North Side—Arrangement of hoisting Derricks at *AL13*.

Figure No. 60.—Main Span, North Side—Erection proceeding on Cantilever Arm. Traveller No. 3 being set up on Anchor Arm.

Figure No. 61.—Main Span, North Side—Erection proceeding concurrently on Anchor and Cantilever Arms.

which would provide sufficient clearances at the centre for every contingency, all adjustments thereafter being in the nature of slacking off.

Before proceeding with the design of the mechanisms all the governing conditions were carefully reviewed and a study made of the data available on comparable operations, particularly the erection methods employed in the case of the Beaver bridge of the Pittsburgh and Lake Erie Railway, over the Ohio river at Beaver, Penn., in 1910. Although the mechanisms as finally designed are similar in many respects to those used in the bottom chords of the Beaver bridge, notable differences exist, particularly in the method of operating and in the use of wedges rather than toggles in the plane of the top chords. The loads to be carried were also considerably greater in the case of this structure and the range of movement to be provided for very much so.

It was a basic principle that the mechanisms be self-locking under load as uncontrolled slippage would have precipitated a disaster. It was desirable, however, to ensure the utmost ease of operation and singularly little data was available as to friction co-efficients under the conditions in question. The design was purposely very conservative in view of the importance of the operations, safety being the paramount consideration.

It was essential that the closure operations be planned and conducted with extreme care, not only to ensure geometrical accuracy in making the centre connections but also to guard against an uneven distribution of loading which, if sufficiently pronounced, might have produced serious stresses in different parts of the structure or in the wedge mechanisms themselves. A comprehensive memorandum was prepared on "The Erection of the Suspended Span," in which all important information was condensed and issued to those having a responsible connection with the operations, which followed rigidly the instructions laid down. This memorandum is reproduced in full in appendix "A," and reference to it is invited for detailed particulars. The actual operations will be discussed in the narrative dealing with the field-work.

Effect of Camber

It is common practice in bridge engineering to introduce "camber" into each structure with the object in view that the trusses will assume their geometric shape under dead load plus average or maximum live load, as may be specified, thus minimizing secondary bending stresses in the members at the time of maximum primary stress. This is accomplished by fabricating the members to lengths greater or less than the geometric accordingly as they are compression or tension members respectively. This change in length causes distortion in the structure when framed together with little or no stress in the members, such distortion being proportional to the permissible unit stresses and becoming particularly pronounced where the construction is of alloy steel with high permissible unit stresses.

In rivetted construction, the practice referred to above also requires that the members meeting at a point be

Figure No. 62.—Main Span, North Side—Further concurrent Erection Progress on Anchor and Cantilever Arms.

Figure No. 63.—Main Span, North Side—Stage completed. Tower at *AL9* removed and Traveller No. 4 being dismantled. Progress as at June 12th, 1928.

connected with true geometrical angles between their ends, the gusset connections being laid out accordingly during fabrication and all distortion being taken up by bending in the body of the members between their end connections. In ordinary construction the springing of the members is usually successfully accomplished by drifting at the connections during assembly. In large structures of heavy construction, however, where the distortions are pronounced, more elaborate methods must be adopted.

The chord sections and other members in which field splices occur must be held in proper alignment at the splices while these connections are being made and experience proves the necessity of at least partial rivetting of the splices before attempting to spring the members.

Figure No. 64.—Main Span, South Side—Traveller No. 8 being set up on South Approach. Temporary Piers at *AL7* under Construction. Progress as at June 22nd, 1928.

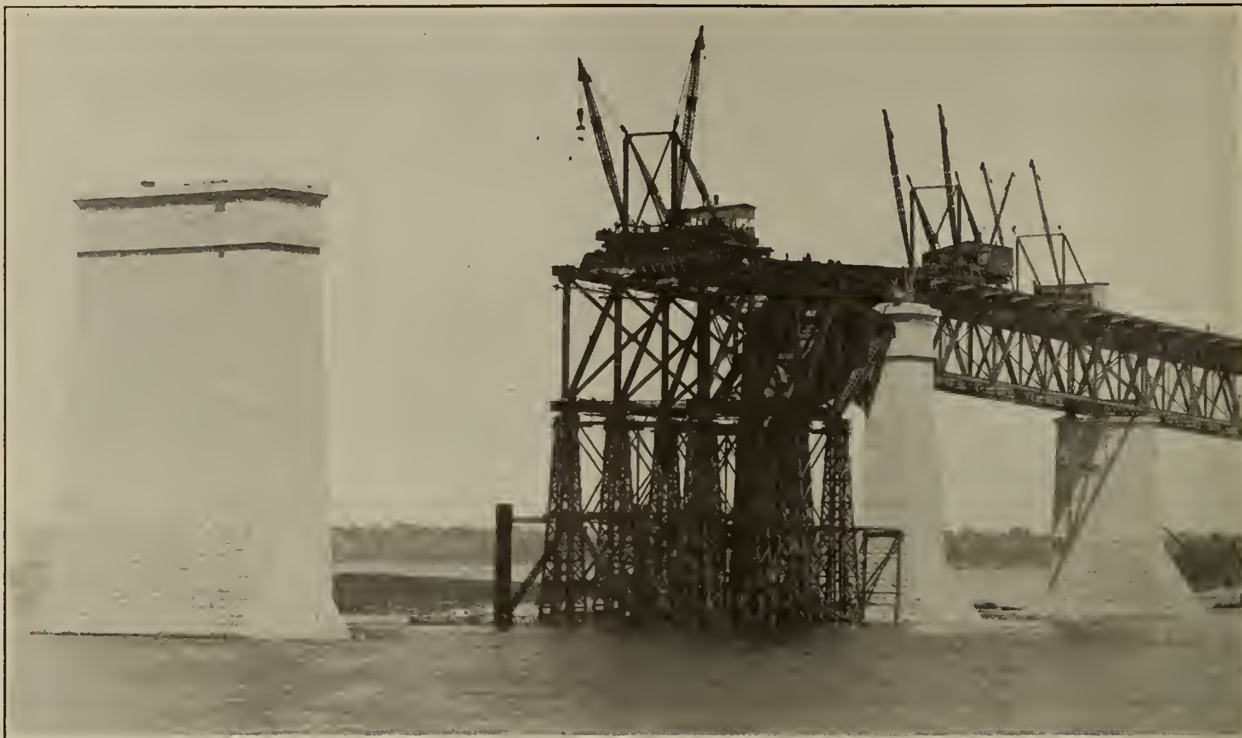


Figure No. 65.—Main Span, South Side—Erecting Falsework Span under Anchor Arm—First Stage.

After the making of the splices these members must then be sprung to meet the members they connect to, this necessitating the application of considerable force in the case of such heavy members as the chord sections.

In this instance the structure is cambered for dead load plus a specified live load of approximately 50 per cent on the channel span. The resultant springing in the main bottom chord sections was approximately ½ inch upward in each panel and required a force of about 10 tons at the ends of the heavier members. In the case of the main top chord sections the springing was in general about 1 inch upwards in each panel and required a force of about 20 tons at the ends.

In the latter instance the springing was accomplished without difficulty by means of the traveller booms. Jacking was resorted to in the case of those portions of the structure erected on the falsework spans as being simple and expeditious. For those portions erected by cantilevering, adjustable tackles were devised to support the bottom chord sections and lower diagonals during the making of the splices, being used thereafter in springing them to make their connections.

The arrangement of these tackles is illustrated in figure No. 39, the operating lines being carried to the spools of the hoisting engines.

Figure No. 66.—Main Span, South Side—Erecting Falsework Span under Anchor Arm—Second Stage.

Lifting Hitches

For convenience in handling at the shops and in the field, the heavier members were provided with "lifting hitch" brackets, these being bolted in place on the members in the shops. The position of these brackets was determined in advance to suit the handling conditions during erection, after the centres of gravity of the members had been located by calculation. The lifting tackle consisted of evener beams suspended on the derrick fall lines and connected to the lifting hitches on the members by wire rope slings with spools, using 3-inch diameter pins.

In the case of the main top chord webs, the lifting hitches were replaced by adjustable cradles which were placed on the members in the field prior to hoisting them.

Coating of Pins and Bushings

Before leaving the shop all pins, bushings and pin holes were given a protective coating of oil to prevent rust, the pins being crated to protect the finished surface from damage during shipment.

Immediately before the pins were driven in the field, the bearing surfaces of the pins, bushings and pin holes were thoroughly cleaned of all dirt and grease and were given a coating of hot paraffin.

Erection Falsework

North Anchor Arm

The falsework for the north anchor arm is shown in figure No. 49. It consisted of a steel tower at *AL9*, and a temporary span supported at its ends by the tower and main pier respectively, the span being a section of the long span provided for use the following season on the south side, with a few modifications at the end to be supported by the tower.

It was originally intended to use pile foundations under the tower but during the construction of the north main pier it was established that no suitable bearing stratum existed above rock, some 70 feet below ground level. It was also found that old wharf construction had previously been filled over in close proximity to the tower location, possibly presenting obstacles to the driving of piles. Pronounced settlements at the tower, particularly if unequal, were to be avoided and stable construction was decided upon.

Accordingly, two reinforced concrete caissons were sunk by the pneumatic process immediately under the respective trusses at *AL9* and carried down to rock about 80 feet below ground level at that point. The caissons

Figure No. 67.—Main Span, South Side—Arrangement for jacking of Falsework Span at *AL7*.

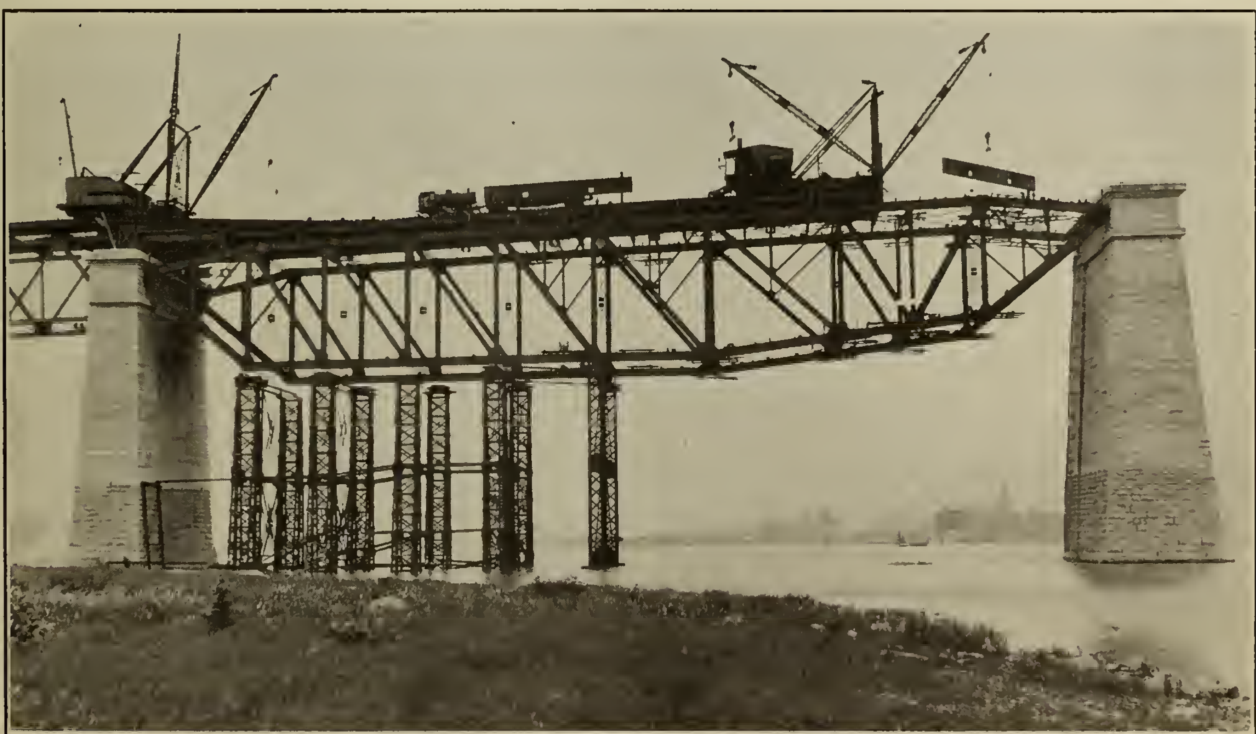


Figure No. 68.—Main Span, South Side—Erecting Falsework Span under Anchor Arm—Third Stage.

were 12 feet in diameter and consisted of a steel working chamber on top of which the concrete cylinder was built, stage by stage, as the working chamber was sunk. A shaft 3 feet in diameter was provided in the centre of each caisson with a combination man and material lock at the top. Four 2½-inch diameter anchor bolts were built into the caissons to stay the tower and the tops of the caissons were bush-hammered to a true surface at the proper level. This work was executed for the contractor by the Dufresne Construction Company Limited, of Montreal, contractors for the adjacent bridge sub-structure. It was commenced in January, 1927, and completed by the following April.

The tower consisted of two steel posts at 66 feet 6 inches centres, connected by substantial swaybracing. Each post was made up of two built webs 36 inches wide, spaced 5 feet apart, and connected by heavy lacing. The posts rested on planed steel slabs 4 inches thick which were set on the caissons on several layers of heavy canvas freshly coated with red lead. Each post was spliced in three sections with butt joints, the upper section being provided with large gussets for the connections to the falsework span. The posts were bored at the top for 15-inch diameter pins which engaged temporary shoes bolted to the underside of the bottom chords at *AL9* and were designed to transmit the load from the anchor arm to the tower.

After a review of the various conditions of loading on the tower an arbitrary maximum was adopted, provision being made for the weight of the structure and erection equipment, together with a 30-lb. wind pressure. Under the assumed conditions, the resultant maximum load on the top of each caisson was 1,500 tons and they were designed for this load. Silicon steel was used throughout the posts and in part of the bracing, the balance being of special carbon steel.

The temporary span, of which a description appears later, was connected to the top of the tower by pins of 11 inches diameter, independent pins connecting the chords and end diagonals to the post gussets. At the main pier end, the span was supported on rollers in recesses provided in the pier during construction. This end of the span was temporarily secured at the pier until the connection of the bottom chords to the tower had been made, after which it was released, the tower thereafter being braced from the main pier by the bottom chord and lateral system. The connection of the tower to the bottom chords was so located as to average the bending stresses due to temperature changes and varying deflections in the structure as erection progressed. Pedestals with jacking girders were provided at the main panel points for the temporary support of the upper structure.

Figure No. 69.—Main Span, South Side—Setting Main Shoe on Main Pier.

South Anchor Arm

The falsework for the south anchor arm is shown in figure No. 71. It consisted of a temporary span, 402 feet long between bearings and supported at its ends by the main and anchor piers respectively. It appeared unlikely that this span could be adapted for commercial use afterwards and it was, therefore, designed solely for convenience and economy during erection. It was necessary to provide ample clearance between the top chord of the span and bottom chord of the bridge to permit blocking and jacking under the panel points of the anchor arm. A pedestal was developed for the support of the main points with jacking girders incorporated, the difference in the chord widths being provided for in the pedestal design and the arrangement necessitating a uniform clear distance between the chords of 4 feet 9 inches. The design of the piers limited the location of the recesses for the support of the span to that selected, thereby governing the shape of the end panels. The depth of the trusses was chosen for economy, a portion of the bottom chord being made horizontal to facilitate its support during the erection of the span itself. The general arrangement, while hardly pleasing to the eye, nevertheless proved exceedingly practical.

The span was provided with top laterals and sway-bracing, but bottom laterals were omitted; it was assumed that the overturning effect of the wind pressure on the span would partially offset that on the anchor arm and the traveller. Methods were devised for making use of the permanent floor system in temporary position on the span during its erection, as the cost of an independent floor would have been excessive. The material required for the span was thus limited to the trusses, top laterals and bracing.

As previously outlined, the method of erecting the superstructure consisted in setting up four panels of the anchor arm with the tower traveller, followed by concurrent erection of the cantilever arm with the tower traveller and the rear portion of the anchor arm with a deck traveller. A complete schedule of operations was developed, a feature of which was that each anchor arm truss would have a single main point of support at all stages, this point being transferred backwards from the main pier panel by panel as erection progressed. This method of support undoubtedly required somewhat heavier material in the span than would have been necessary if the anchor arm had been left supported at each panel point. The uncertainty as to the weight distribution in the latter case would, however, have prevented full advantage being

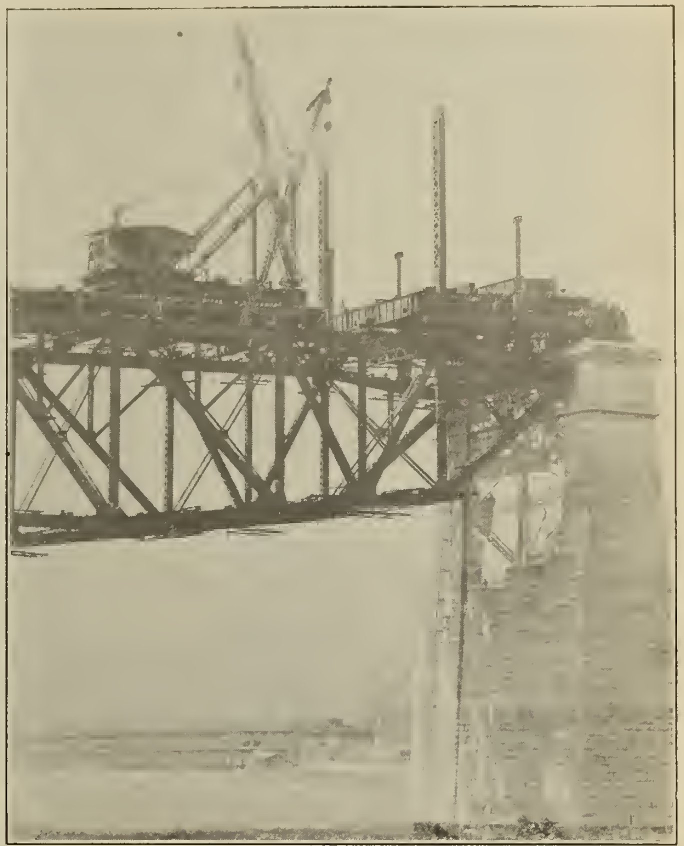


Figure No. 70.—Main Span, South Side—Erecting Bottom Chords and Floor System of Anchor Arm—First Stage.

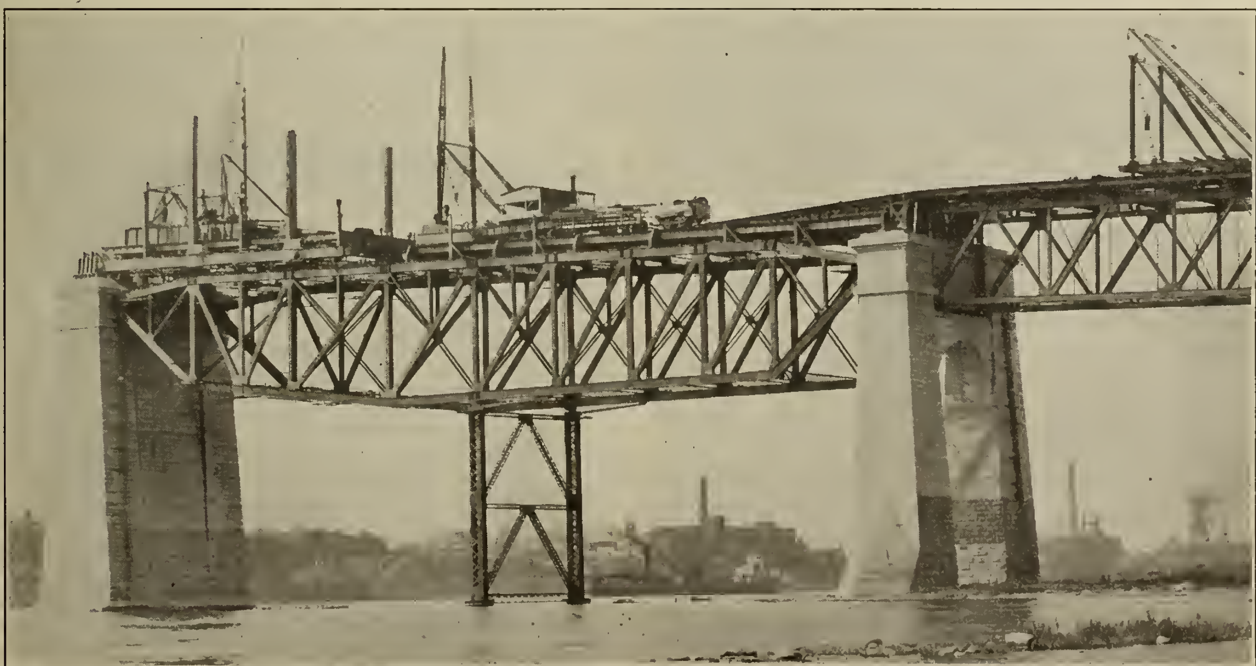


Figure No. 71.—Main Span, South Side—Erecting Bottom Chords and Floor System of Anchor Arm—Second Stage. Erection also commenced on Traveller No. 4.

Figure No. 72.—Main Span, South Side—Erecting Bottom Chords and Floor System of Anchor Arm—Third Stage. Erection proceeding on Traveller No. 4.

taken of the theoretical economy. The method adopted was much the safer, and very much more simple and expeditious in operation.

The loads on the span were calculated for the various stages and the span designed accordingly, provision being made for the weight of the structure and erection equipment, together with a 30-lb. wind pressure. Silicon steel was used throughout the trusses and in part of the bracing, the balance being of special carbon steel. The members were of standard design, the chords being 42 inches in depth with two webs 28 inches apart and with butt joints.

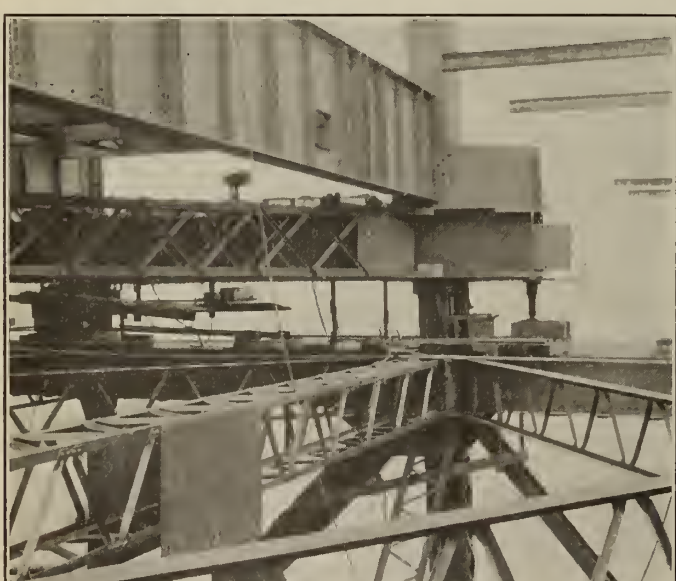


Figure No. 73.—Main Span, South Side—Method of supporting Bottom Chords on Falsework Span.

The erection of the temporary span was in itself a work of some importance. It was necessary to commence at the south anchor pier, and after a study of the river bottom conditions, it was decided to erect the first portion of the span on falsework and cantilever the remainder to the main pier, this necessitating a main point of support near the midspan in the form of a tower. This tower support was at first intended to be under *AL9*, but further examination of the bottom resulted in a change to *AL7*, from which point the distance to the main pier is 212 feet. As the maximum load to be carried on the tower during the erection of the span was 1,230 tons per truss, use was made of a steel tower composed of the lower two sections from the tower as used on the north side with special caps on

Figure No. 74.—Main Span, South Side—General Arrangement of Pedestals on Falsework Span.

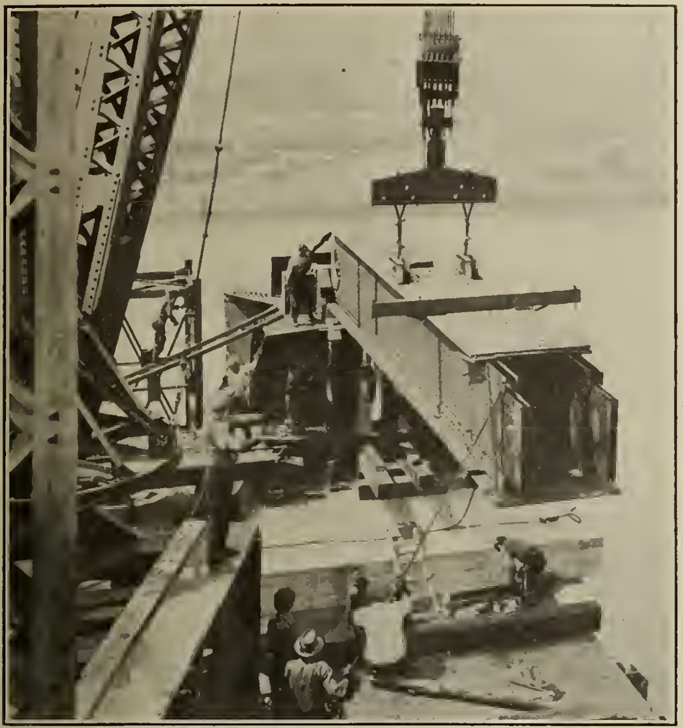


Figure No. 75.—Main Span, South Side—Placing First Bottom Chord Section of Anchor Arm.

the tops of the posts. These caps were designed to permit the span being jacked at that point during the process of landing on the main pier. The top of the tower was braced to the span by horizontal pin-connected struts extending from the top of each post to brackets on the underside of each truss at *AL5*. The magnitude of the erection stresses in the span required reinforcement in the trusses and bracing over the tower, this being liberally provided.

To provide adequate foundations for the tower, two circular piers were built under the respective trusses at *AL7*. Steel cylinders 12 feet in diameter were sunk to the bottom and anchored to protective cribs. The hardpan bottoms within the cylinders were shattered with explosives and cleared by clamshelling, after which the bottoms were sealed with sandbags by a diver. Concrete to a thickness of about 3 feet was then deposited under water, after the setting of which the upper shells were pumped dry and the remaining concrete poured to the desired level, anchor bolts being set at the same time. The tops of the piers were treated in the same manner as at the caissons on the north side. This work was executed for the contractor by Quinlan, Robertson & Janin, Limited, of Montreal, contractors for the substructure south of St. Helen's island.

The timber falsework under the temporary span was of the same general type of construction as used for the south approach. It was erected on low concrete pedestals which had been constructed the previous autumn.

The temporary span was placed on fixed bearings at the main pier to reduce to a minimum any difference in longitudinal movement at the points of support, due to temperature variations or changing deflections. At the anchor pier, the span was carried on rollers, this end being secured against movement during the erection of the span and released after its completion. Possible uplift at the anchor piers during erection of the span was provided for by blocking the ends in the recesses to engage the weight of the pier and by additional weight on the span adjacent to the pier.

Erection Travellers

The type and number of the travellers required by the erection programme has been previously outlined, with the considerations which led to their adoption. A brief description of the respective types follows.

Travellers Nos. 5 and 6

These travellers, (see figure No. 42), which were similar, were the towers set up on the ground on the north side for the first stages of erection. Each consisted of a well braced timber tower 40 feet square and 120 feet high, mounted on a structural steel base, which was in turn carried, on two runways parallel to the bridge. The runways were spaced 40 feet apart, the nearer one being 20 feet outside the line of the bridge, and consisted of lines of 85-lb. rails laid on timber cribwork. As the runways extended over the yard service tracks, the cribwork was arranged to permit any track being readily cleared by the removal of sections. As a track became blocked by the traveller in a working position, another track was cleared for the passage of material. The travellers were moved on the runways by means of solid 2½-inch diameter rollers, bearing slabs being provided under each corner of the base.

The tower posts were built of 12- by 12-inch B.C. fir, four being used at each inner corner and two at each outer. Each tower face was double-braced with 4- by 8-inch timber, and the whole additionally braced against sway by wire cables with turnbuckles.

Figure No. 76.—Main Span, South Side—Placing Second Bottom Chord Section of Anchor Arm.

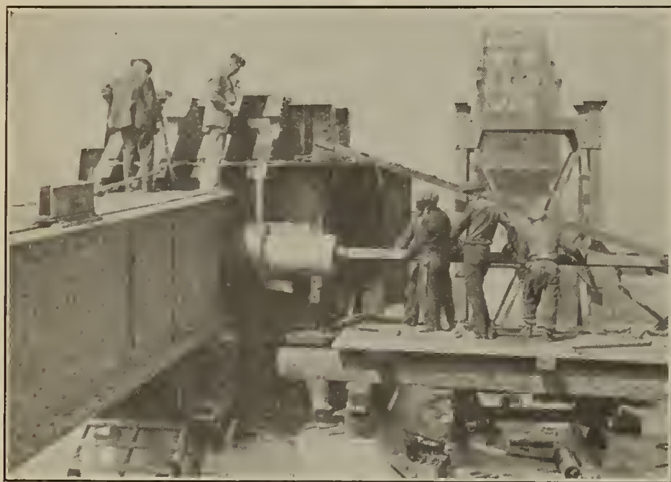


Figure No. 77.—Main Span, South Side—Driving Pin connecting Bottom Chord to Main Shoe.

A steel stiffleg derrick was mounted on the top of each tower with the mast over a forward corner, the derrick falls being led down inside the post to a special footblock at the base from which they were carried to a hoisting engine placed on the diagonally opposite corner of the base. Each derrick was equipped with a 75-foot boom provided with main falls of 50 tons capacity and an auxiliary line of 5 tons capacity for light loads. The main falls consisted of twelve parts and the boom falls of seventeen parts of ⅞-inch diameter special wire rope. Swinging of the booms was provided for by 9 feet diameter bullwheels, operated by independent single drum steam hoists on the top of the tower. The derrick falls were operated by 10- by 12-inch 3-drum steam hoisting engines specially designed and built by the Canadian Mead-Morrison Company, Limited. Steam was supplied by a 60-inch diameter vertical boiler.

The derricks and towers were designed for a load on the boom of 50 tons at 35-foot radius, at any point on the swinging arc of the boom. Uplift from the stifflegs was provided for by 1¼-inch diameter wire cables with turnbuckles, attached directly to the legs and carried down to the base of the traveller where counterweight was provided in the form of pig iron. Each traveller weighed 315 tons in working order.

TRAVELLER No. 4

This traveller, (see figures Nos. 54 and 78), was designed for the erection of the high portions of the structure adjacent to the main piers. It was of steel construction throughout and consisted of a tower 108 feet high mounted on a base consisting of two longitudinal girders connected by cross girders. The longitudinal girders were 8 feet 4 inches deep and 74 feet long, and were spaced 37 feet 2 inches apart. It was essential that the traveller be supported directly by the floorbeams of the bridge in all working positions; the longitudinal girders were, therefore, designed for the purpose, the underside being kept about 6 inches above the top of the floorbeams and shims placed at the points of support. The traveller was in general supported on floorbeams two sub-panels apart, the lengths of the girders being governed by special conditions at the main piers. The cross girders were 4 feet deep and connected near the top of the longitudinal girders. They carried the floor on which was placed the hoisting equipment and, during movement of the traveller, transferred the weight through special loading girders to four trucks placed below the base on the traveller tracks 24 feet apart. The trucks were 4-wheeled, and equipped with a 100-ton hydraulic jack on each by means of which the weight of the traveller was transferred to the trucks during movement from one working position to another. The trucks were so located as to divide the weight equally over all during the movement of the traveller.

The tower was carried directly on the longitudinal girders, the depth parallel to the girders being 27 feet as determined by the available space in the first position on the cantilever arm where it was necessary to clear the swaybracing of the main post. The tower was rigidly braced on all faces.

Two stiffleg derricks were mounted on the top of the tower with their masts on the centre line of the bridge, at the front and rear respectively. The derrick falls were carried down to guide sheaves near the foot of the tower and thence to the hoisting engines on the floor. The derricks were equipped with 70-foot and 60-foot booms respectively each provided with main falls of 35 tons capacity and an auxiliary line of 5 tons capacity. The main falls consisted of eleven parts and the boom falls of seventeen parts of ⅞-inch diameter special wire rope. These derricks were also provided with 9-foot bullwheels operated by independent swinging engines on the floor. Considerable ingenuity was required to obtain an arrangement at the top of the tower whereby the derrick backlegs cleared each other, this being finally accomplished by stepping the front derrick about 2 feet higher than the rear and by making the masts of different height. The derricks were operated by steam hoists similar to those on travellers Nos. 5 and 6, one boiler being found capable of supplying all the steam necessary.

The arrangement of the derricks permitted each boom a swinging arc of about 240°, it being thus possible to use one or both booms on either side. The capacity of the

Figure No. 78.—Main Span, South Side—Rear View of Traveller No. 4 and of Deck. Erection proceeding on Anchor Arm.

booms was governed by heavy lifts to the front and rear which could be handled by one boom only. On the other hand such long members as the top chords and upper diagonals were erected with the travellers alongside, permitting both booms to be used with moderate loads on each and ensuring perfect control during the hoisting and connecting of the members. The boom to the rear placed the swaybracing between the trusses as the traveller moved forward.

On the cantilever arm the tower was erected with its front face at the extreme forward end of the base. On the anchor arm, however, it was moved back 13 feet 6 inches to obtain a more convenient working position in this case for the derricks and permit the completion of the swaybracing in each panel immediately after the traveller had moved to its next position.

This difference in the tower position necessitated a re-arrangement of the hoisting equipment when the traveller was moved from the anchor to the cantilever arm, the trucks being also re-arranged to maintain equalized loads during movement. The clearance under the sway-bracing over the roadway made it unnecessary to remove any of the hoisting equipment from the traveller base during its transfer to the cantilever arm. Movement of the traveller along the floor was provided for by hauling ropes leading from a forward floorbeam to the main falls, over sheaves on the traveller base. The traveller was securely moored in each working position against movement down the grade.

The height of the tower was determined after the length of the booms had been decided, and was governed by the reach necessary when placing the links at the top of the main posts.

The traveller was stable in the working positions without counterweight or anchorage. The weight in working order was 320 tons.

Figure No. 79.—Main Span, South Side—Front View of Main Posts and Bracing, and of Traveller No. 4.

Figure No. 80.—Main Span, South Side—Erection proceeding on Anchor Arm.

Figure No. 81.—Main Span, South Side—Erection of Anchor Arm being completed to *AL7*.

Figure No. 82.—Main Span, South Side—Erecting Top Chord Web showing Method of Handling.

TRAVELLERS NOS. 3 AND 8

These were the deck travellers, (see figure No. 70), used for the erection of such portions of the structure as were within reach from the floor with the exception of the central panels of the suspended span. Each traveller consisted of a structural steel base on which were mounted two stiffleg derricks. Traveller No. 3 was used on the north side and traveller No. 8 on the south, both bases being alike in construction but the derricks on No. 8 being of greater capacity than on No. 3.

The base consisted of two longitudinal box girders 3 feet deep and 60 feet long with connecting beams and bracing, these girders framing into a transverse loading girder at the front 6 feet deep and 38 feet 6 inches long. The longitudinal girders were spaced 24 feet apart over the traveller tracks, each girder being carried on two 4-wheeled trucks spaced 40 feet apart. The rear trucks were designed to permit the elevation being changed to suit the varying gradient towards the centre of the span, the traveller deck being thus kept level at all times. In each working position the loading girder was kept over a floorbeam of the bridge and blocked from it by shims at points 37 feet 2 inches apart, the traveller base being first jacked clear of the front trucks. The beams between the longitudinal girders provided a floor on which was placed the hoisting equipment.

Two steel stiffleg derricks were mounted on the base of each traveller, the masts being placed at the junction of the cross girder and longitudinal girders, 24 feet apart. The masts were braced together in the front plane and the backlegs connected directly to the longitudinal girders. Traveller No. 3 was equipped with two 75-foot booms provided with main falls of 30 tons capacity and a 5-ton auxiliary line. Traveller No. 8 was equipped with the masts and booms from travellers Nos. 5 and 6 which were dismantled before No. 8 commenced operations. The backlegs of travellers Nos. 5 and 6 were used for the same purpose on the deck travellers. The boom swinging equipment, hoisting engines and boilers were of similar type to those used on the other travellers. An auxiliary 6-ton derrick was set up on the rear end of traveller No. 3 for the erection of the swaybracing on the north anchor arm.

The travellers were securely moored in all working positions against movement down the grade and were moved from one position to another by rigging similar to that employed on traveller No. 4. They were stable against overturning in most working positions, the rear ends being anchored to the floor by heavy cables in the case of a few heavy lifts. Each traveller weighed 180 tons in working order.

Wedge Mechanisms

The wedge mechanisms used for the final closure at the centre of the suspended span are illustrated in figure No. 40. For descriptive purposes, each unit may be divided into four parts, as follows:—(a) wedge unit, (b) shoes, (c) links, and (d) cross-head and operating unit.

(a) The wedge unit consisted of the wedge proper and the operating shaft.

The wedge proper was a steel casting 6 feet 6 inches long and 2 feet wide, tapering in the plane of the truss from 25 inches at the bottom to 12 inches at the top. The tapered bearing surfaces were machined and polished by hand to a bevel of 1 in 12 with respect to the vertical axis. The flanges were also machined on the edges to a uniform width.

The operating screw was of forged steel 6 inches in diameter and 14 feet 6 inches long. It was inserted in the wedge casting, the lower end being forged into a square head and fitted in a socket in the bottom of the wedge. The screw was rigidly secured in the wedge by a lock nut mounted on the projecting portion of the shaft which was threaded with ½-inch pitch Acme thread.

(b) The shoes were two in number, mounted on the opposite bearing surfaces of the wedge casting. Each shoe was a steel casting, bored to bear on the pins placed in the chords. The surface facing the wedge was machined and lined with ¾-inch "Lubrite" plates, these being of bronze and studded with holes filled with graphite. These liner plates were for the purpose of reducing the sliding friction: they were secured to the casting by stud screws and also held in place by flanges of the shoe which engaged the machined edges of the wedge casting. The upper portion of the shoe was cast in the form of lugs which were bored for 3¼-inch diameter pins.

(c) The links were built of structural steel in the form of box struts, bored at the ends for 3¼-inch diameter pins with which they were connected to the shoes and cross-head respectively.

(d) The cross-head and operating unit consisted of the cross-head, the operating nut with thrust bearings and wormwheel attached, the worm and shaft, and the hand-wheels.

The cross-head was a steel forging 4 feet long, 19 inches wide, and 12 inches deep. The centre was bored vertically to receive the operating nut and the ends were slotted vertically and bored for the pins connecting the cross-head to the links.

The operating nut was of bronze, 9½ inches diameter and 28 inches long, the lower end being enlarged to a diameter of 19 inches to form a shelf on which was placed a heavy-duty ball thrust bearing. The nut was threaded to fit the operating screw, on which it revolved in the cross-head.

The nut was first assembled in the cross-head, with the latter resting on the ball thrust bearing. The wormwheel was then threaded onto the top of the nut above the cross-head and secured to the nut with tap-bolts, a bronze washer of 14 inches diameter and ¾ inch thickness being first placed between the wormwheel and cross-head. The

Figure No. 83.—Main Span, South Side—Erection commenced on Cantilever Arm.

Figure No. 84.—Main Span, South Side—Ice Conditions on March 28th, 1929, just prior to Resumption of Erection.

wormwheel was of cast iron with a rim of Hy-ten-sl bronze bolted securely to it, the latter being cut to match the pitch of the worm.

The worm and shaft was forged and turned as a single unit of 0.40 carbon steel, the shaft being 3 inches in diameter and 4 feet 6 inches long. It was supported on bearings on a heavy steel plate, mounted at one end of the cross-head and firmly secured to it by stud-bolts. The bearings were bronze bushed, and a ball thrust bearing was also added.

Handwheels of cast iron, 28 inches in diameter, were placed on each end of the worm shaft for operating purposes, short handles being attached to the rims. The rims were also provided with sockets in which bars could be inserted at will to obtain a greater leverage.

A graduated vertical scale was attached to each wedge casting and a fixed pointer placed on each cross-head. In this manner, movement of the wedge with respect to the shoes was readily recorded.

Each wedge mechanism was fully assembled in the shops and operated to overcome the initial stiffness of the parts. Tests were then conducted on all wedges to determine the frictional resistance of the operating devices, it being found impracticable to carry out satisfactory tests on the sliding friction between the wedge and shoes. The results of these tests were remarkably uniform and agreed closely with the assumptions used in the design of the mechanisms.

Before leaving the shop each wedge was set carefully in a pre-determined position, all operating parts were thoroughly cleaned and lubricated, and grease cups filled. Metal hoods were then placed over the operating screws and worm drives to protect them from dirt and rain. Each mechanism was securely blocked and clamped for shipment as a unit, the exposed machined surfaces being protected by burlap wrapping.

The design of the operating parts of the mechanisms was governed by the frictional resistance between the moving parts. It was assumed that the sliding friction between the wedge and shoes would exceed the vertical component of the load on the wedge,—in other words, that the coefficient of friction would in this case exceed 0.083. Under this condition, the operation of the wedge would entail compression in the operating screw with resultant tension in the links, the torque required to operate the mechanism being governed by the sliding friction between the wedge and the shoes, the rotating friction of the nut on the operating screw and the rotating friction between the wormwheel and worm. Maximum coefficients of friction were assumed as being 0.18, 0.15 and 0.10 respectively and the operating parts designed accordingly for a maximum load on the wedge of 800 tons.

There remained the possibility, however, that the coefficient of friction between the wedge and shoes might prove to be less than 0.083, in which case the inclination of the wedge to slip out from between the shoes would entail tension in the operating screw and compression in the links. Under this condition the load from the operating screw would be transferred to the cross-head through the bronze washer above instead of through the ball thrust bearing below. Free movement of the wedge would be restricted by the friction on the washer as well as that of the nut on the screw and that of the worm drive. Investigation established that the mechanisms were self-locking under any conditions that might reasonably be expected.

As a matter of interest, it was found during the use of the mechanisms in the field that the coefficient of friction between the wedges and shoes was in all cases and at all stages less than 0.083, being apparently about 0.06. The load from the operating screw was transferred to the cross-head through the bronze washer, the ball thrust bearing being free of load throughout. The principal result of this action was that the advantage in ease of operation from the low friction between the wedge and shoes was offset by the friction on the bronze washer being considerably greater than would have been the case with the load on the ball thrust bearing. The effort required to operate the mechanisms was approximately equal to the maximum provided for and much greater than was actually expected. Had this condition been anticipated, a ball thrust bearing might have been used in place of the bronze washer and some parts of the mechanism reduced in size. The mechanisms, nevertheless, operated very satisfactorily as actually designed, no difficulties being experienced in the making of the required adjustments.

Field Operations on Main Span

The field programme for the main span resolved itself into three divisions,—north side, south side and centre section respectively. The operations will be described in narrative form with special reference to features of an unusual nature. Numerous illustrations have been included from which the details of the methods and equipment used may be better understood.

North Side

Season of 1926

The north anchor pier was built by the contractor for the substructure during the summer of 1926. During its construction, the anchorage grillages were set in place, the location and levels being carefully checked. (See figure No. 41.) The pier was thereafter completed, wells being provided for the members connecting the anchor arm trusses to the anchorage grillages.

Season of 1927

Commencing in May, 1927, the north storage yard was installed with the necessary railway sidings and other facilities. Travellers Nos. 5 and 6 were then erected on cribwork runways on either side of the anchor arm, the towers being set up by a locomotive crane with lengthened boom and the derricks assembled on the tower by auxiliary equipment. Owing to the limited ground space on the north side, the timbers for the traveller towers were cut to length, bored for bolting and framed in convenient handling units in the south storage yard, from which point they were shipped by rail to the north storage yard. Figure No. 42 shows these travellers in a nearly completed condition. The first operation was the assembling of the shoes in place on the main pier, (see figures Nos. 43 and 44), their setting being checked by means of previously established centre lines and the pin bearings of all four webs carefully aligned. Rivetting of the shoes was proceeded with immediately after their assembly as the interior connections became inaccessible for this purpose with the adjoining members in place.

Meanwhile the travellers were moved as far back from the main pier as possible and the steel tower set up on the caissons at *AL9*, the splices of the tower posts being fully bolted and the bracing connections rivetted. The temporary falsework span was then erected on timber falsework, commencing at the tower and working towards the main pier. The early stages are illustrated by figures Nos. 45 and 46, and special attention is drawn to the congested condition of the railway tracks and power wires at this point with the obvious restrictions imposed on the erection. The span was erected sufficiently high to enable the end members being entered in the recesses at the main pier and connected, after which the span was landed on its roller shoes in the recesses by jacking on the timber falsework under *AL13*. The final stage is illustrated by figure No. 47. As the stresses in the span were at all stages much lower than for those for which the members were designed, except in the diagonals adjoining the tower, the truss and bracing

Figure No. 85.—Main Span, South Side—Erection proceeding concurrently on Anchor and Cantilever Arms.

Figure No. 86.—Main Span, South Side—Arrangement for jacking at Anchor Pier.

connections were bolted sufficiently for the stresses to be carried, except in the case of the above diagonals which were rivetted. The general arrangement of the travellers and falsework is also shown in figure No. 48, a view from the top of the north anchor pier. On the completion of the temporary span, the timber falsework was dismantled and removed.

The bottom chords and laterals of the anchor arm were next erected on the temporary span, commencing at the main pier and continuing to *AL9* at which point the special shoes on the underside of the chords were connected to the tower by driving the pins. The temporary span which had been previously secured to the main pier was now released, the tower being braced longitudinally through the bottom chord and lateral system to the pier. The chords were supported at the main panel points on steel pedestals, shims being used to obtain the desired elevations. Timber trestles were used as temporary supports at the intermediate points. The placing of the first chord sections is illustrated by figure No. 49 which also shows the pedestals in place on the temporary span.

Particular care was taken to ensure good bearing at the chord splices, the ends of the members being thoroughly scraped before assembly to remove paint, and any burrs filed away.

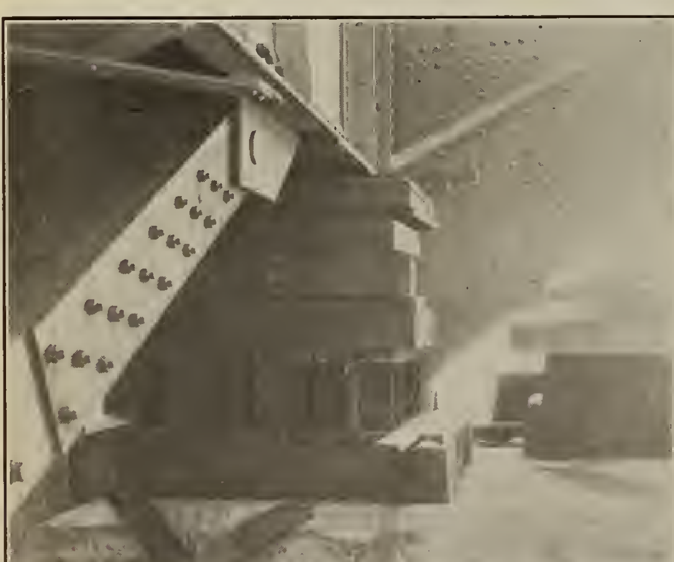


Figure No. 87.—Main Span, South Side—Arrangement of Shims and Blocking at Anchor Pier.

For the chord sections supported on the temporary span, the procedure in making the splices was to first connect the bottom flanges, using turnbuckles to ensure good contact. The bottom flange connections were then fully rivetted, after which the forward end of the chord being placed was raised carefully by jacking to bring the entire face at the splice in close contact. The joint was carefully inspected with "feelers" during this operation and not accepted until only occasional clearances of under seven thousandths of an inch were found. The splice was then bolted tightly to the extent of about 50 per cent and completely rivetted, it being found that after the rivets were cold the slight upsetting from the rivetting was apparently sufficient to take up all clearance at the joint and establish perfect contact. A certain amount of trouble was experienced at the first splices before satisfactory methods were fully developed but this was corrected, and eliminated in the making of the remaining joints.

On the completion of the chord splices and the connection to the tower at *AL9*, the lower verticals were erected together with the floor system, working from the tower to the main pier. (See figure No. 50.) At the sub-panel point *AL10* the sub-verticals, to which the floorbeam connects, were supported and braced directly on the chords; at the other sub-panel points the sub-verticals were replaced by temporary extension brackets to provide clearance while handling materials to the deck with travellers Nos. 5 and 6. The end connections of the floorbeams and longitudinal roadway stringers were at once rivetted and the service and traveller tracks laid on the deck.

Traveller No. 4 was now erected on the deck adjacent to the main pier, the lower portion being handled by lengthened booms on travellers Nos. 5 and 6 and the upper portion by auxiliary equipment. (See figure Nos. 51 and 52.) A rear view of the base is shown in figure No. 53 during the installation of the hoisting engines.

The first section erected by traveller No. 4 consisted of the three lower sections of each main post and the connecting portal strut, lower diagonals *AM13L15*, sub-diagonals *AM14M15* and sub-chords *AM13M15*, (see figures Nos. 54 and 55). The post sections were held upright by temporary connections at the base and each splice was partially rivetted immediately after assembly. The sub-chords were temporarily connected to the posts at *AM15* by adjustable details by means of which the distance between *AM13* and *AM15* was set to a pre-determined dimension which compensated for the shop camber in the members of the first panel and was intended to facilitate the connecting of the members at the top of the post. The traveller was next moved forward until its tower was immediately behind the portal strut, in which position it erected a portion of the first panel of the cantilever arm. This portion consisted of the first section of bottom chords and laterals, lower diagonals *CL13M12*, sub-diagonals *CM13M12* and the floor system to *CL12*, this providing a base for the future erection of the traveller on the cantilever arm. The outer ends of the chords were supported by adjustable tackles connected at one end to cradles bolted on the underside of the chords and at the other end to temporary brackets on the main post near its midpoint.

Traveller No. 4 having been moved back to its first position, completed the erection of the main posts, links and swaybracing between, the splices of the post sections being partially rivetted as placed. In the erection of the links, the inner sections were placed first and stabilized by a temporary connection to the main post on the cantilever arm side, the pins connecting the link sections to the extended wings of the upper post sections being driven part way through from the inside. The outer link sections were then placed and the pins just referred to driven home, thus providing a stable connection for the links with the sections in proper alignment. The link sections having been connected were rivetted together. The upper diagonals *AM13U15* were next erected, the pins at *AU15* being first driven and the connections at *AM13* then drifted home. This connection was made without difficulty as the result of the initial adjustment in the sub-chords *AM13M15*.

The upper verticals *AM13U13* having been placed, the top chords *AU13U15* were erected, each in two sections. Each section was about 84 feet long and weighed 45 tons. To avoid the difficulty of warping such long members through the trusses, each section was raised in turn from the ground on the boom of traveller No. 5 or No. 6 and transferred in mid-air to the booms of traveller No. 4, the falls of which were connected to special lifting cradles spaced about 30 feet apart on the chord section. These cradles were made adjustable for the varying depth of the chord sections and were placed on them on the ground in advance; they were specially designed for quick placing and removal. Such a detail was rendered necessary by the fact that it was impossible to provide holes in the top flanges of the chords for the usual type of hitch. Each inner section was placed first and the pin at *AU15* driven halfway through from the inside, thus engaging the chord section and two webs of the link; the other end was then bolted at *AU13*. The outer sections were placed last, the pins driven home, and the connections completed at *AU13*. Detail connecting the two webs of a chord, such as lacing or tieplates, was hoisted in bundles and assembled in place by hand.

Traveller No. 4 was now moved back into the second panel. In the typical moving operation the traveller was first raised sufficiently by means of 100-ton hydraulic jacks on each truck, to permit the removal of the shims from between the traveller girders and the floorbeams, after which it was lowered onto the trucks. The traveller was then eased back to its next position, being kept in control by cables leading from the traveller base to hooks engaging the top flange of a floorbeam and thence to the main falls of each boom. On reaching the next working position the traveller was jacked from the trucks and shimmed on the floorbeams in readiness for further handling. The entire moving operation was quickly executed, taking about two hours on the average to complete.

As soon as the traveller was in working order in the second panel, the swaybracing was placed behind in the planes *AU13M13M14*, this completing the first panel of the anchor arm. The diagonals for the second panel were next placed and connected at *AM11*. Four 285-ton hydraulic jacks were now placed on the jacking girders of each of the pedestals under the bottom chord at *AL13* and the load taken by them. The height at *AL13* was then adjusted by the jacks to enable the connections of the lower vertical to the diagonals at *AM11* after which the shims at *AL13* were removed, thus transferring the point of support from *AL13* to *AL11*. The panel was completed by the erection of the upper verticals and top chords, the latter members in this instance being placed on the floor by the booms of travellers Nos. 5 and 6 and there taken by the booms of traveller No. 4. The top chords were first connected at *AU13*, being held in alignment on the falls until the bolting was well advanced. The connections to the upper verticals at *AU11* were then made, the chords being sprung the required amount by means of the traveller booms.

The third panel was erected in similar manner. At the corresponding stage the hydraulic jacks were transferred to the pedestals at *AL11* and the connections completed at *AM9*, the shims at *AL11* being, however, left in place. This stage of erection is illustrated by figure No. 56 and attention is called to the arrangement of the top chord splices of which those at *AU9* are typical. The splices were designed as lap joints, the main material at each end

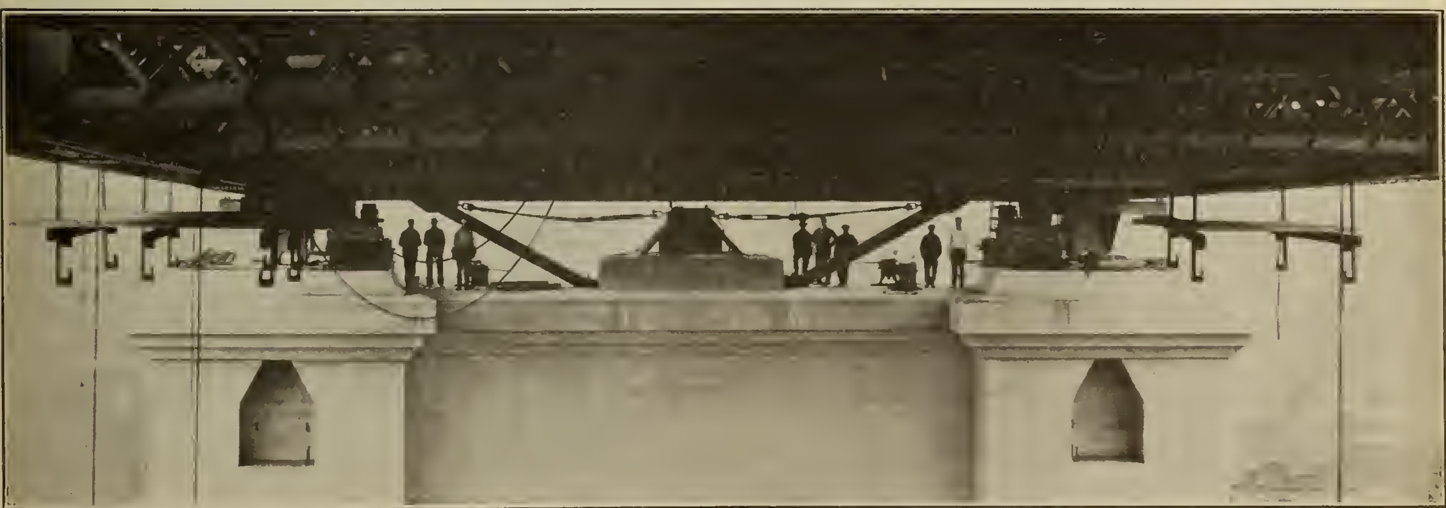


Figure No. 88.—Main Span, North Side—General Arrangement at Anchor Pier while jacking Anchor Arm for Connection to Anchorage.

Figure No. 89.—Main Span, Centre Section—Detail at *SL0* showing Erection Wedge Mechanism in Place.

of the chord sections being cut at several planes. The splice material was rivetted to the chords, that on one side of each web to one section and that on the other side to the adjoining section, resulting in a stepped arrangement at the end of the section, as illustrated, which eliminated forked ends and greatly facilitated the erection of the chords.

A temporary strut having been placed between the upper verticals at *AM9*, the traveller was moved back to just clear the strut and the panel beyond the tower erected, this completing the portion of the anchor arm which it was necessary to erect with traveller No. 4 on account of the height. The traveller, having been moved again to its first position in the third panel, erected the bracing at *AU9M9-M10*, after which the shims at *AL11* were removed. This operation relieved all load from the temporary span, the erected portion of the anchor arm being supported entirely by the main pier and the tower at *AL9*.

The temporary span was now dismantled for use on the south side and concurrently, traveller No. 4 was moved from the anchor to the cantilever arm. In this operation, the tower was dismantled, the base moved forward until its front stood at *CL12* on the cantilever arm, and the tower re-erected on the channel side of the main post. In this case the tower was mounted at the forward end of the base, this necessitating some re-arrangement of the hoisting engines and other equipment. Erection proceeded on the first panel of the cantilever arm, the second bottom chord sections being placed and supported by adjustable tackles similar to those already supporting the first sections. By means of these tackles, the adjoining sections were aligned and the splices rivetted. The procedure in this case differed somewhat from that where the chords were supported on the temporary span. The top flanges were first connected and rivetted, the outer end of the chord being then eased off on the adjustable tackles to establish close contact over the entire face. The remaining web members having been erected and connected, the chords were adjusted by means of the outer tackles and connected to the lower verticals at *CL11*. This stage is illustrated by figure No. 57, and was reached by December 15th, 1927, erection of the superstructure being then suspended for the winter.

Season of 1928

During the winter months preparatory work was carried on with a small organization. Travellers Nos. 5 and 6 were completely dismantled, thus releasing material and equipment for use elsewhere and increasing the storage area on the ground. To provide facilities for hoisting materials from the ground to the deck, a special hoisting derrick was set up in the plane of each anchor arm truss at *AL13*, (see figure No. 58). Each derrick consisted of a mast and short boom, the latter having main falls of 50 tons capacity and a 5-ton auxiliary line. The mast footblock was mounted on a pedestal supported by the bottom chord and the head of the mast was held by temporary brackets on the truss members near the swaybracing strut at *AM13*. The hoisting lines were operated from hoisting engines on the ground and the mast bullwheels by independent swinging engines on the deck. The booms were designed to swing through the trusses in the panel *AL13L15*, the sub-hangers at *AL14* being temporarily omitted for the sake of greater clearance. A flatcar was placed on each service track, operated by wire cables leading over snatchblocks and guide rollers to steam winches on the deck near the main pier. The method of handling materials thereafter was to hoist from the ground to floor level outside the trusses, swing inboard, and place on the flatcars for distribution over the service tracks.

Erection was resumed on the cantilever arm with traveller No. 4 early in March. Shortly afterwards the setting-up of traveller No. 3 on the anchor arm was commenced, the base with the hoisting engines being assembled on the floor near the main pier and moved back to *AL9* where the rigging was completed with the booms facing the anchor pier. During the erection of traveller No. 3 the first two panels of the cantilever arm were completed, the load on the tower at *AL9* being thereby considerably reduced.

Figure No. 90.—Main Span, Centre Section—Arrangement of Floorbeams and Lateral System Connection at North End of Suspended Span.

Traveller No. 4, having been moved forward to *CL11*, erected bottom chords *CL11L10*, the outer ends being supported on adjustable tackles from *CM11*. By means of the tackle the chords were aligned with the adjoining sections and the splices rivetted. The remainder of the sub-panel was then erected. (See figure No. 59.) The upper verticals *CU11M11*, and top chords *CU13U11* were next placed, after which the traveller was moved forward to *CL10*. The bottom chords *CL10L9*, having been erected on the adjustable tackles which were released from the adjacent chord sections and swung forward, were aligned and the splices rivetted. (See figure No. 60.) The lower diagonals were also erected, the upper ends being supported on adjustable tackles from *CM11* while the splices at *CM10* were rivetted. The upper diagonals were then erected, the lower diagonals being sprung by means of the adjustable tackles to enable the connections to be made at *CM9*. The lower verticals having been placed, were connected at *CM9* and the chords sprung by means of their tackles to make the connection at *CL9*. On the completion of the floor to *CL9* the traveller was moved forward to that point and the swaybracing *CU11M11M12* was at once placed. The erection of the upper verticals and top chords completed the panel. (See figure No. 61.)

Thereafter erection alternated on the arms in predetermined cycles which permitted the rivetting of the splices in the compression members immediately after assembly. Relative progress on the two arms is typified in figure No. 62. The load on the tower at *AL9* fluctuated within a narrow range, being at all stages moderate and much below the maximum during the erection of the first portion of the anchor arm.

The anchor pier was reached by the middle of May, concurrently with the completion of the five panels of the cantilever arm scheduled for erection by traveller No. 4. The load on the tower at *AL9* was at this stage 975 tons per post, exclusive of wind. During the completion of the rivetting of the connections, the wind anchorage was set in place on top of the anchor pier and concreted, and the anchorage struts at *AL0* lowered into the wells in the pier and connected to the anchorage grillages by pins. The end floorbeam of the anchor arm was also braced securely

Figure No. 91.—Main Span, Centre Section—Erecting First Panel of Suspended Span on North Side—First Stage.

to the wind anchorage by inclined timber struts and by 1¾-inch horizontal wire cables with turnbuckles. (See figure No. 88.)

Hydraulic jacks were next placed on the pier under each end of the floorbeam for the operation of releasing the tower at *AL9* and connecting the anchor arm to the anchorage struts at *AL0*. The arrangement at each point consisted of two 285-ton Dudgeon hydraulic jacks with 8-inch runout, operated in tandem through equalizing valves from two hand-driven pumps. The jacks were mounted on steel grillages and, beside them on the same base, steel blocking and shims for the following-up of the jacks, The general arrangement was similar to that used on the south anchor arm as illustrated in figure No. 86.

The end of the anchor arm was first jacked upwards about 8½ inches, the load being gradually transferred to the jacks from the tower at *AL9* and finally entirely relieved at that point. The pins and shoes at *AL9* were then removed, the top of the tower being temporarily lashed to the anchor arm. The jacks were then carefully lowered about 11 inches at which point the pins connecting the arm to the struts were driven. The jack movements

Figure No. 92.—Main Span, Centre Section—Erecting First Panel of Suspended Span on North Side—Second Stage. Erection proceeding at Outer End of South Cantilever Arm.

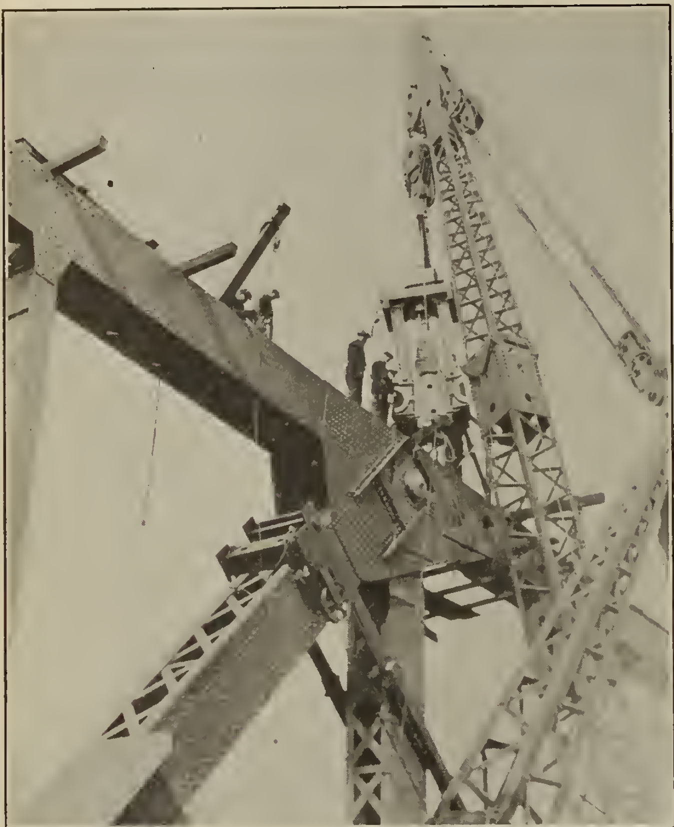


Figure No. 93.—Main Span, Centre Section—Detail at *CU0* showing Erection Wedge Mechanism being Placed.

were conducted in stages, the compressibility of the large thickness of shims reducing the net movement in each stage to about 3 inches. The jacks were followed closely by shims and the load landed on them during the process of fleeting the jacks. Cross anchorage was maintained by keeping the cables taut and the inclined timber struts tight by means of hardwood wedges.

The calculated jacking load during the landing of the anchor arm was approximately 400 tons per truss which agreed closely with the observed load as recorded on the jack gauges. The actual amount of jacking also conformed remarkably to that anticipated, based on the calculated deflections in the structure during the operation.

The permanent brackets which engage the wind anchorage were assembled temporarily and the position of the connecting holes marked, after which they were returned to the shops for drilling. They were then finally assembled in place and rivetted, after which the temporary cross-bracing was removed.

The tower at *AL9* was dismantled by means of auxiliary equipment for use on the south side, such portions as necessary being first returned to the shops for alteration. Subsequently traveller No. 4 was also dismantled and transferred to the south side, the condition at this period being illustrated by figure No. 63. Traveller No. 3 was left at the end of the anchor arm for later use at that point. The above operations were completed during June, and apart from incidental work, erection was suspended on the north half of the main span pending the completion of the south half to a similar stage.

South Side

Season of 1927

During the construction of the south anchor pier, the anchorage grillages were transported to the site from the north side on scows belonging to the pier contractor, and assembled in place, as on the north side.

Season of 1928

The south approach was completed to the south anchor pier by June 15th, 1928. By this date the construction of the temporary falsework piers under the anchor arm at *AL7* was also well advanced. Traveller No. 8 was immediately set up at the forward end of the approach deck, with booms facing the channel, conditions at this period being illustrated by figure No. 64.

Erection was then commenced on the temporary falsework span for the south anchor arm, the first portion being assembled on timber falsework, (see figure No. 65), with the rear end secured to the anchor pier to prevent longitudinal creeping on the rollers at that point. On reaching *AL5*, the modified steel tower was erected on the temporary piers just completed at *AL7*. The water level at this time was somewhat higher than had been anticipated, being about 2 feet above the base of the tower posts. The steel shells encasing the piers had been designed to meet such a condition, being well above water level, permitting the bearing slabs and lower post sections to be set on a dry top. The shells were then cut by burning and the bottom bracing strut connected without difficulty. The span having been completed to *AL7* was landed on shims on the tower, the latter being braced by horizontal pin-connected struts extending from the top of the tower to brackets on the underside of the bottom chords at *AL5*.

The remainder of the span was then erected as a cantilever, the bottom chords being supported on adjustable tackles for the rivetting of the splices before their connection to the diagonals. The reactions and stresses produced by the long overhang necessitated deck loads being minimized as much as possible on nearing the main pier. Uplift at the anchor pier was also provided for by moving traveller No. 1 onto the rear end of the span; by placing several heavy

Figure No. 94.—Main Span, Centre Section—Rear View of Wedge Mechanism in Place at *CU0*.

members on the rear chords, and by blocking the end of the span securely in the pier recesses. Figure No. 66 shows the span shortly before completion.

The size of the recesses in the main pier did not permit of jacking at that point. The top of the tower posts had, therefore, been designed for this operation and a cluster of four inter-connected 285-ton hydraulic jacks was now placed under each truss at this point, operated by three hand-driven pumps, (see figure No. 67.) As soon as the assembly of the trusses and the bracing in the end panel was complete, the span was jacked upwards at *AL7*, the shims at that point removed, and the span landed on the fixed shoes at the main pier, the rear end being simultaneously released. The remainder of the floor system was then placed on the span, thus providing access to the main pier. (See figure No. 68.) Subsequently the timber falsework was removed by traveller No. 1, the tower was, however, left in place with loose shims until the end of the season, principally for the psychological effect on the erectors.

The weight of the temporary span, with floor system included, was approximately 1,625 tons, the jacking load at the towers during the landing of the span being 960 tons per truss. The limited clearance in the pier recesses and the deflections under the heavy erection stresses in the span made accurate calculations necessary for the thickness of the shims at *AL7*, to ensure the span being completely free at the tower after being landed at the main pier, and also when subjected to its maximum load during a later stage. The elevation of the top of the tower was determined by these considerations, the thickness of the shims being such as to permit the assembly of the end members in the recesses clear of the shoes. The net downward movement at *AL7* during the jacking operation was 8¾ inches which agreed closely with the calculated amount.

During the erection of the temporary span, a working floor was provided by assembling the permanent floorbeams and longitudinal stringers on the chords of the span at an elevation about 10 feet below the final position, the service and traveller tracks being laid on the stringers. The floorbeams were supported on the chords by means of the sub-verticals and extension brackets, the chords being provided with diaphragms and stiffeners at the points of support. To permit the erection of the bottom chords, the floor system was shifted backwards about 11 feet to ensure each floorbeam being clear of the end of the adjacent chord section. As the stresses in the span were much below their maximum while this arrangement of the floor existed, the bending stresses in the chords produced by the offset floorbeams were not serious. The service and traveller tracks were carried down from the deck of the approach on ramps built up of timber blocking, the re-handling of material at the end of the span being thus avoided.

Immediately after the completion of the temporary span, the shoes were set in place on the main pier, the general assembly being well illustrated in figure No. 69. Traveller No. 8 was then moved backwards towards the anchor pier, placing panel by panel the bottom chords and laterals, lower verticals, and the floor system which was disconnected and re-assembled in its permanent position. On approaching the anchor arm the traveller was backed up the ramp to the deck of the approach, removing the ramp and completing the assembly. As soon as a portion of the floor adjacent to the main pier was completed, the erection of traveller No. 4 was commenced, the material being passed forward across the intervening gaps by traveller No. 3 and transferred to the front end on track lorries. Different stages during this period are illustrated in figures Nos. 70, 71 and 72.

Figure No. 95.—Main Span, Centre Section—Side View of Wedge Mechanism in Place at *CU0*.

The bottom chords were supported at the main panel points by the pedestals on the temporary span, timber trestles being used at intermediate points. The general arrangement is illustrated in figures Nos. 73 and 74, the large thickness of shims at each pedestal being governed by the later jacking requirements. The method of handling the heavy chord sections is shown in figures Nos. 75 and 76 and the driving of the pins at the shoes in figure No. 77. Each chord splice was aligned and fully rivetted immediately after assembly with fullest precautions to obtain tight joints. On reaching the anchor pier temporary connections were made between the end floorbeam and the wind anchorage which had been previously set on the pier top, thus completing the bottom lateral system which thereafter assisted the top lateral system of the temporary span in distributing wind load to the two piers.

Traveller No. 4 was completed shortly after the bottom chord and lateral system and erection of the upper structure was then commenced, the order of operations being similar to that the season previous on the north side until *AL7* was reached, four panels from the main pier. Progress at various stages is shown in figures Nos. 78, 79, 80 and 81 and the method of handling the top chord sections in figure No. 82. As on the north side, the points of support were transferred by jacking as each panel was completed, the ultimate support for the anchor arm trusses being at *AL7*. As the load on the temporary span approached its maximum, shims were again placed between the top of the tower and the span to moderate the stresses in the span, this step being taken as a general precaution rather than from necessity.

Traveller No. 4 was then transferred to the cantilever arm and erection commenced at that point, traveller No. 8 being shortly after moved forward to *AL5* where it dismantled the tower under the temporary span and proceeded with the erection of the anchor arm. (See figure No. 83.) Two panels of the cantilever arm were completed, after which operations were suspended for the winter.

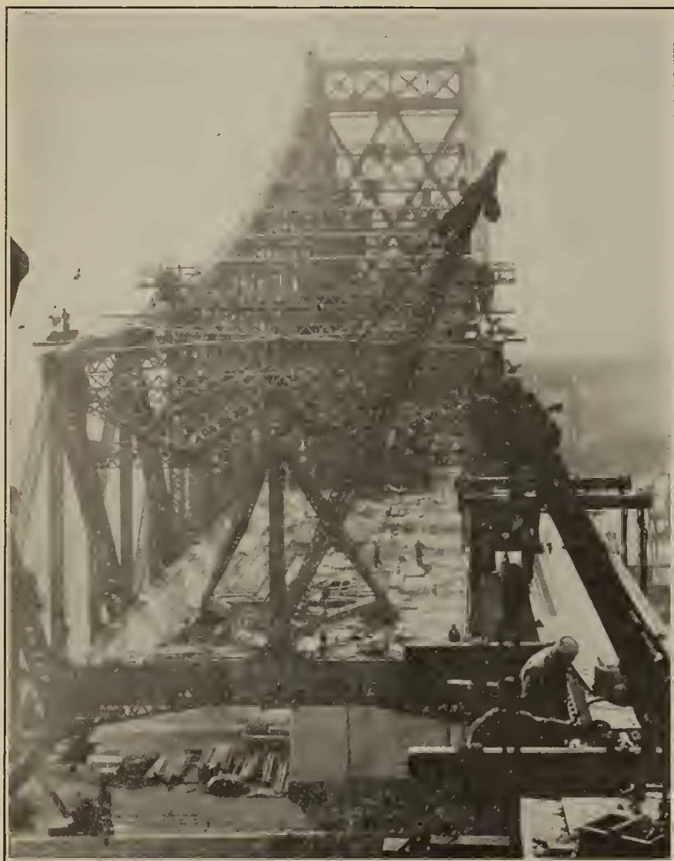


Figure No. 96.—Main Span, Centre Section—Arrangement of Moveable Derrick used in Erection of Centre Panels of Suspended Span.

Season of 1929

Erection was resumed about April 1st, 1929, by traveller No. 4 on the cantilever arm and traveller No. 8 on the anchor arm. Conditions at this date are illustrated in figure No. 84 which is of a special interest as showing the level in the channel during the ice breakup. The extreme variation in level may be noted by comparison with figure No. 85 which shows the condition about three weeks later, by which date the channel was clear of ice and the water level down about 20 feet to normal spring high water level. Erection followed a pre-determined programme of cycles similar in principle to that on the north side. In this case, however, the point of support for the anchor arm was transferred backward by jacking as each panel was completed until the entire arm was assembled and supported on the temporary span at *AL2*, coincidently with the completion of five panels of the cantilever arm.

A similar jacking operation to that on the north side was then carried out on the anchor pier, the general arrangement of the jacks and blocking during this stage being illustrated in figures Nos. 86, 87 and 88. The anchor arm was first jacked upwards sufficiently to permit the removal of the shims at *AL2*, being then lowered and the connection to the anchorage struts made by the driving of the pins at *AL0*. The amount of jacking in this instance was much less than on the north side, owing to the difference in the influence of deflections.

Traveller No. 4 having completed its operations was now dismantled and removed. Traveller No. 8 was partially dismantled, the base moved to the forward end of the cantilever arm, and the derricks re-erected. This stage was completed by the end of May.

Centre Section—1929

The centre section consisted of the suspended span and three panels at the end of each cantilever arm. As previously noted, erection had been suspended on the north side in July, 1928, pending further progress on the south side, traveller No. 3 being left at the anchor pier to participate in the erection of the north approach. During April, 1929, traveller No. 3 was dismantled and re-assembled at the forward end of the cantilever arm with booms facing the centre, and erection operations were resumed at that point concurrently with those on the south side outlined in the previous section.

On reaching the end of the cantilever arm, the hangers *CU0SL0* were erected and the pins driven at *CU0*. The special details at *SL0*, consisting of the main gussets, diaphragms, etc., had been built as independent units with field connections for the adjoining members, as the weight if combined with the bottom chord sections, would have been beyond the capacity of the booms at the necessary reach. These details were now connected to the hangers at *SL0* by the pins at that point, being blocked temporarily in position. The floorbeam at *SL0* was then placed and connected to the gusset details, and braced to the adjacent floorbeam by blocking and turnbuckles. The bottom wedges were next lowered carefully into position in the chords between *CL0* and *SL0*, the connecting pins driven, and the wedges adjusted to the prescribed initial setting. The general arrangement of the bottom wedges at *SL0* is illustrated in figures Nos. 89 and 90.

The first bottom chords of the suspended span were now placed, the forward ends being supported on adjustable tackles from *CU0*. (See figure No. 91.) The bottom laterals of the first panel were also placed and the chord connections to the gussets at *SL0* then rivetted. The sub-verticals at *SL1* and the diagonals *SL0M1* were next erected, followed by temporary links of pre-determined lengths between *CU0* and *SM1*. These links consisted of four 14- by ⅝-inch plates in each truss, connected by pins to brackets on the truss members. The load having been transferred from the adjustable tackles to the links, the remaining truss members of the first panel were erected, the general arrangement being shown in figure No. 92. The chord sections *CU0SU2* were next placed and the top wedges set in position at *CU0*. (See figure No. 93.) The arrangement of the top wedges after their erection is illustrated in figures Nos. 94 and 95, these views being taken prior to the construction of the proper working platforms. The wedges were first adjusted to transfer the load from the links to the top chords, the links being then removed and the wedges slacked off to the prescribed initial setting.

The second panel of the suspended span was now erected with traveller No. 3 standing at *SL2* and a moveable derrick was set up at *SL4* on the centre line of the deck for the completion of the remainder of the north half. The weight of traveller No. 3 prohibited its movement beyond *SL4* as otherwise the end chords of the cantilever arm would have been seriously overstressed, and the above alternative method was, therefore, adopted. The derrick was equipped with a 75-foot boom of 35 tons capacity from traveller No. 4, the general arrangement being illustrated in figure No. 96. Meanwhile the alignment and levels of this portion of the suspended span were carefully checked, the wedges being slacked off a small amount and re-set to accord with the check measurements. Traveller No. 3 was then moved back off the suspended span, erecting the swaybracing and top laterals on its way, after which it was partially dismantled and the base moved back to *CL3* to reduce the effect of its weight on the truss members. Hoisting lines were carried from the engines on the base to the derrick at *SL4* for the operation of the latter.

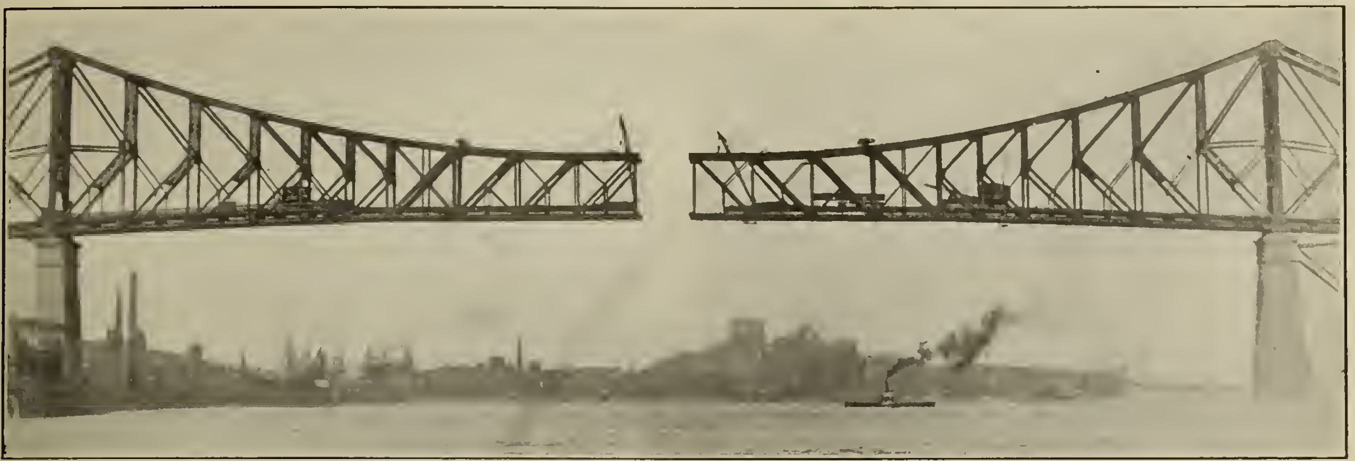


Figure No. 97.—Main Span, Centre Section—Progress as at July 1st, 1929.

The third panel of the suspended span was next erected by the moveable derrick, it being then moved forward to *SL6* in readiness for the erection of the centre panel. The wedges were slacked off a further small amount at this time, the load on each wedge being about 600 tons. This stage of the programme was reached by the end of June.

Meanwhile erection had been proceeding on the south half of the centre section, the corresponding stage being reached by July 1st. (See figure No. 97.) A portion of the centre panel was then erected, the only members left unplaced being those involved in the closure. A few days were devoted to rivetting and incidental work during which period precise field measurements were completed, the result showing a high degree of accuracy throughout.

A brief reference to the results of the field measurements may be of interest. After the completion of the main piers, the span length was checked by triangulation and found to be ¾ inch short between centres. This error was accepted without compensation, being readily taken care of by a slight inclination in the suspended span hangers. Final measurements in the centre panel before the closure indicated an error of ⅞ inch, which agreed almost exactly with the results obtained by triangulation.

On the completion of each cantilever arm, the alignment and levels at the end, *CL0*, were carefully checked. The lateral deflections were found to be ¼ inch on the north and ⅝ inch on the south, in each case downstream. The relative levels at the same points were,—north, downstream truss ⅛ inch high; south, upstream truss $\frac{1}{16}$ inch high.

With each side erected to *SL6*, the final measurements disclosed lateral deflections at *SL6* of ½ inch on the north and ¾ inch on the south, in each case downstream.

As noted above, the wedges were slacked off definite amounts at certain stages. It was a further rule, however, to make a few turns of all the operating hand-wheels each day, the intent of these preliminary adjustments being to maintain the mechanisms in free working order and guard against seizure of the bearing surfaces.

Closure Operations

These operations were commenced on Monday, July 8th, by placing the bottom chords *NSL6-SL7*, the pins being entered at *NSL6* and the chords supported freely at *SL7*. The bottom laterals of the centre panel were then placed with free ends at *NSL6*, followed by the diagonals which were connected at *SM7* but left free at the opposite ends. Finally, the top chords *NSU6-SSU6* were placed, followed by the centre top laterals, the laterals being left free at *SSU6*. The top chords were connected on their lower flanges at *NSU6* and supported freely at *SSU6*.

Adjustable tackles were connected in the plane of each truss and pulling jacks at the free ends of all laterals to assist in the making of the connections, (see figure No. 98). The wedge operating crews and observers were also assigned to their stations at the respective wedges and final preliminary adjustments made under full load by slacking off all wedges to the positions which resulted in the stipulated clearances for temperature movements at the open connections. The arrangement on the top of the suspended span in the final stage is illustrated in figure No. 99. All preliminaries were completed on July 9th and, as weather conditions appeared favourable, orders were issued for the final operations to be undertaken on the following day.

Work was commenced at 5 a.m. on July 10th, weather conditions proving ideal. The air was practically still and

Figure No. 98.—Main Span, Centre Section—Arrangement of Adjustable Tackles in Centre Panel of Suspended Span.

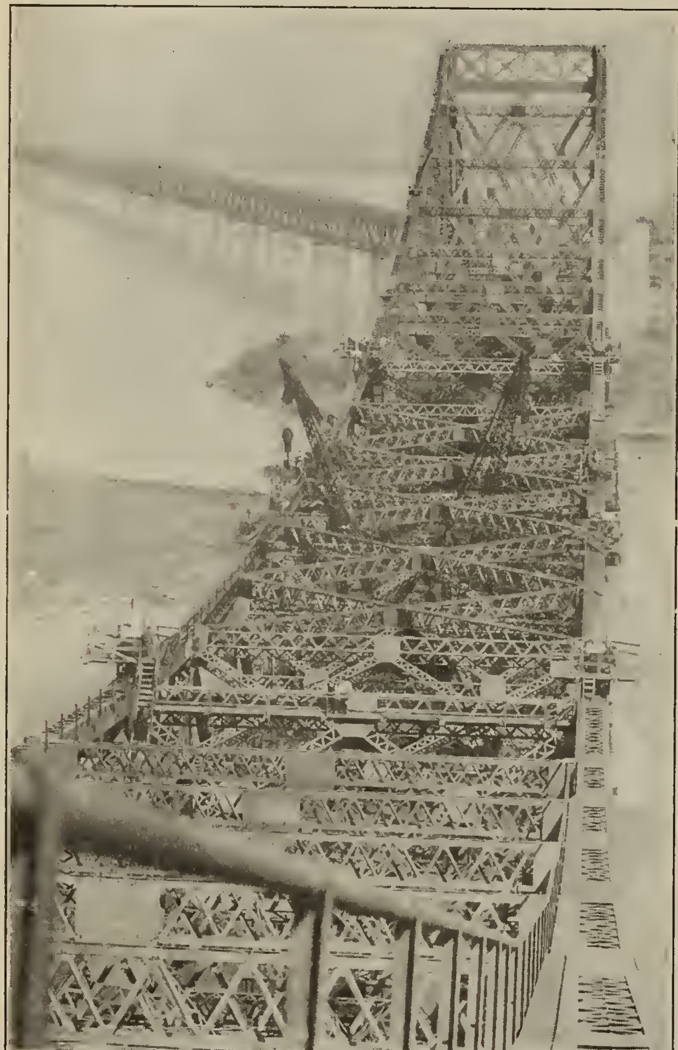


Figure No. 99.—Main Span, Centre Section—View of Top of Suspended Span just prior to Closure.

a dull cloudy sky persisted for several hours, the atmospheric temperature remaining practically constant at 72° F. The pins were immediately driven in the centre bottom chords at *SL7*. (See figure No. 100.) The slacking off of the wedges commenced at 5.20 a.m. and proceeded in regulated cycles until 8.30 a.m. when the top chord joints closed, the bottom chords being kept slightly slack. Wedge operations were temporarily suspended during the bolting of the chord splices; the top lateral connections, being found to match, were also bolted.

The bolting of these connections being well advanced by 9.00 a.m., the bottom wedges were then gently slacked off to bring the centre pins in bearing. At this stage the bottom lateral and diagonal connections all matched and were connected, it being found unnecessary to make use of the auxiliary tackles or jacks. Operations were resumed at all wedges about 9.30 a.m. with continuous slacking off in regulated cycles until a considerable portion of the load on the wedges had been relieved. At 9.45 a.m., it was obvious that the closure had been successfully accomplished, the event being celebrated by a brief informal ceremony in the presence of Hon. Dr. W. L. McDougald, president of the Board of Harbour Commissioners, (see figure No. 101), and other prominent officials identified with the enterprise.

After a brief interval, operations were continued until, about 11 a.m., all wedges were released and the suspended span was swinging freely between the ends of the cantilever arms. The wedges were run out sufficiently to provide clearance for temperature movement and work was then suspended for the day.

Final Operations

During the following period the wedges were dismantled and removed, and the remainder of the superstructure erected. The permanent connections were also made in the bottom lateral system at each end of the suspended span. The erection equipment was finally dismantled and removed, with the exception of traveller No. 8 which was again placed in working order at the south anchor pier.

The last major operation was the dismantling of the temporary span under the south anchor arm. The span was first suspended from the anchor arm trusses by long rods and brackets at the panel points, the nuts on the rods being tightened to partially relieve the sag in the span due to its own weight. The rivets in the connections were then cut out and replaced by sufficient bolts to carry the weight of the span, after which dismantling commenced at the anchor pier, the end panel being removed by traveller No. 8. The members were disengaged by lowering them on tackles lashed to the structure above and operated from the traveller engines and auxiliary hoisting engines on the deck. They were fleeted towards the anchor pier on the suspended tackles, several fleets being necessary for the more remote members. At the anchor pier, they were hoisted to the deck by the booms of traveller No. 8 and placed on cars for removal. All important operations were completed by September 30th, 1929. The completed span is shown in figure No. 102.

Field Rivetting

It was the policy to complete the field rivetting as closely behind the erection as practicable at all stages. Whenever possible the members were forwarded from the material yards with specially designed scaffold brackets bolted in place, thus greatly reducing the rigging and enabling the bolting of the connections, as well as the rivetting, to be proceeded with rapidly.

On the south side air was supplied in the early stages from a steam-driven compressor plant on the shore and distributed along the deck by piping. Later this compressor plant was transferred to St. Helen's island for the work beyond, and reinforced by portable gasoline compressors during the erection of the main span. For the north side, a steam-driven compressor plant was installed on the ground adjacent to the main pier and the air distributed by piping to and along the deck.

In the south approach the field rivets were of ⅞ inch and 1 inch diameter, the latter size being used in the trusses of the 245-foot spans. In the case of the spans which were erected by cantilevering, the field rivetting was in general about two panels behind the erection, as a result of which extra bolting for stress requirements was greatly minimized. The field rivets in the north approach were of ⅞ inch diameter.

In the main span the field rivets were of ⅞ inch, 1 inch and 1⅛ inch diameter, the latter size being used in the case of the longer grips. As noted previously, all important compression joints were rivetted immediately after the placing of the members. The end connections of the deck stringers carrying the main travellers were also rivetted before moving this equipment over them. The rivetting of the remaining main connections was carried along promptly after the erection, usually about two panels in the rear. In the case of the bottom laterals and sway-bracing which were fabricated to geometrical dimensions, it was anticipated that the shop camber in the lengths of the truss members would prevent the matching of the connections at the time of placing. Holes for 1-inch diameter rivets were, therefore, provided in all lateral and bracing connections, the number being based, however, on the use of ⅞ inch diameter bolts during the erection period. It was found necessary to use the ⅞-inch bolts in the connections of the diagonal members of the laterals and bracing to the trusses and at a few other points; elsewhere the connections were drifted to match and rivetted in due course. The bolted connections were drifted together without difficulty concurrently with the laying of the concrete floor slabs on the deck and were then rivetted.

In the case of the temporary span under the south anchor arm, all connections were fully rivetted on account of the high stresses in the members. The lateral and bracing connections in both the span and the steel tower were also fully rivetted to ensure maximum rigidity. On the north side, the bracing connections of the steel tower were fully rivetted, and such of the span connections as were heavily stressed. The compression butt joints of the tower were fully bolted.

In the rivetting of the heavier connections, driving and bucking-up guns were used on opposite sides to ensure proper upsetting. Pains were taken to avoid heavy paint films on the surfaces to come in contact in the field and the ends of the compression members were carefully scraped before being placed. Extremely rigid inspection while the rivetting was under way resulted in only a negligible percentage of the driven rivets being condemned and re-driven.

Conclusion

The contract date for the completion of the superstructure, exclusive of the field painting, was July 1st, 1930, this being afterwards extended to March 1st, 1931, owing to delays occasioned during the season of 1927 by backward progress on the substructure. The work was actually completed by October 1st, 1929, representing a saving in time in the opening of the bridge for traffic of more than a year.

Although three years may appear a lengthy period of field construction it should be borne in mind that the actual working period consisted of twenty-two months or less than two years. Considerably more work might have been carried on during the winter seasons but only at greatly increased hazard and expense. Winter ice conditions under the south anchor arm made it impossible in any event to commence operations at that end of the main span at an earlier date. Hence only the time saved by continuous erection during the final winter would have been of value and could not have exceeded two months. Considering the importance of this stage of the work it would have been unwise to incur the risks which would attach themselves to such operations during the winter or early spring.

It will have been noted that steam power was used throughout on all hoisting engines, in spite of the present-day tendency towards electric power on construction. Among the objections to the latter in this instance, however, were the expense of power transmission on the south side,

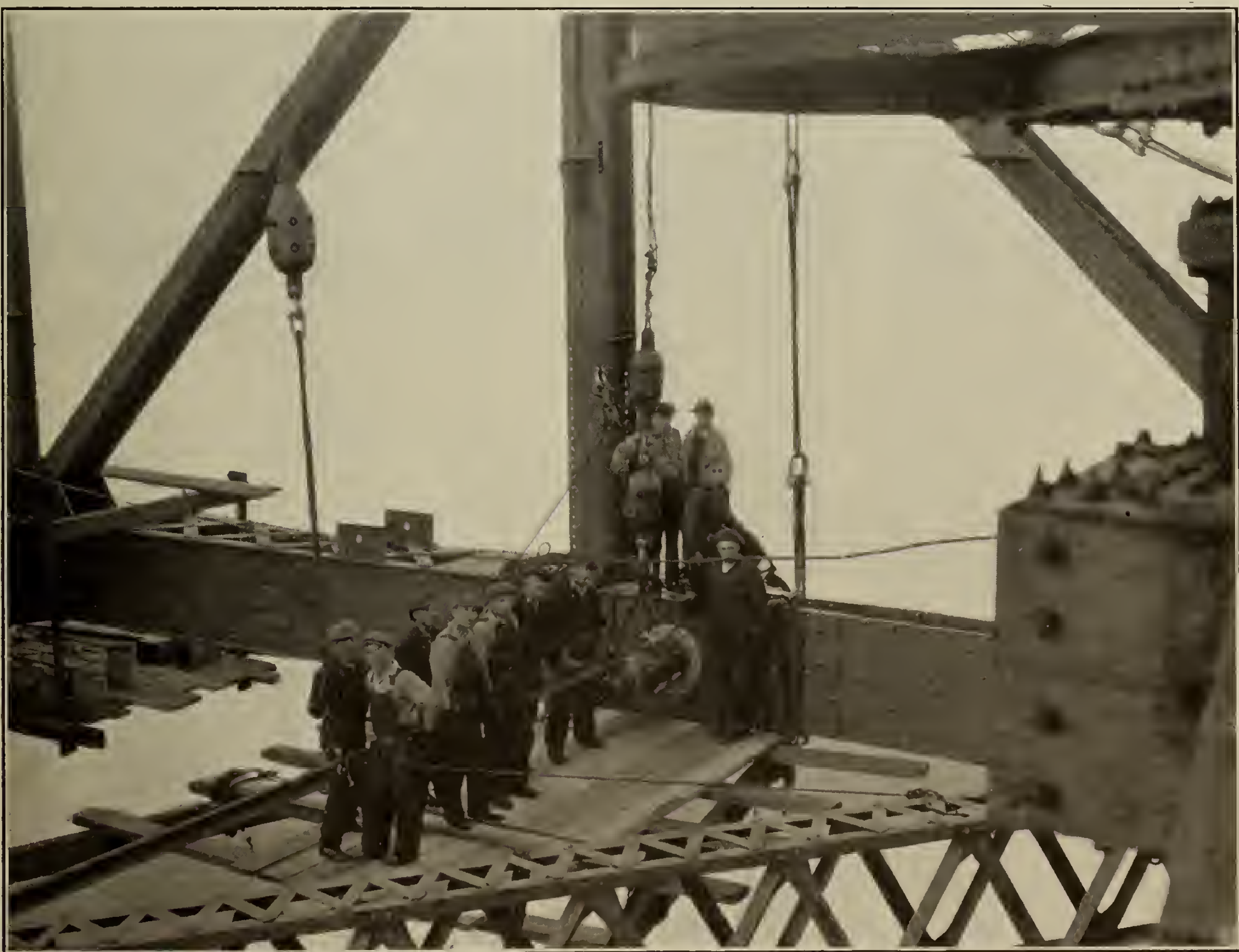


Figure No. 100.—Main Span, Centre Section—Driving Pin in Bottom Chord at *SL7* on Day of Closure.

Figure No. 101.—Main Span, Centre Section—Hon. Dr. W. L. McDougald, President of the Montreal Board of Harbour Commissioners, making the Last Turn of the Wedge Mechanism which released the Suspended Span.

greater difficulty in obtaining electric hoist operators experienced in steel erection, possible power shut-offs during critical handling periods, and maintenance problems. Investigation showed that no economy would result from the use of electric power and steam power was therefore adhered to, a further advantage being that the equipment provided would be more generally usable on future work.

In every instance the equipment provided proved even more satisfactory than was anticipated. The same may be said of the methods adopted and in this connection an interesting fact may be noted. It has been evident that the installation of the temporary falsework under the south anchor arm was a governing feature in the programme. The construction of a temporary pier in the river at this point was purposely delayed until the spring of 1928 although reluctantly, as it seemed certain that considerable loss of time would result. One of these piers was completely overturned by the ice shove in March 1929, fortunately long after its utility had ended. This fact demonstrates convincingly the wisdom of adopting methods which avoided the ice risk in the river.

The main span required only a small amount of reinforcement for erection stresses, chiefly in the floor system on account of the heavy concentrated loads from the travellers. It may be noted, however, that the suspended span was virtually the limit in length for economy, as the erection stresses from a longer span would have necessitated heavy reinforcement in the chords near the ends of the cantilever arms. The use of the K-system in the trusses, as in the case of the Quebec bridge, proved how excellently it is adapted to erection, no temporary members being required and all connections being readily made. It may also be safely said that the method actually employed in the erection of the suspended span was in this case more economical and very much safer than would have been any attempt at floating or lifting into place, even if such a method had been permissible.

A noteworthy point is the close agreement found throughout the field operations between the calculated and actual deflections in the various parts of the structure. This may be largely attributed to the rational and apparently accurate allowance in the calculations for the influence of local reinforcement from detail material and other factors. This influence was determined for each member independently and the resultant calculated deflections were found to be from 15 to 20 per cent less than if based only on the gross areas of the main material in the members.

The working force in the field varied considerably during the several seasons, reaching a maximum in the early summer of 1928 at which time approximately 350 men were employed, divided about equally between the north and south sides. Relations with the erectors were at all times satisfactory as is evident by their refusal to participate in a strike during May, 1928. As a further comment on their interest, loyalty and confidence, every man of the 150 required was on hand at 5 a.m. July 10th, 1929, the day of the final closure.

Every precaution was taken to guard the workmen against accident, as well as traffic passing under the bridge. A gasoline launch with life-saving equipment was stationed in the channel under the main span during working hours, and rowboats under the south approach. Flooring and scaffolding were used liberally, and all equipment or construction materials maintained in first class condition. During the final season, work over the navigation channel was suspended during the passage of vessels under the structure in spite of a considerable resultant delay in the erection.

The plans pertaining to the erection programme were fully discussed with and calculations verified by the engineers. It is a pleasure to record the cordial relations that existed at all times between the engineers and the contractor, and the valuable assistance rendered by the engineers, particularly by Mr. Pratley who was intimately associated with the work, in the capacity of supervising engineer. The shop and field inspection was ably and promptly performed under the direction of Mr. J. Rankin, M.E.I.C., chief inspector for the engineers.

The operations were planned and carried out in their entirety by the Dominion Bridge Company, Limited, under the supervision of G. H. Duggan, D. Sc., M.E.I.C., president; F. P. Shearwood, M.E.I.C., chief engineer; and the author who assumed the duties of engineer-in-charge. A special organization was created for the work entirely from within the staff of the company, consisting of D. B. Armstrong, A.M.E.I.C., and R. S. Eadie, A.M.E.I.C., assistant engineers; F. J. McHugh, A.M.E.I.C., chief draughtsman; D. Bell, general superintendent of erection; A. M. MacDermid and L. J. McMahon, erection superintendents; F. Bowman, A.M.E.I.C., W. E. Bell and C. Phillips, field engineers. The shop fabrication was under the direction of H. W. McMillan, A.M.E.I.C., works manager; R. E. Cape and L. Leclaire, superintendents; and T. Lochhead, chief inspector. F. Newell, M.E.I.C., mechanical engineer, collaborated in the design of the wedge mechanisms used in the erection of the suspended span. To the loyal and intelligent efforts of the entire organization associated with the operations is largely due the success of the undertaking.

Appendix A—Memorandum re Erection of Suspended Span

General

The suspended span will be erected by cantilevering each half from adjoining cantilever arm to centre of span. If no compensations were provided, however, centre top chord would be too long and centre bottom chord too short at normal temperature to permit final connections being made. To provide for this condition and also ensure adequate clearance under temperature movements while centre members are being placed, adjustable wedges will be placed at each end of suspended span in top and bottom chords at *CU0* and *SL0* respectively. Wedges will be so adjusted when placed that those at *CU0* draw suspended span top chord back and those at *SL0* move suspended span bottom chord forward.

Initial wedge settings are such that preliminary adjustments may be made as erection of suspended span proceeds, thus testing mechanisms under gradually increasing load and preventing seizure of contact surfaces where sliding or other movement occurs.

After both halves of suspended span are erected to *SL6* and before erecting centre panel, field measurements will be made on distance across centre panel in line of both chords and levels taken at all corners *SL6*. Alignment of trusses will also be checked. Any necessary compensations will be determined.

Zero on scales corresponds to geometric horizontal dimensions; i.e.,—when pointer is at zero, wedge is in that position which results in geometric distance between shoe pinholes.

Plus (+) *on scales* indicates distance between wedge pinholes greater than geometric.

Minus (−) *on scales* indicates distance between wedge pinholes less than geometric.

Wedges run in refers to movement which *increases* distance between wedge pinholes.

Wedges run out refers to movement which *decreases* distance between wedge pinholes.

Determination of Wedge Settings

Wedge settings are governed by clearance which must be provided in centre panel to permit members being placed with adequate provision for temperature movements.

If bottom wedges at *SL0* were placed with zero setting, centre bottom chord would be *short* by following amounts when both halves of span are erected—

3.28 inches due to calculated deformation of structure.
−0.75 " " " known error in distance between main piers.
1.70 " " " possible drop in average temperature of steel from 60° F. to 40° F.

———

4.23 inches total amount short at temperature of 40° F.

Figure No. 102.—The Main Span as at September 11th, 1929—Erection completed, Falsework Span removed and Last Equipment being dismantled.

Centre panel will then be erected and final preliminary wedge adjustments made. Wedge settings must permit expansion due to temperature of 120° F. after centre panel is erected. Notes following show wedge settings which may be expected to produce this result but actual settings before closing operations must be determined from field measurements referred to above and by check measurements at joints.

After centre panel has been erected and final preliminary wedge adjustments made, closing operations will be carried out. Wedges will be slacked off to bring all joints together for final connection. Wedges will then be all slacked off concurrently to release suspended span during which operation stresses change gradually from cantilever condition to that of simple span under its own weight. Wedges must be slacked off further to provide sufficient clearance at ends of suspended span for movements due to temperature variations between 40° F. and 120° F. and may then be removed when convenient.

While cantilevering each half of span to centre, governing stresses are produced in certain chords at ends of cantilever arms. Erection methods have been carefully planned to minimize these stresses and no modification will be permitted which increases them. During final stages of erection, load on suspended span and end of cantilever arm must be kept to minimum.

All wedge operations will be directed by the engineer and no adjustments will be made except on his personal instructions.

Wedge Adjustments and Operations

General

Erection wedges at *SL0* (bottom) and *CU0* (top) are provided with vertical scales which indicate vertical travel of wedges in inches, this being six times horizontal movement produced by wedges at centre line of chords.

Hence bottom wedges must be run in to compensate for ½ × 4.23 =2.12 inches at each end of span. This requires that bottom wedge setting when erected to centre = + 2.12 inches horizontal + 12.72 inches vertical.

If top wedges at *CU0* were placed with zero setting, centre top chord would be *long* by following amounts when both halves of span are erected.

1.60 inches due to calculated deformations of structure.
0.75 " " " known error in distance between main piers.
4.25 " " " possible rise in average temperature of steel from 60° F. to 110° F.

———

6.60 inches total amount long at temperature of 110° F.

Hence top wedges must be run in to compensate for ½ × 6.60 =3.30 inches at each end of span. Since bottom wedge adjustments also affect horizontal centre distance in top chord, further compensation must be provided for bottom wedge centre setting = 0.12 × 2.12 = 0.25 inches. Total compensation required is 3.30 + 0.25 = 3.55 inches at each end of span. This requires that top wedge setting when erected to centre $= 3.33 \times \frac{1}{0.88} = +4.03$ inches horizontal + 24.18 inches vertical.

Operations and Wedge Adjustments

(1) *Shop adjustment*
- (*a*) Bottom wedges — set at + 21.00 inches vertical (+3.50 inches horizontal).
- (*b*) Top wedges — set at + 21.00 inches vertical (+3.50 inches horizontal).

(2) *Initial setting and adjustments*

(*a*) Bottom wedges —
Place with shop setting.
Run in to +24.00 inches vertical (+4.00 inches horizontal) and remove blocking between floorbeams *CF0* and *SF0*. Leave thus until suspended span erected to *SL4*.

(*b*) Top wedges —
Place with shop setting.
Run in to +27.00 inches vertical (+4.50 inches horizontal). Leave thus until suspended span erected to *SL4*. Temporary links *CU0 SM1* will be released at 24.0 inches vertical (+4.0 inches horizontal) and should be then removed.

(3) *Preliminary adjustment at SL4.*

After suspended span has been erected to *SL4*, wedges will be run out to test operating mechanisms under moderate load of 280 tons each approximately.

(*a*) Bottom wedges—
Run out to +21.00 inches vertical (+3.50 inches horizontal).

(*b*) Top wedges—
Run out to +26.50 inches vertical (+4.41 inches horizontal). Leave thus until suspended span erected to *SL6*.

(4) *Preliminary adjustment at SL6.*

After suspended span has been erected to *SL6*, and before placing centre panel, wedges will be run out to test operating mechanisms under heavy load of 600 tons each approximately.

(*a*) Bottom wedges—
Run out to + 18.00 inches vertical (+3.00 inches horizontal).

(*b*) Top wedges—
Run out to +26.00 inches vertical (+4.33 inches horizontal).

(5) *Final preliminary adjustment at centre.*

After centre panel has been erected, check field measurements will be made at all joints, particularly top chord. Final adjustments will be made under maximum load on wedges of 720 tons each to establish required centre clearances for closing operations. After allowance for all compensations, clearances must be provided for expansion due to temperature 120° F., (assumed average of steel 110° F.). Theoretically, wedge adjustments required are as follows:—

(*a*) Bottom wedges—
Run out to +12.72 inches vertical (+2.12 inches horizontal).

(*b*) Top wedges—
Run out to +24.18 inches vertical (+4.03 inches horizontal).

(6) *Closing operations at centre.*

At commencement of closing operations, wedges will be run out to enable final connections being made, during which period load on wedges is maximum = 720 tons each. They will be then run out to swing suspended span free as simple span. They will be run out further to provide adequate clearance at ends of span for temperature expansion until wedges have been removed. Theoretically, adjustments required are as follows:—

(*a*) Bottom wedges—
Run out to +7.62 inches vertical (+1.27 inch horizontal) at 60° F.

(*b*) Top wedges—
Run out to +9.00 inches vertical (+1.5C inch horizontal) at 60° F.

At this stage, top chords joints should close, bottom chord pins should bear, web members and lateral connections should match, thus enabling all connections to be permanently made.

(*a'*) Bottom wedges—
Run out to −1.50 inch vertical (−0.25 inch horizontal) at 60° F.

(*b'*) Top wedges—
Run out to −4.44 inches vertical (−0.74 inch horizontal) at 60° F.

At this stage, suspended span should swing free as simple span, thus releasing all load off all wedges.

(*a''*) Bottom wedges—
Run out to −16.75 inches vertical (−2.80 inches horizontal).

(*b''*) Top wedges—
Run out to −12.50 inches vertical (−2.08 inches horizontal).

Wedges will be left in this position until removed. Clearance is provided for movements due to a temperature range between +30° F., (top chord), and +120° F., (bottom chord).

Field Measurements

During erection of suspended span, accurate field measurements will be necessary as follows:—

(1) Length of span—surveys have already determined that distance between main piers, (i.e. main shoes), is ¾ inch less than geometric.

(2) Wedge settings at *SL0*—points *SL0* at each end of span must be exactly opposite each other with respect to axis of suspended span.

(3) Vertical relation of trusses—when erected to *SL4* and before any swaybracing is placed, levels will be taken at all points *SL0* and *SL4*. Levels will be compared on both halves of span and top wedge adjustments made as may be determined to maintain correct relations between trusses. After swaybracing is erected, relations will be verified by check measurements.

(4) Alignment of span—check measurements will be made at each panel as erection proceeds to ensure true alignment top and bottom with respect to axis of suspended span.

(5) Check measurements at *SL6*—when both halves of span are erected to *SL6*, levels will be taken at all points *SL6*. Alignment of each half will also be checked. From information obtained, any necessary compensating adjustments will be determined. Distance between ends of chords at *SU6* and *SL6* will also be checked and compared with expected distances at normal temperature.

(6) Final check measurements—after centre panel is erected, all joints will be checked before and after final preliminary adjustments to ensure that expected conditions are realized.

Final Instructions re Closing Operations

Final closing operations will be carried out during a single day after all members are in place and all preliminary work completed, including necessary field measurements. Everything will be in readiness to commence wedge adjustments immediately as soon after daybreak as possible to ensure the maximum of daylight in case of delays and to minimize the effect of rising temperature.

Wedges will be run out in prescribed manner to bring centre panel connections together. Bottom chord pins will be driven but a little slack maintained at pinholes until top chord joint is closed. As soon as top chords make contact, wedge operations will be suspended briefly until splices are well started and top lateral connections made. Special care must be taken that chords come to good bearing. Further wedge adjustments will then be made carefully to bring bottom chord pins to bearing and match web members which will then be connected. Bottom laterals will also be connected.

All wedges will then be run out concurrently with least delay possible to release suspended span. Simultaneously all connections will be proceeded with and should be at least 50 per cent bolted before span is released.

Drift pins and bolts will be started in all connections during these operations at earliest moment possible.

Open Joints.

When centre top chords come together, joints at each end *SU6* will be slightly open at upper side. Ends of centre top chords are chamfered top and bottom to permit bearing on central portion of end face only. As joint comes together it should close by drifting and if necessary help may be provided by upward springing of chord at its centre.

Relative Speed of Wedge Adjustments.

During all operations, both top wedges at one end of span, or alternatively both bottom wedges, must be operated together at same speed to avoid stresses in bracing and elsewhere due to twisting action on span.

During preliminary operations, wedge adjustments may be made independently at each end of span. Top and bottom wedge adjustments may also be made independently.

During closing operations, adjustments will be regulated as follows:—

(*a*) While bringing joints together in centre panel to make final connections, top and bottom wedge adjustments may be made independently but both ends of span must be operated at same speed to ensure symmetrical movements of both halves of suspended span.

(*b*) While swinging suspended span free all wedges must be operated concurrently, both ends of span at the same speed. If normal temperature conditions prevail (i.e., 60° F.) top wedges will be operated at rate 48 per cent faster than bottom wedges, respective movements being top 13.44 inches vertical (2.24 inches horizontal) and bottom 9.12 inches vertical (1.52 inch horizontal). If temperature varies during period of releasing span any necessary compensations will be determined at time.

(*c*) After suspended span swings free all further wedge adjustments may be made independently.

Wedges must never at any time while under load be run out beyond setting required as they are designed for movement outward only under load and cannot be moved back.

Approximate Time Schedule, (at normal temperature 60° F.).

(*a*) Time required from commencement of wedge operations until joints are closed.................................2.0 hours
This is governed by required movement in top chord wedges from +24.18 inches vertical to +9.00 inches vertical = 15.18 inches vertical travel.

(*b*) Time required to make connections during which wedge operations are suspended.............................0.5 hours
(*c*) Time required to release suspended span...............1.5 hours
This is governed by required movement in top chord wedges from +9.00 inches vertical to −4.44 inches vertical = 13.44 inches vertical travel.
Total elapsed time until span released.................4.0 hours

Temperature Effects and Allowances

Coefficient of expansion for steel = 0.0000065.
Total change in length in channel span (1,100 feet) due to variation of 10° F. = ±0.85 inches.
Normal average temperature of steel assumed as +60° F.
Maximum " " " " " " +110° F.
Minimum " " " " " " +40° F.

(*a*) *Top chord.*
After centre top chord is placed and connected at one end, gap at other end should be 5.95 inches at 40° F., 4.25 inches at 60° F., 0 at 110° F.

(*b*) *Bottom chord.*
After centre bottom chord is placed, pins may be driven at any temperature between 40° F. and 110° F., pinholes in chord being slotted 6 inches total. Chords should just clear adjoining members at 120° F. which requires a clearance for expansion of 5.10 inches at 60° F.

Pins should not be driven until day of closing operations.

During closing operations it is probable that expansion will occur due to slowly rising temperature. This will accelerate top chord adjustments as joint will close and span be released with less wedge movement. Bottom chord adjustments will be retarded with corresponding increase in wedge movement. Should sun be shining, top chord will probably be effected considerably more than bottom chord which will accelerate top chord adjustments relatively to those in bottom chord. Modified adjustments to compensate for these influences can only be determined at time of operations to suit actual conditions that may exist.

Unless compensated for by wedge adjustments, compressive stress will be induced in top chord of suspended span, should expansion occur due to rising temperature after centre top chords are in contact. This results in arch action of suspended span between ends of cantilever arms, thrust from which produces bending in main piers. Similarly, falling temperature after bottom chord pins are bearing produces suspension action between ends of cantilever arm which also causes bending in main piers. Investigation shows that stresses under either of above cases are not serious even under extreme conditions.

In principle, however, every care should be taken to minimize above action by proper co-ordination of top and bottom wedge adjustments.

Relative Movements and Times

(1) 100 revolutions of hand wheel =1.5 revolutions of screw.
=0.73 inch (¾ inch) vertical wedge travel.
=0.12 inches (⅛ inch) horizontal wedge travel.
1-inch vertical travel of wedge =136 revolutions of hand wheel.
1-inch horizontal travel of wedge =6-inch vertical wedge travel
=816 revolutions of hand wheel.

(2) *Time Coefficients.*
Under operating conditions with load on wedges, it is estimated that rate of movement can be maintained equivalent to 20 revolutions per minute of hand wheel after starting friction is overcome.
Average time per revolution of hand wheel = 3 seconds
Time required for 1-inch vertical wedge travel = 7 minutes
" " " 1-inch horizontal " " = 42 "

(3) *Influence of Wedge Movements at Centre.*
At Top Chord—SU6
Bottom wedge movement of 1-inch horizontal produces at *SU6*
−0.12 inch horizontal
2.64 inches vertical.
Top wedge movement of 1-inch horizontal produces at *SU6*
−0.88 inch horizontal
2.65 inches vertical:
At Bottom Chord—SL6.
Bottom wedge movement of 1-inch horizontal produces at *SL6*
−1.00 inch horizontal
2.64 inches vertical.
Top wedge movement of 1-inch horizontal produces at *SL6*
−0 inch horizontal
2.65 inches vertical.
Transversely
Bottom wedge movement of 1-inch horizontal produces at *SL6*
−2.43 inches cross.
Top wedge movement of 1-inch horizontal produces at *SU6*
−2.43 inches cross.

Independent transverse adjustments cannot be made at *SU6* and *SL6* owing to rigidity of sway bracing.

Power Required to Operate Wedges

Wedge mechanisms have been designed for assumed frictions as follows, each wedge being operated by two hand wheels:—

	Max. per cent	Probable starting per cent	Probable turning per cent
Sliding friction on wedge surfaces....	18	12½	10
Turning " between screw and nuts.............	15	12	10
" " on worms and wheels	10	8	6
Force required on two hand wheels (22 inches dia.)			
to operate under 720-ton load...	350 pds.	110 pds.	30 pds.
to operate under 720-ton load using bars in wheel sockets to increase effective diameter to 60 inches..................	135 "	40 "	11 "

Tests made on wedges under nominal loads indicate the following as required effort under 720-ton load for various assumed values of sliding friction on wedge surfaces.

	18 per cent	12½ per cent	10 per cent
Force on two hand wheels (22 inches dia.)...........................	380 pds.	160.0 pds.	65.0 pds.
Force on two hand wheels (60 inches dia.)...........................	140 "	60.0 "	25.0 "

THE

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Council's Proposal to Increase the Annual Fees

The activities of a society like The Institute, and the services it renders to its members, are limited by the funds available. It would seem fair to take the revenue per member as a measure of the possibilities for service, and the expenditures per member as an indication of the efficiency of administration.

The Institute's gross revenue per member, (from members' fees), is thirty-nine per cent of the same item for one of the larger engineering societies in the United States, whose standards approximate to our own. Our net revenue per member available for headquarters activities (gross revenue less local rebates) is twenty-three per cent of the American figure.

On the other hand the ratio as regards operating expense, as shown by headquarters expenditure per member, is forty-seven per cent, and as to expenditure on meetings, seventy-two per cent.

Our net cost of publications per member, (i.e. total cost, less revenue from sales and advertising), is one-seventh of the corresponding figure in the other society.

The Institute has no reserve fund from which unforeseen but desirable expenses can be defrayed. This year, for example, it was necessary to incur the cost of preparing a report on, and giving publicity to, the question of the salaries of technical men in the Civil Service.

For some years successive Finance Committees of The Institute, in order to obtain balanced budgets, have had to refuse authorization for desirable items of expenditure. Under this head come such features as increased rebates to Branches; additional expenditure on the meetings of The Institute; the publication of Transactions and Year Book; improvement in the Journal; further development of our Employment and Information Services; adequate representation of The Institute at international conventions, and a number of others.

Prizes for Students and Juniors

The rules governing the award of prizes for the best papers presented by Students and Juniors of The Institute are given below:—

(1) Five prizes may be awarded annually for the best papers presented by Students or Juniors of The Institute in the Vice-Presidential zones of The Institute, as follows:—

The H. N. Ruttan Prize,—
in Zone A—The four western provinces.

The John Galbraith Prize,—
in Zone B—The province of Ontario.

The Phelps Johnson Prize,—
for an English Student or Junior in Zone C—The province of Quebec.

The Ernest Marceau Prize,—
for a French Student or Junior in Zone C—The province of Quebec.

The Martin Murphy Prize,—
in Zone D—The Maritime provinces.

(2) Awards shall only be made if, in the opinion of the examiners for a Zone, a paper of sufficient merit has been presented to a Branch in that particular Zone.

(3) The winner of a prize shall be required to specify such technical books or instruments as he may desire to the total value of approximately twenty-five dollars when suitably bound and printed or engraved, as the case may be.

(4) The award of prizes shall be for the year ending June thirtieth. On that date, each Branch secretary shall forward to the examiners for his particular Zone all papers presented to his Branch by Students and Juniors during the prize year, regardless of whether they have been read before the Branch or not.

(5) The prizes shall be awarded only to those who are in good standing as Students or Juniors of The Institute on June thirtieth following the presentation of the paper.

(6) The papers must be the bona fide production of those contributing them and must not have been previously made public or contributed to any other society in whole or in part. It is to be understood, however, that a paper which has won or been considered for a Branch prize is nevertheless eligible for The Institute Prize. No paper shall be considered for more than one of the five prizes.

(7) The examiners for each Zone shall consist of the Vice-President of that Zone and two Councillors resident in the Zone, appointed by Council. In the case of Zone C, two groups of examiners shall be appointed under the two Vice-Presidents, one for the English award and one for the French award. The awards shall be reported to the Annual Meeting of The Institute next following the prize year, and the prizes presented as soon thereafter as is reasonably possible.

Forty-Fourth Annual General and General Professional Meeting

The Annual General Meeting will be convened at Headquarters, 2050 Mansfield street, Montreal, on Thursday, January 23rd, 1930. After the reading of the Minutes of the last Annual General Meeting, the appointment of Scrutineers to count the Officers' Ballot, and the appointment of Auditors for the ensuing year, the meeting will be adjourned to reconvene at the Chateau Laurier, Ottawa, Ontario, February 12th, 13th and 14th, 1930.

Programme of Meeting at Chateau Laurier, Ottawa

(*Subject to Revision*)

Wednesday, February 12th

9.00 a.m. *Registration.*

10.00 a.m. *Annual General Meeting* (Assembly Hall).

Reception and discussion of Reports from Council, Committees and Branches. Discussions of proposed amendments to By-laws and other matters.

12.45 p.m. *Luncheon* (Banquet Hall).

(Complimentary to visiting ladies).

Welcome to members by J. McLeish, M.E.I.C., Chairman of the Ottawa Branch, who will preside. Brief address by His Worship Mayor Plant.

2.15 p.m. *Annual General Meeting* (Assembly Hall).

Scrutineers' report and elections of officers.
Retiring President's address.
Induction of new President.

4.30 p.m. *Ladies Tea* (Details later).

8.30 p.m. *Smoking Concert* (Ball Room and Banquet Hall).

Thursday, February 13th

Technical Sessions:

9.30 a.m. *Assembly Hall.*

Rigid Air Ships,—by Group Captain E. W. Stedman, M.E.I.C., R.C.A.F., Department of National Defence, Ottawa.

The Engineer's Work in Surveying and Mapping, —by F. H. Peters, M.E.I.C., Surveyor General, Department of the Interior, Ottawa.

9.30 a.m. *Ladies Cafe.*

Radio Communication as an Aid to Aviation in Canada,—by Major W. A. Steel, A.M.E.I.C., Radio Engineer, R.C.C.S., Department of National Defence, Ottawa.

Development of Radio in Canada,—by A. N. Fraser, A.M.E.I.C., Chief Engineer, Radio Branch, Department of Marine and Fisheries, Ottawa.

Recent Improvements in Mechanical Transport Vehicles, with Particular Reference to Multi-wheeled Cross Country Commercial Types,—by Captain N. G. Duckett.

12.45 p.m. *Luncheon* (Banquet Hall).

(Complimentary to Visiting Ladies).

Address by Dr. H. M. Tory, Chairman of the National Research Council of Canada.

2.15 p.m. *Assembly Hall.*

The Application of Aerial Surveys to Engineering Problems,—by A. M. Narraway, M.E.I.C., Controller of Surveys, Topographical Surveys Branch, Department of the Interior, Ottawa.

Ladies Cafe.

Aeronautical Laboratories of the National Research Council of Canada,—by J. H. Parkin, National Research Council, Ottawa.

3.00 p.m. Through the courtesy of the Department of National Defence, a demonstration will be staged of six wheel vehicles working across country in snow. Busses will be provided at the Chateau.

4.30 p.m. *Ladies Tea* (Details later).

9.00 p.m. *Reception and Engineers' Ball* (Ball Room).

Friday, February 14th

Technical Session.

9.30 a.m. *Assembly Hall.*

Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge,—by Major LeRoy Wilson, M.E.I.C.

Ladies Cafe.

Water Power Resources of Canada, by N. Marr, M.E.I.C., Chief Hydraulic Engineer, Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa.

12.00 p.m. *Visit to Engineering Works.*

Through the courtesy of the Gatineau Power Company, a special train will leave the Union Station for Paugan Falls, Quebec, for an inspection of the power plant at that site. Luncheon will be served on the train. The train will return to Ottawa in time for dinner.

2.30 p.m. Through the courtesy of the Department of Mines, a visit has been arranged to the Fuel Research Laboratory and the Ore Dressing and Metallurgical Laboratories of the Department of Mines on Booth Street. Busses will be provided at the Chateau Laurier.

7.30 p.m. *Annual Dinner of the Institute* (Banquet Hall).

A special programme of the functions prepared for the ladies will be available at the registration desk.

Toronto Branch Honours President Mitchell

In recognition of the signal honour that has been bestowed on the Toronto Branch by the election of one of its members to the position of President of The Engineering Institute of Canada, that Branch tendered a banquet to Brigadier General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., on the evening of December 4th. The banquet was fittingly held in the comfortable quarters of the Engineer's Club and was attended by some eighty members of The Institute. Among those present at the head table were T. Taylor, M.E.I.C., chairman of Toronto Branch; Sir Robert Falconer; Professor DeLury, Dean of the Faculty of Arts; Canon Cody; R. J. Durley, M.E.I.C., our general secretary; Mr. Justice Middleton and Mr. R. C. Harris, Commissioner of Works, City of Toronto. These comprised a truly representative gathering of the leaders in the various spheres of activity of our Canadian life and all were present to do honour to one who had shown his leadership not only as an engineer but as a soldier, an educationalist and the one who now holds the highest honour that can be conferred in our Institute.

Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C.

Professor DeLury in proposing the toast to General Mitchell recalled those days some forty years ago when he was an undergraduate with Charley Mitchell and H. J. Cody, and referred to the activities of the Literary and Scientific Society and the friendly rivalry of the members of the Arts Faculty and the School, especially at election time.

In replying to this toast General Mitchell expressed in a fitting way his gratitude of the honour that was being given to him. Continuing General Mitchell said, "These are days of prosperity in Canada and in running over briefly all the engineering works at present under construction in the Dominion, one can read of stupendous tasks performed by the engineer. Right from Halifax to Victoria there are monuments to engineering skill and knowledge." General Mitchell then enumerated some of the work at present under construction from coast to coast. Speaking of The Institute the General said "The Engineering Institute of Canada is of inestimable value to the whole of the Dominion, and though we here are members of the profession I take no exception to saying that the world in general little realizes what the engineer is doing to make the average citizen's life more comfortable and pleasant."

Col. Hertzberg proposed the toast to "Our Guests" in a very able manner. Sir Robert Falconer replied paying tribute to the great work that General Mitchell had done as an intelligence officer in the Great War. Canon Cody in his remarks stated that "One cannot but thrill with pride at what the engineers of our country are doing. Forty years ago this year I graduated from the University of Toronto, and recall with every happiness my association, remote though it was, with the engineering fraternity. I have to thank General Mitchell for a very lovely stained glass window which was unveiled in St. Paul's Church, the pieces of glass of which it is composed being collected by him from many ruined churches and cathedrals in France. I like to think of him as a soldier and an engineer, but I also like to think of him as my old church warden and with all his wonderful abilities General Mitchell has remained a plain, honest Christian gentleman."

Third (Triennial) Empire Mining and Metallurgical Congress

The Third (Triennial) Empire Mining and Metallurgical Congress will be held in March 1930 in South Africa, when meetings and technical sessions will take place in the following centres: Cape Town, Kimberley, Johannesburg, Bulawayo and Durban.

Delegates to this Congress will have the opportunity of touring the Union of South Africa and Rhodesia in special trains, which will visit the principal mining centres and other places of interest. The organization of the Congress and its tours is similar to that which made the Second Congress such an outstanding success in Canada in 1927.

Information regarding the Congress and conditions of participation can be secured from the Secretary's office.

Dimensional Standards of the Canadian Engineering Standards Association

A publication of a new type has been received from the Canadian Engineering Standards Association, beginning a series which will be published in loose-leaf form in a special binder for the convenient use of engineers, designers and purchasing agents. Hitherto the work of the Association has consisted largely in the preparation of standard specifications for engineering material or equipment, dealing with standards of quality or performance. There is, however, a wide field of work for the Association in promoting agreement among manufacturers and users regarding the limitation of sizes and varieties of engineering products, and in agreeing on the standards of accuracy which are desirable as governing the cost and finish of the work.

The publication now issued* deals with stove bolts and machine screws, and presents the results of considerable discussion in regard to these products along the above lines. For example, if the lists now published are adhered to by the manufacturers of machine screws, the forty-three varieties now in the market will be reduced to a working list of twenty-one, which will still provide a range sufficient for all practical purposes. The adoption of this list by manufacturers and users would be of mutual benefit, relieving the manufacturer of the extra expense involved in tooling up machines to fill small orders for sizes of screws subject to infrequent call, and enabling him to manufacture for stock with the assurance that the market demand will be adequately met. The user will be assured of quicker delivery and will derive benefit from reduced manufacturing costs. Work of this kind cannot fail to enhance the reputation of the Canadian Engineering Standards Association as an organization mutually beneficial to engineers, manufacturers and users of engineering equipment.

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*C.E.S.A. Established Lists of Dimensional Standards:
B18-1929 Established list of Stove Belts.
B29-1929 Established list of Machine Screws.
Canadian Engineering Standards Association, Ottawa.

The Canadian General Electric Company, Ltd. is now distributing its latest Industrial Control Catalogue. This catalogue, which will prove invaluable to every control user, contains over 250 pages of the most up-to-date information on industrial control. There are listed the latest developments in motor-starters and controllers for fans, pumps, elevators and other electrically operated equipment to which industrial control is now applied. Considerable space has been given to a detailed description of the devices listed, particularly regarding the operation of the automatic and magnetic controllers. Special attention has been devoted to the question of thermal overload protection and definite time acceleration—two desirable features now standard in practically all Canadian General Electric magnetic controllers. Copies of the catalogue may be obtained from the nearest office of the company.

ELECTIONS AND TRANSFERS

At the meeting of Council held on December 3rd, 1929, the following elections and transfers were effected:

Member

FELLHEIMER, Alfred, B.Sc., (Univ. of Ill.), architect and engineer, 155 East 42nd Street, New York, N.Y.

Associate Member

YACK, Wilfrid Laurier, B.A.Sc., (Univ. of Toronto), mech'l. dept., Price Bros. & Co. Ltd., Kenogami, Que.

Juniors

McCRONE, Donald Gordon, B.A.Sc., (Univ. of Toronto), junior designer, Chapman & Oxley, Architects, Toronto, Ont.

MINARD, Guy McRae, B.Sc., (Queen's Univ.), lab. foreman, Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont.

Transferred from the class of Junior to that of Associate Member

PATTERSON, Thomas Bilton, B.Sc., (Univ. of Sask.), res. engr., constrn. dept., C.N.R., Saskatoon, Sask.

WINTER, Thomas Henson, B.Sc., (N.S. Tech. Coll.), senior dftsman., New Jersey State Highway Dept., Newark, N.J.

Transferred from the class of Student to that of Junior

BALLARD, Bristow Guy, B.Sc., (Queen's Univ.), rly. motor engrg. dept., Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MILLAR, James Wallace, B.A., B.A.Sc., (Univ. of B.C.), P.O. Box 170, Field, B.C.

THOMPSON, William Lennox, B.A.Sc., (Univ. of Toronto), sales service engr., Bailey Meter Co. Ltd., Montreal, Que.

Students Admitted

BENNETT, George Francis, (Undergrad., McGill Univ.), 1126 Sherbrooke Street West, Montreal, Que.

CAPELLE, William A., (Undergrad. Univ. of Man.), 79 Cobourg Avenue, Winnipeg, Man.

CLARK, Samuel Findlay, (Undergrad., Univ. of Man.), 519 Sherburn Street, Winnipeg, Man.

CLARKE, George F., (Undergrad., McGill Univ.), 1126 Sherbrooke Street West, Montreal, Que.

CLARKE, Owen Mawbey, (Undergrad., McGill Univ.), 1126 Sherbrooke Street West, Montreal, Que.

EGAN, Edward J., (Undergrad., N.S. Tech. Coll.), 2 Summer Street, Halifax, N.S.

EMERSON, Robert Alton, (Undergrad., Univ. of Man.), Plum Coulee, Man.

FOGARTY, James William Patrick, (Undergrad., McGill Univ.), 461 Sherbrooke Street West, Montreal, Que.

GOODERHAM, Walter James, (Undergrad., Univ. of Man.), 759 Simcoe Street, Winnipeg, Man.

HENDERSON, Robert Pritchard, (Undergrad., Univ. of Man.), 1-A Wellington Apts., Winnipeg, Man.

JONES, Llewellyn Edward, (Undergrad., Univ. of Man.), Transcona, Man.

KENT, William Leslie, (Undergrad., Univ. of Alta.), 7805-107th Street, Edmonton, Alta.

MITCHELL, John, B.Sc., (McGill Univ.), 3429 Peel Street, Montreal, Que.

MURRAY, Walter M., (Undergrad., Univ. of Man.), 194 Montrose Street, Winnipeg, Man.

NIX, Charles Edward, (Undergrad., Univ. of Alta.), 10219-115th Street, Edmonton, Alta.

ODDLAFSON, Axel Leonard, (Undergrad., Univ. of Man.), 590 Victor Street, Winnipeg, Man.

SKELTON, C. Hastings, (Undergrad., McGill Univ.), 379 Roslyn Avenue, Westmount, Que.

STARR, Charles Harry, (Acadia Univ. 1927-29), Engineering Department, Northern Electric Co. Ltd., Montreal, Que.

THOMSON, Elihu, (Undergrad., McGill Univ.), 695 Grosvenor Avenue, Westmount, Que.

WALLACE, Keith B., (Undergrad., McGill Univ.), 195 Belgrave Avenue, Montreal, Que.

The Combustion Engineering Corporation, New York, have reprinted for distribution two papers; one is entitled "Test of Boiler No. 4, East River Station The New York Edison Company" by W. H. Lawrence, chief operating engineer, New York Edison Company, and the other is "High Pressure Steam in the Paper Industry" by J. B. Crane, of the Combustion Engineering Corporation. Additional copies of these papers are available, and will be sent upon request to those interested.

OBITUARIES

Edmund Wragge, M.E.I.C.

Members of The Institute throughout Canada and abroad have learned with sincere regret of the death of Edmund Wragge, whose passing has taken from The Institute one of its first members. The late Mr. Wragge was widely known in Canada, England and South Africa in connection with his work on railway construction.

At the time of his death, which occured at his home in Toronto, Ont. on November 27th, 1929, he was in his ninety-third year, and was the oldest member of The Institute.

Mr. Wragge was born in Worcestershire, England, and received his education at Rossall school. From 1854 to 1858 he was apprenticed to the London firm of Messrs. Fox Henderson and Company, with which he acquired his first ideas of railway construction.

On the completion of his term of apprenticeship at the age of twenty-two, Mr. Wragge accepted a commission to go to South Africa, where, from 1859 to 1862 he was district engineer on the Cape Town and Wellington Railway, constructing the first railway in that country between Cape Town and Stellenbosch. Returning to England on the completion of this work in 1863, he became assistant engineer with the London, Chatham and Dover Railway. In 1864 he was appointed engineer in charge of the works of the London, Chatham and Dover, London, Brighton and South Coast and London and Southwestern Railways at Battersea and Victoria. In 1867-69 he entered private practice in London, during which time he carried on the works of the Waterloo and Whitehall Railway, and went to Costa Rica for the government of that country.

In 1869 Mr. Wragge came to Canada, and from that time until 1883 was chief engineer of the Toronto Grey and Bruce Railway, now part of the Canadian Pacific Railway, and from 1869 to 1875 he was also chief engineer of the Toronto and Nipissing Railway, now part of the Canadian National Railways, and from 1875 to 1883 he was also general manager of the Toronto Grey and Bruce Railway.

In 1883 Mr. Wragge was appointed Toronto manager of the Grand Trunk Railway, and remained in that capacity until 1896 when he returned to England to build the Marylebone terminal of the Great Central Railway. He returned to Canada eight years later, and was appointed consulting engineer to the Canadian Pacific Railway Company. From that time until 1914, when he retired, Mr. Wragge was associated with the improvement projects undertaken by the railway.

Mr. Wragge was the oldest member of the Toronto Club and the Toronto Golf Club. He was a Member of the Institution of Civil Engineers to which he was admitted as a Member on January 11th, 1870, and was the recipient of the Telford Medal and the Telford Premium from that Institution.

The late Mr. Wragge was one of the few remaining members of The Institute whose membership dates back to January 20th, 1887, prior to the incorporation of the Canadian Society of Civil Engineers. In the early days of the Society he took a very active part in its affairs, and served on its Council during the years 1889 and 1890.

Stephen Williams, Jr.E.I.C.

Deep regret is expressed in recording the death of Stephen Williams, Jr.E.I.C. which occurred following a brief illness in the Montreal General Hospital, Montreal, on December 17th.

Mr. Williams was born at Toronto, Ont., on January 8th, 1900, and received his primary education at Ridley School at St. Catharines, Ont. He graduated from the Royal Military College at Kingston in 1920, and received the degree of B.A.Sc. at the University of Toronto in 1922.

During summer vacations Mr. Williams was variously employed in engineering work with the Toronto Harbour Commission, the John Inglis Company, Toronto, the Dominion Ship Yards, Toronto, and the Chapman Double Ball Bearing Company, Toronto. Following graduation in 1922, he was, for a time, instrument man with the Toronto Harbour Commission and was later a surveyor with the Ontario Department of Public Highways. Mr. Williams joined the staff of the Imperial Refineries Ltd. at Sarnia, Ont., at the end of 1922, and has remained with that concern ever since that time.

In 1926 he was transferred to Montreal and at the time of his death was chief engineer of the Montreal refinery of the company.

Mr. Williams joined The Institute as a Student on July 20th, 1920, and transferred to the class of Junior on July 7th, 1924.

James W. Moffatt, M.E.I.C.

Members of The Institute will learn with deep regret of the death of James W. Moffatt, M.E.I.C., which occurred at his home in Toronto on October 28th, 1929.

The late Mr. Moffat was one of the earliest members of The Institute, having joined The Canadian Society of Civil Engineers as Member at the time of its establishment on February 24th, 1887. He was perhaps best known through his work as a metallurgist and as construction engineer on important works for the Canadian Pacific Rilway.

Mr. Moffat was born at Walkerton, Ont., in 1860, and received his education at Brantford Collegiate, the School of Practical Science, Toronto, and McGill University, graduating from the latter institution in civil engineering in 1883.

Following graduation he joined the engineering staff of the Canadian Pacific Railway Company, and was employed on the construction of the bridge over the St. Lawrence river at Lachine, Que. Later, he was in charge of a party which ran the initial survey through the Sudbury district. He was also in charge of construction of the Canadian Pacific Railway bridge at Sault Ste. Marie. Mr. Moffat later practised as a consulting mining engineer in Denver and then in Nelson, B.C. In 1905 he took up his residence in Toronto, Ont., where he operated a plant for the reduction of iron ores by electricity. In 1912 he built the Moffat Electric Steel plant at Toronto, and for several years operated an electrical furnace plant on a commercial basis. His initial experiments having proved successful, he closed down the Moffat Iron Works in order to carry on further research along similar lines. He was endeavouring to develop a process which would be suitable for smelting Ontario ores, and at the time of his death this process was on the point of successful application.

PERSONALS

A. D. Porcheron, A.M.E.I.C., is now a member of the staff of the Asbestos Corporation, Ltd., and is located at Vimy Ridge Mine, Que.

John Stewart, A.M.E.I.C., who, since 1920, has been a member of the firm of Black McKenney and Stewart, consulting engineers, Washington, D.C., is now in private practice in Washington.

B. K. Boulton, S.E.I.C., who was formerly with the Duke-Price Power Company at Arvida, Que., is now electrical engineer with the Beauharnois Construction Company at Beauharnois, Que. Mr. Boulton graduated from McGill University in 1925 with the degree of B.Sc.

R. H. Keefler, S.E.I.C., has been appointed general commercial engineer, with the Bell Telephone Company of Canada Ltd., at Montreal. Mr. Keefler, who graduated from the University of Toronto in 1924 with the degree of B.A.Sc., has been with the Bell Telephone Company since 1927.

E. L. Baillie, Jr.E.I.C., who was formerly on the staff of the Nova Scotia Power Commission at Halifax, N.S., is now with the Department of Highways in the same city. Mr. Baillie who graduated from the Nova Scotia Technical College in 1926 with the degree of B.Sc., was at one time professor of mathematics and later professor of engineering at the St. Francois Xavier College, Antigonish, N.S.

G. H. Kingston, S.E.I.C., has joined the staff of the Alcoa Power Company at Arvida, Que. Mr. Kingston, who graduated from McGill University in 1927, with the degree of B.Sc., was with the Bell Telephone Company of Canada, Ltd. in Montreal, at one time, and prior to accepting his present position was connected with the Fraser-Brace Engineering Company also in Montreal.

C. A. Wakeham, S.E.I.C., is at present employed by the Shawinigan Water and Power Company at Joliette, Que. Mr. Wakeham, who graduated from the University of New Brunswick in 1928 with the degree of B.Sc., was for a time on the staff of the Northern Electric Company, at Montreal, and later took the Canadian Westinghouse Company's test course, at Hamilton, Ont.

J. P. Fraser, A.M.E.I.C., is now electrical engineer with the Northwestern Power Company at Winnipeg, Man. Mr. Fraser graduated from the University of Manitoba in 1914, with the degree of B.E.E. Following graduation he joined the staff of the Canadian Westinghouse Company as an engineering apprentice, and has remained with that firm up to the present time. Since 1923 he had been designing engineer on switching equipment, and was located at Hamilton, Ont.

H. W. Small, Jr., M.E.I.C., who was formerly chief engineer with the Alcoa Power Company, Ltd., at Arvida, Que., has accepted a position with the W. S. Lee Engineering Corporation and will be located at Charlotte, N.C. Mr. Small was for a time with Stone and Webster Inc., on the supervision of design, investigations, reports and appraisals on steam and hydro-electric power plants, and later was connected with the Fargo Engineering Company at Jackson, Mich., as principal assistant on the same kind of work.

S. B. Wass, A.M.E.I.C., terminal engineer with the Canadian National Railways, has been transferred from Toronto to Montreal. Mr. Wass, who is a graduate of the University of Toronto of the year 1903, has been with the Canadian Government Railways since 1918, when he was division engineer at Moncton, N.B. He was appointed terminal engineer for western lines in 1922, when he was located at Fort William, Ont. Prior to joining the staff of the Government Railways, Mr. Wass was inspection engineer, Highways Branch, of the Department of Railways and Canals for the provinces of Nova Scotia and Prince Edward Island.

M. du Bois, Jr.E.I.C., who has been in Canada and the United States for several years, has returned to Switzerland, and will live in Geneva. Mr. du Bois graduated from the Federal Polytechnical Institute at Zurich in 1926, and was awarded the degree of M.Sc. by the Massachusetts Institute of Technology in 1927. In 1928 he was, for a time, marine engineer with Alex. McKay Company, Ltd., at Quebec, Que. and was later in the hydraulic department of the Dominion Engineering Company, Ltd. at Montreal. The last position Mr. du Bois held prior to his departure was in the construction office of the Consolidated Mining and Smelting Company at Trail, B.C.

W. G. MacNaughton, M.E.I.C., who until recently has been connected with the News Print Service Bureau, New York, N.Y., is now with the manufacturing department of the International Paper Company, New York, N.Y. Mr. MacNaughton is a graduate of McGill University of the year 1904, and for three years following graduation he was employed as chemist with the Canadian Consolidated Rubber Company, Montreal, and also had supervision of rubber cement department and crude rubber preparation. In 1908, he became chemist for the Nekoosa Edwards Paper Company, at Port Edwards, Wis., and in 1912 he was promoted to the position of plant manager. In 1917 Mr. MacNaughton was appointed general manager of the Inland Empire Paper Company at Spokane, Wash., and in 1921 he became secretary of the Technical Association of the Pulp and Paper Industry, New York, N.Y.

R. G. Barbour, S.E.I.C., is now electrical engineer with Messrs. McDougall and Friedman, consulting engineers, Montreal. Mr. Barbour graduated from the University of New Brunswick in 1924 with the degree of B.Sc., and obtained the degree of M.Sc. from the same university in 1927. From 1924 to 1926 he was with the Canadian General Electric Company, Ltd. at Peterborough and Toronto, including test course, engineering offices, draughting room and engineering sales offices. From 1926 to 1929, Mr. Barbour was with the Aluminum Company of Canada at Arvida, Que., during which time his work included the installation of a 65,000-kw. rotary converter station and industrial power equipment; the operation, as assistant chief operator, of rotary and transformer stations; and the designing and installation for transmission, power and lighting for the alumina electrical reduction plant. Subsequently Mr. Barbour was electrical engineer in charge of construction, operation and maintenance, in connection with the electrical equipment.

G. Lorne Wiggs, A.M.E.I.C., has recently been appointed manager of the Montreal sales office of the C. A. Dunham Company, Ltd. Following graduation from McGill University in 1921 with the degree of B.Sc., Mr. Wiggs was engaged on test work with the Canadian Westinghouse Company at Hamilton, Ont., later becoming sales engineer with the Canadian Crocker Wheeler Company. During

G. LORNE WIGGS, A.M.E.I.C.

1922-1923, he was sales engineer with the Mechanics Supply Company, Ltd., at Quebec, Que., and in 1923 he was for three months with the C. A. Dunham Company at Chicago, Ill., on heating design work. From 1924 to 1929 Mr. Wiggs was manager of the engineering department of the Mechanics Supply Company at Quebec, being in charge of all designs, plan work, etc., in that department. In June 1929 he entered private practice in Montreal as a consulting engineer on the mechnical and electrical equipment of buildings, and has given up that practice to accept his present position.

C. H. McL. Burns, A.M.E.I.C., has succeeded Mr. G. L. Grass who has for some years been chief engineer of the Dodge Manufacturing Company, Ltd., Toronto, Ont. Mr. Burns will have direct charge of all engineering as manager of the company's engineering department. Mr. Burns after some years' engineering experience in coal and metalliferous mining in eastern Canada, having been chief engineer of the Maritime Coal, Railway and Power Company from 1911 to 1920, spent a number of years with the Link-Belt Company in the United States, first as designing engineer in the engineering department, and later as construction and development engineer in charge of important changes and construction of the company's own plants in the United States. In 1928, Mr. Burns returned to Canada to join the engineering staff of the International Nickel Company at Copper Cliff, Ontario, taking charge of the general arrangement and design of the ore handling equipment from their new crushing and screening plants, concentrator and smelter.

F. M. Byam, M.E.I.C., is now connected with the National Bridge Company Ltd., at Montreal, Que. Following his graduation from the School of Practical Science, University of Toronto, in 1906, Mr. Byam was for a time structural draughtsman with the Canada Foundry Company, Toronto. From September 1907 to June 1908 he was structural draughtsman and checker with the Riverside Bridge Company of Wheeling, West Va., and from June to October 1908 he was structural checker and designer and mechanical designer for the Dickson Bridge Works Company at Campbellford, Ont. In 1908, Mr. Byam joined the staff of Messrs. Smith, Kerry and Chace, Toronto, as stuctural and hydraulic designer, and in November 1909 he was placed in charge of the civil engineering drawing office, having charge of all the structural and hydraulic design. In 1911 he became associated with Messrs. McGregor and McIntyre, Ltd., structural steel and bridge manufacturers, as chief engineer, and remained in that position until December 1919 when he went into private practice with Messrs. Ewart and Jacob under the name of Ewart, Jacob and Byam, Ltd., engineers and architects, Toronto. In 1928 Mr. Byam returned to McGregor and McIntyre Ltd., as chief engineer, and has remained with that firm up to the present time.

M. V. Sauer, M.E.I.C., until recently with the Winnipeg Electric Company, Winnipeg, Man., is now hydraulic engineer for the Beauharnois Construction Company, at Beauharnois, Que. Mr. Sauer is a graduate of the School of Practical Science, University of Toronto, of the class of 1901, and took a post graduate course in 1902, receiving a fellowship in 1903.

After his university course Mr. Sauer, was with the Ontario Power Company at Niagara Falls, first as draughtsman, and the following year as assistant to the mechanical engineer. He was appointed chief designer of the Niagara Falls Power Company, Niagara Falls, N.Y. in 1905, and the following year was construction engineer for the Iroquois Construction Company, Buffalo, N.Y. In 1907 he again became associated with the Ontario Power Company as chief designer, then as mechanical assistant to the engineer-in-charge, and subsequently in 1912, as mechanical engineer in full charge of design, field, and inspection department. He later became associated with the Hydro-Electric Power Commission of Ontario, and occupied a prominent position in connection with the design and construction of the Queenston-Chippawa power development.

In 1923 Mr. Sauer became hydraulic engineer for Canadian Vickers Limited, with headquarters at Montreal, and in 1925 he was transferred to Toronto, and was chief engineer of the hydraulic department of the then recently incorporated Vickers and Combustion Engineering Ltd., which was a consolidation of the Canadian Vickers Ltd., and the Combustion Engiheering Corporation Ltd. Shortly afterwards, in 1926, he was appointed vice-president of William Hamilton, Limited at Peterborough, Ont.

M. V. SAUER, M.E.I.C.

BOOK REVIEW

Practical Television

By E. T. Larner, with a foreword by John L. Baird. D. Van Nostrand Company, New York, 1929, buckram, 5¼ x 8½ in., 223 pp., front., illus., figs.

Many people, including even technicians of various kinds, hear or read of television ("seeing from afar") and remark on its marvels to their friends, but wish they knew how it came about and how the process may be accomplished.

This little book of twelve chapters and two hundred and twenty pages purports to tell the tale in easy and non-mathematical language for the general reader, who may not be too well versed in the principles of physics. Although the book is small, illustrations abound; there are one hundred and twenty-seven figures altogether.

The book treats concisely the history of television and shows how it was thought of and striven for even before telephony ("hearing from afar") was accomplished. Modern physical devices, electron tubes, photo-electric cells and radio, discovered since telephony was developed, have brought television near to practical and commercial achievement. The author brings out the distinction between television and phototelegraphy and telekinematography, and gives short descriptions of "phonovisor" and "noctovisor" perception.

In the history (chapters 2 and 5) the older attempts at television are reviewed, including those by help of beams of cathode rays. It clearly stands out that it is one thing to transmit silhouettes and shadowgraphs but another and more difficult thing to transmit the images of actual scenes and persons. For the benefit of those who need it there is a chapter on the now superseded selenium cell (chapter 3) which has given way to the photo-electrical cell, "the magic lamp of physics," (chapter 4); a chapter on the cathode ray (chapter 6), and even one on the elementary principles of optics which the television process involves (chapter 7).

The rest is modern television and the details of television technique, including the methods of subject illumination, image formation and its modulation in light and shade, synchronization, and transmission and reception of the image by radio or by wire. All of these essentials are quite simply explained, and must be read to be understood.

Of the modern systems, that of Baird is starred. Possibly it would have brought a better balance to the concluding portion of the book if a little more attention in detail had been given to the system of the American Telephone and Telegraph Company and their successes, even though these were attended by so much labour and expense. From what the reviewer has seen of television he ventures the opinion that no system is yet quite ready for the public.

R. W. Boyle, M.E.I.C.,
Director, Division of Physics and Engineering Physics, National Research Council of Canada, Ottawa.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- Royal Philosophical Society of Glasgow: Proceedings, 127th Session, 1928-29.
- The Institution of Civil Engineers: Engineering abstracts, series 41. Proceedings, Meeting, February 18, 1929.
- American Society for Testing Materials: Index to A.S.T.M. Standards and Tentative Standards, as of Sept. 3, 1929.
- National Council of State Boards of Engineering Examiners: Proceedings of the tenth Annual Convention, Yellowstone Park, Wyoming, Aug. 26-28, 1929.
- The Institution of Mechanical Engineers: Proceedings, Vol. 1, Jan.-May, 1929.
- National Electric Light Association: Proceedings, Vol. 86, 52nd Convention.
- American Institute of Electrical Engineers: Quarterly Transactions, Vol. 48, October, 1929.

Reports, etc.

Department of the Interior, Canada:
- Catalogue of Publications of the Natural Resources Intelligence Service, 1929.

Department of Mines, Canada:
- Bulletin No. 70: Metal Production of Ontario for the first nine months of 1929.
- Investigations in Ceramics and Road Materials, 1927.
- Rapport du Ministère des Mines pour l'année financière se terminant au 31 mars, 1928.
- Investigations of Fuels and Fuel Testing, 1927.

Geological Survey, Canada:
- Preliminary Report on Woman River and Ridout Map Areas, Sudbury District, Ontario.
- Bear River and Stewart Map-Areas, Cassiar District, B.C. Rapport sommaire, 1927, Partie C.

Bureau of Standards, United States:
- Misc. Pub'n No. 95: Protection of Electrical Circuits and Equipment against Lightning.
- Cir. No. 377: Some Properties of Sponge Rubber.
- Cir. No. 376: Thermal Insulation of Buildings.

Bureau of Mines, United States:
- Economic Paper No. 6: Summarized Data of Gold Production.
- Bulletin 302: Fuel-Efficiency Tests on Batch Oil Stills.
- Technical Paper No. 439: Geophysical Investigations at Caribou, Colo.

Geological Survey, United States:
- Water-Supply paper No. 607: Surface Water Supply of the United States, 1925.
- Water-Supply paper No. 636-B: Suspended Matter in the Colorado River in 1925-28.

Bureau Provincial du Tourisme, Quebec:
- Sur les routes de Québec—Guide du touriste.

National Electric Light Association:
- Report of the Rate Research Committee: Electric Rates and Their Status in 1929.
- Report of the Industrial Relations Committee: Public-Contact-Training Methods and Principles.
- Report of the Hydraulic Power Committee: Power House Cranes.
- Serial Report, Electrification of Steam Railroads Committee, 1928-1929.
- Report of the Insurance Committee: Casualty Insurance for Gas and Electric Utilities.
- Report of the Overhead Systems Committee, Engineering National Section, 1929.
- Report of the Underground Systems Committee, Engineering National Section, 1929.

American Society of Mechanical Engineers:
- Report of the Research Committee: Bibliography on Mechanical Springs.
- Standards: Cast Iron long turn sprinkler fittings; Symbols for Hydraulics; Aeronautical symbols; Screw threads for fire hose couplings; Shafting dimensions; Tool holder shanks and tool post openings.
- Power Test Codes: Centrifugal and rotary pumps; Gas producers; Hydraulic power plants and their equipment; Reciprocating steam engines; Speed responsive governors; Steam locomotives; Steam turbines; Pressure measurements, Part 2.

University of Michigan:
- Department of Engineering Research: A Vapour-Pressure Chart for Hydrocarbons.
- Baking Practice for Oil-sand Cores.

Technical Books, etc.

Presented by Constable & Co. Ltd., London:
- Practical Design of Simple Steel Structures:
  - Vol. 1: Shop practice, riveted connections and beams, etc.
  - Vol. 2: Plate girders, columns, trusses, etc.
  - Vol. 3: Tables.

Canadian Engineering Standards Association:
- Established lists of dimensional standards; B-29-1929, Established list of machine screws.

Presented by Van Nostrand Co., Inc.:
- Transmission Networks and Wave Filters.
- The Rayon Industry, 2nd edition.

Presented by McGraw-Hill Book Co., Inc.:
- Basic Principles of Concrete Making.

The Canadian Ingersoll-Rand Company, Limited have just published a new booklet entitled "Drill Steel—Instructions for Selecting, Preparing, Forging, Heat Treating, and Tempering."

A concise treatise on modern rock drill steel preparation, written in plain language while retaining the necessary technical data, this booklet should be of great value to users of steel.

In addition to the text matter dealing with essentials to be looked for in a properly formed drill steel, tables for ready reference are given. A few of their titles are "Length of steel required for shanking and forging shank," "Weights of drill steel," "Length of steel required for forging four-point bits," "Length of steel required for forging six-point bits." An interesting and very practical feature appears on page 6, in the form of a working drawing of a proposed smith shop, which shows, conveniently arranged for speedy work, an outfit consisting of drill steel sharpener, oil furnace, grinder for shanks, quenching tank, steel racks, etc. Correct temperatures at which steel should be worked, are also explained, supplemented by a handy reference table showing the dangers of working steel below certain temperature or heating it to too high a degree. Copies of this booklet will be gladly furnished by the Canadian Ingersoll-Rand Company, Limited, 10 Phillips Square, Montreal, Que.

BRANCH NEWS

Halifax Branch

Wm. J. De Wolfe, A.M.E.I.C., Secretary-Treasurer.

The regular monthly supper meeting of the Halifax Branch of The Engineering Institute of Canada was held on November 20th, at 6.30 p.m., at the Halifax Hotel.

Previous to this meeting a conference of the executive was held at which various matters relating to Branch affairs were discussed, particularly with regard to the year's work, and the reception of the Nominating Committee report.

At the regular meeting, Chairman Harry Bennett, A.M.E.I.C., presided and there were 27 present, including Prof. F. H. Sexton, principal of Nova Scotia Technical College, who had been invited to address the meeting.

After the conclusion of supper, the meeting came to order, when the October minutes were read and approved. Chairman Bennett then praised the work of the October meeting committee for the excellent arrangements, the large number present and the general success of meeting. He also made reference to a proposal that there be no banquet at our annual meeting in as much as it had been suggested that our Branch join with the Professional Association to stage a joint banquet on the occasion of the annual meeting of the Association, instead.

The suggestion was well received and, on motion, was approved and Prof. W. P. Copp, M.E.I.C., Messrs. H. W. L. Doane, M.E.I.C., and J. Lorne Allan, M.E.I.C., were appointed the Branch Committee to assist in arranging the banquet.

Two auditors were appointed, they being Prof. F. R. Faulkner, M.E.I.C., and Prof. H. C.Burchell, M.E.I.C.

The report of the Nominating Committee was then received and ballots were ordered printed.

Chairman Bennett announced that the general executive of The Institute is preparing a case to present to the Civil Service Commission in behalf of the engineering services of the federal government. In that connection there had been a suggestion that letters of an editorial nature be sent the several newspapers but the suggestion was not well received by the Branch.

Chairman Bennett made a few introductory remarks in relation to the closer co-ordination of The Engineering Institute and the various Professional Associations throughout Canada, and introduced Prof. Sexton, who is chairman of the local joint committee in that connection.

Professor Sexton, on arising to speak, said he had been asked to open the discussion in this matter and began by explaining that several meetings of the committee had been held in order to try to find some basis on which closer co-operation of the two bodies could be founded.

He remarked that most engineers in Nova Scotia are members of the two bodies and there is not a great distance to be traversed to effect the co-operation aimed at. He read the objects of The Institute and stated that they are comprehensive and cover about all that may be desired of the social and technical and ethical aspects of our profession for which we stand before the public, but they do not cover the legal standard for which we contend and, hence, the Professional Association.

The Association was formed by a small handful of men who have striven to make The Institute the success it is but since a federal association could not immediately be formed, by enactment, provincial ones were formed and now there is a Professional Association in each province, excepting Saskatchewan. Each association has an act under which it operates to safeguard the practice of engineering, by setting standards designed to enable engineers to be of greater value in the general public interest and to protect themselves.

Due to the fact of different standards set up in different provinces the several acts vary in their make up. It is the aim to get all the acts into closer agreement and to have all engineers registered that gives rise to the present movement and also to have one body to cover all the different aspects of the profession.

Perhaps not every member of either organization favours co-ordination, but Professor Sexton was sure that most members will be found in agreement with the scheme.

We say little in these Maritimes about many things, especially the payment of dues. He favoured small dues but there must be one fee large enough to cover the cost of operating the two bodies, in the event of co-ordination. The Professor asserted that there should be one body to cover the social, technical and legal sides of the profession, and the fee must be large enough for the purposes outlined. There are, no doubt, those who contend that the present fees are too high, without giving thought to the large values obtained from membership. Compared with the fees required for hawker's licenses our fees are very low and all should be willing to pay what may be required to carry on.

The committee, he said, will not at this time propose a concrete method for co-ordination but, when we read of business mergers and the advantages of them, The Institute should go far in trying to get both organizations joined up for the mutual value to be obtained and the association should do the same to the end that there be, finally, unity of purpose and uniformity of effort and standards throughout the Dominion.

Other professions had had a long struggle to reach such a goal but it should not be so for us and Professor Sexton said, in conclusion, that he hoped to see this unity and uniformity an accomplished fact in the near future.

Prof. F. R. Faulkner was the next speaker and he said that the working out of a scheme of co-ordination is not all pleasure but it is a work in which we are all interested and for which we hope to find a solution. Prof. Faulkner gave a résumé of the meeting at Montreal in that connection and while he could not give details of the discussion there he could say that it was quite diversified and profitable. He read some extracts from the minutes of the meetings to bring out the point that there is a fast growing desire all over for some kind of co-ordination. He read a report to the Branch covering the meeting and said that, in his opinion, this co-ordination is very desirable and very possible of consummation.

Many angles must be considered before a final solution is found but the present Institute Committee is being continued and further, and greater, effort will be made to attain to the solution.

Mr. H. W. L. Doane said that he had nothing to add to the remarks already made but stressed the point that all the delegates at the meeting had been strongly for some one organization to co-ordinate all the activities of The Institute and the Professional Associations in order to get the best possible results for the profession throughout Canada.

A letter was read from Mr. C. E. W. Dodwell, a Past Vice-President of The Institute, and an Honorary Member, outlining his views with regard to the difficulties in the way to co-ordination of the two bodies.

Several members present expressed their views. It was agreed that the Committee had done excellent work to date and that we must do our part to bring about a happy and satisfactory scheme of co-ordination; that it is not a question of whether it is advisable but, really, of how soon it can be brought about.

Chairman Bennett summed up the situation as favourable and commended our Branch Committee for their active interest.

A motion was carried that our present committee be continued.

It was announced that the annual meeting will be held on December 19th and that, in view of the joint banquet to be held later, no special speakers will be invited but full reports of all the year's work will be presented.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.
J. R. Dunbar, A.M.E.I.C., Branch News Editor.

Meeting of September 27th

The opening meeting of the Branch took the form of a dinner meeting and was held on September 27th at the Wentworth Arms. H. A. Lumsden, M.E.I.C., chairman of the Branch, occupied the chair. The guests were A. J. Grant, M.E.I.C., vice-president for Ontario, and E. G. Cameron, A.M.E.I.C., chairman of the Niagara Peninsula Branch, as well as other members of the Niagara Peninsula Branch. There were about forty at dinner including the guests.

E. G. Cameron, A.M.E.I.C., spoke on Institute affairs from the Branch viewpoint. He advocated decentralizing control of Institute affairs by throwing more work on the Branches. This would result in reduction of work at headquarters and could be effected by increasing the responsibility of the Branches regarding The Institute at large. As a particular instance, he mentioned the question of admission and transfer, which he thought could be handled by having the Branch make a thorough and complete report. By increasing interest in The Institute, its standing would be improved. Mr. Cameron referred to the discussion at the last annual meeting regarding increased dues. There was very little adverse discussion at the annual meeting but the increase was defeated in the vote when only 900 votes were recorded out of 3,600 corporate members.

Other points touched on by Mr. Cameron covered the use of questionnaires to get members of the Branch to express an opinion, the co-operation with the provincial associations by the Branches, management of Branch affairs and question of rebates. He felt that the rebates should be just sufficient to finance the activities of the Branch from year to year.

A general discussion followed in which a great number of those present took part.

Regular Meeting November 6th

A regular meeting of the Branch was held in the Technical Institute with Mr. Lumsden in the chair.

The speakers were all members of the Hamilton Branch. Mr. Graham Bertram gave a very interesting address on "Machine Tools" and showed photographs and models of a new line of tools for railroad shops.

R. K. Palmer, M.E.I.C., Branch Councillor, spoke on some of the matters discussed at the Plenary meeting of Council, stressing most particularly the question of Institute publications. A general discussion followed terminating in a motion that a resolution regarding publications be prepared by the chairman, the secretary and Mr. Palmer and that it be submitted to the Branch for discussion.

J. E. Grady, A.M.E.I.C., spoke on "Coke Ovens at the Steel Company of Canada's Plant." An interesting development is the use of a supply of calcium chloride to provide a dustless coke for domestic use.

J. R. Dunbar, A.M.E.I.C., spoke on the subject of "Power Factor" and showed the reduction in power cost possible by the use of condensers.

Refreshments were served after the meeting.

MEETING WITH INSTITUTE OF RADIO ENGINEERS

The members of the Hamilton Branch were the guests of the Institute of Radio Engineers at a meeting held in the Westinghouse auditorium on November 15th. K. S. Weaver of the Westinghouse Lamp Company, Bloomfield, N.J., spoke on the "Production Testing of Vacuum Tubes."

JOINT MEETING WITH NIAGARA PENINSULA BRANCH

On Wednesday, October 23rd, a joint meeting of the Buffalo Engineering Society, the Frontier and Toronto Sections of the A.I.E.E. the University of Toronto Engineering Society and the Hamilton and Niagara Peninsula Branches of The Institute was held. The early part of the day was devoted to inspection of the Welland ship canal followed by a dinner and meeting in the evening.

EXECUTIVE MEETING NOVEMBER 20TH.

A dinner meeting of the executive committee and past chairmen was held in the Royal Connaught hotel on November 20th at 6.30 p.m. to meet R. J. Durley, M.E.I.C., general secretary.

Among other matters discussed was the report of Mr. Porter's committee on the Professional Engineers' Associations.

Kingston Branch

L. F. Grant, M.E.I.C., Secretary-Treasurer.

On Thursday, November 22nd, the members of the Kingston Branch had the privilege of listening to an address by the President, Brig. Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C.

The President, who was introduced to the meeting by Dean A. L. Clark, M.E.I.C., of Queen's University, spoke first of Institute affairs, giving much interesting information on the activities of other Branches. He pointed out that each Branch had its own individuality instancing the large university element in the case of Kingston, and pointed out the advantage to young engineers in being members of a Branch in which all phases of the profession are represented. In speaking of the fact that The Institute has no less than twenty-five Branches he said that the only other truly national engineering society was that in Germany. He emphasized the growing influence of The Institute and the increase in membership during recent years. He urged upon the younger members the advantages of membership and of taking part in all Institute activities, and described how the Branches were making their influence felt through the medium of Branch councillors and the Plenary meetings of council, giving a brief résumé of the work of the last meeting.

Turning to the status of the profession generally, the President gave a most interesting and gratifying list of the large number of engineering projects which are at present under way in Canada, instancing harbour development and elevator work in the Maritime provinces, and on the St. Lawrence, power development on the Mersey river, Grand Falls, N.B., the Saguenay, Gatineau and proposed work in British Columbia; the Montreal-South Shore bridge; harbour development at Prescott, Kingston and Toronto and elsewhere on the Great Lakes; the numerous large buildings, both public and industrial, which are a feature of every growing Canadian city; the important municipal works which are either in hand or projected, and the machinery which is being produced in Canadian mechanical and electrical shops.

Lastly the President stressed the importance of the engineer being more than simply engineer, and becoming a factor in the public life of the country.

The vote of thanks was moved by Prof. A. MacPhail, M.E.I.C., who took the opportunity of congratulating Gen. Mitchell on having attained the high honour of President of The Institute.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

THE SULLIVAN MINE

The regular meeting of the Lethbridge Branch was held at the Marquis hotel on Saturday, November 16th. There were thirty-five members and affiliates present. The meeting was preceded by the usual dinner, following which a musical programme was enjoyed. Besides the notorious community singing of the Branch, vocal solos by Mr. G. Evans, pianoforte solos by Mr. R. Williams and banjo selections by Mr. Solomon were excellently rendered.

The speaker of the evening, Mr. J. R. Giegerich, was introduced by the chairman, J. B. de Hart, M.E.I.C. Mr. Giegerich, who is on the engineering staff of the Consolidated Mining and Smelting Company, addressed the meeting on "The Sullivan Mine."

This mine, located at Kimberley, B.C., was discovered in 1892, and after varying fortunes, was acquired by the Consolidated, who, after several years of development, have brought it to a high stage of production: some 5,400 tons of ore a day being recovered.

The ore body is a replacement deposit in beds of argillaceous quartzites underlain by diorite sills. The chief minerals are pyrrhotite, pyrite, galena and sphalerite.

Mining is carried on at five levels over a depth of 700 feet. Raises are driven from the drifts, and cross cuts and stopes opened up from the raises. The ore is removed by drilling bench rounds. The inclination of the stope is sufficient to permit the ore to drop by gravity to loading chutes above the drifts.

At present about thirty per cent of the ore is left as pillars, but experiments are being made in the use of concrete replacement pillars. Electric haulage is used throughout the mine, the tracks in the main haulage ways being of 70-lb. steel. The movement of ore trains is controlled by a phone despatching system.

On the surface, a compressor plant of 21,000 cubic feet per minute capacity is located and also large machine shops, warehouses and office buildings. On the townsite near the mine, a complete community has been built up. A fine recreation hall is provided and an up-to-date hospital is operated. Even a company owned greenhouse provides flowers and plants for the employees at a nominal cost.

Mr. Giegerich's address was greatly appreciated and a hearty vote of thanks was expressed on the motion of J. A. Carruthers.

THE KIMBERLEY CONCENTRATOR

The regular fortnightly meeting of the Lethbridge Branch was held on November 30th, at the Marquis hotel. Following an excellent dinner, community singing was indulged in under the violent and jovial leadership of Bob Lawrence. During dinner a musical programme was rendered by A. Morgan's orchestra, after which pianoforte solos by Miss D. Glasser and vocal solos by Tom Smith were well received.

The speaker of the evening was H. B. Banks, assistant superintendent of the Kimberley concentrator of the Consolidated Mining and Smelting Company, who described the operation of that plant.

Two weeks previously, J. H. Giegerich of the same company described the Sullivan mine which supplies the ore for the Kimberley concentrator.

London Branch

Frank C. Ball, A.M.E.I.C., Secretary-Treasurer.
Jno. R. Rostron, A.M.E.I.C., Branch News Editor.

The December meeting took the form of a dinner at the Hotel London, on Thursday, December 12th, with Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., dean of Faculty of Applied Science and Engineering of the University of Toronto and president of The Engineering Institute of Canada, as the guest of honour.

After the company had done full justice to a good dinner the chairman, Capt. W. M. Veitch, A.M.E.I.C., in introducing the speaker, explained that the meeting was in reality semi-military for a large proportion of those present were military men and in fact several who were in full uniform were due to attend a military inspection which was to take place at the Armouries at 9.00 p.m.

The General, in his opening remarks, complimented the engineers and the citizens of London on the fine civic spirit they had shown in supporting by an overwhelming majority the proposal for grade separation of the Canadian National Railways at the recent municipal elections. He said they had recognized the principle as good and were willing to back it and he wished that other cities had that spirit.

The speaker then outlined several developments which were considered at headquarters, notably a proposed arrangement between The Engineering Institute and the various provincial associations of engineers. Details of this had not yet been worked out but proposals had been put forward and a committee had been formed to investigate and report on a workable scheme which would be satisfactory to all. He was careful to explain that there was no idea of either body dominating or absorbing the other but that the object was to devise a scheme where The Institute and the Associations would work together in unison for the protection and advancement of the profession generally. He pointed out that The Institute during the last ten years had made rapid progress with a very much larger increase in membership than formerly. In fact, the prestige and standing of The Institute together with the advantages of membership were now fully recognized.

The question of the proposed increase in fees was still in abeyance and would be brought forward again at the next Annual General Meeting. The benefits that would accrue from the increase were stressed by the speaker.

With regard to the publications of The Institute he said that there had been some discussion regarding the present form and size of the Journal and in this connection he pointed out that consideration was being given to the publishing of the proceedings of The Institute in the form of Transactions, in addition to the Journal.

The E.I.C. News had been very much appreciated and was a distinct success.

The General spoke of his visits to many of the Branches and the work which was being accomplished in the various localities by them. The work of the engineer and his contribution to the progress of the community was manifest everywhere in daily life. He urged all engineers, although they were mostly of a retiring nature when it came to public life, to come forward and take a more prominent part in the affairs of their community as their views, necessarily of a trained and practical nature, were valuable and helpful in the development of available resources and of advancement generally.

He spoke strongly of the industrial development which had taken place throughout Canada in recent years and stressed the fact that in his opinion the country was now on the eve of a great wave of prosperity and industrial expansion. In support of his argument he cited a long list of works, engineering and otherwise, from one end of the Dominion to the other, that were either completed, or in progress, or in commencement. In the latter class he mentioned the Beauharnois power development which he said might be considered as a unit in the St. Lawrence deep waterway and power project. With regard to the latter he said that he did not wish to say much about it because he was officially connected with it, but he said it is receiving very careful and urgent consideration.

Among the items of engineering work he mentioned the building of the 6000 class of Canadian National Railways locomotives at Kingston, the heaviest locomotive in the world. It was a notable fact that these were designed by members of The Institute and were all built by Canadian labour. Other works enumerated were the building of the Manoir Richelieu hotel at Murray Bay, built of reinforced concrete in zero weather and in record time, the Welland ship canal now approaching completion and also a link in the proposed St. Lawrence deep waterway, and many hydro-electric power developments throughout the country.

He also spoke of the value of the research work which was now being done in the direction of by-products from the low grade coal deposits in Alberta and Ontario made possible under Premier Ferguson's scheme of the government advancing dollar for dollar subscribed by numerous industrial firms for this purpose; the funds now available for this purpose running into hundred of thousands of dollars. He also touched on the lead mining industry and indicated a big future for this work. He pointed out the great advances for which engineering had been responsible in the development of agricultural machinery and the benefits derived therefrom.

In closing, the General stated that "indispensability," "versatility" and "ingenuity" should be the motto of all engineers and reminded his hearers that the word engineer came from the French word "ingénieur."

Brig.-Gen. C. J. Armstrong, M.E.I.C., moved a hearty vote of thanks to the speaker, and related how he and General Mitchell were old comrades in the war and reminded him of their journey to the front in France. The train took three days and nights to make the trip and the General, himself, and three others were occupants of a compartment in which two only could sleep on either seat and the fifth had to sleep on the floor. The honour of occupying the distinguished couch was decided by flipping a coin and the General always won.

Col. H. J. Lamb, M.E.I.C., seconded the vote of thanks and also reminded the General that he was one of the illustrious five on that memorable journey and that on the third night war nearly broke out amongst the party on the question of who should have the doubtful honour of sleeping on the floor.

Captain W. M. Veitch, A.M.E.I.C., in excusing those in uniform who had to attend the inspection, including himself, said he would like to inform the Generals that he also was a passenger on that same train to the front but the journey seemed more like three weeks rather than three days as he was in a box car.

On the retirement of the military members the chair was taken by W. G. Ure, A.M.E.I.C., vice-chairman of the Branch, and a discussion followed. Col. Lamb called attention to the good work being done by the National Service Council and asked the General to say a few words on this head.

Gen. Mitchell said he was glad to have his attention called to this and described the need for such a body and the results that were being achieved. One of the objects of this Council was to prevent the outflow of Canadian graduates to the United States by finding them berths in this country, and their efforts in this connection were most successful.

He said the industrial expansion was so great that in a short while there would not be sufficient graduates to fill the positions open. Another phase of this situation was the fact that many of the industrial workers who had left Canada for the United States were returning.

The General said he was glad to see present Mr. Angus, Sr., who would be able to appreciate the rapid strides engineering had made in Canada during the last decade or two, and paid a high tribute to Mr. Angus' son, Professor R. W. Angus, M.E.I.C., of Toronto, who was doing wonderful work and with whom he was closely associated.

After a general discussion in which several members spoke, the chairman adjourned the meeting.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.

Archie B. Crealock, A.M.E.I.C., Branch News Editor.

On Thursday evening, November 7th, 1929, the Toronto Branch of The Institute held a joint meeting with the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, the speaker being Professor R. W. Angus, M.E.I.C., of the University of Toronto. The lecturer described a visit to the continent of Europe extending over a period of many months, in which engineering matters of interest were studied. The lecture was fully illustrated with lantern slides.

The first place mentioned was Delft, Holland, where a very fine engineering college exists with large numbers of engineering students. The hydraulic laboratory was particularly interesting on account of the work being done with hydraulic models.

After leaving Holland an extensive visit was made to Germany, covering first the cities of Braunschweig, Hanover and Göttingen. The former two places contained large engineering schools and extensive research work was in progress in both of them, and Göttingen has long been celebrated for its aerodynamic laboratory, which is under the direction of Professor Prandtl. This laboratory contained many things of value, besides the wind tunnel.

Proceeding next to Berlin, which proved to be a real centre of engineering interest, the first place visited was the headquarters of the German Society of Engineers, where every kindness was shown and where the speaker was placed in contact with many engineering matters. This society works harmoniously with the larger engineering societies, both in Britain and America, and there are helpful exchange arrangements amongst them. Berlin, of course, contains the very large shops of Siemens-Schuckert and the General Electric Company, the former employing 55,000 workers in its Berlin plant. These shops proved models of efficiency and were turning out some very large work, the 80,000-k.w. steam turbines for the new Klingenburg station at Berlin having been made at the General Electric shops. The Klingenburg steam station with three 80,000-k.w. turbines and three 10,000-k.w. turbines, was a fine piece of the latest type of engineering and the application of 16 Ruths accumulators at the Charlottenburg power station showed development along the line of steam storage. The University Engineering Department at Berlin was also mentioned and the names of some well-known men visited by Professor Angus were given. In the same part of the city is the large government river flow laboratory and ship channel, in which extensive experiments are made to solve problems connected with ships, river flow and harbour design. In addition to this a brief description of the extensive outdoor laboratory at Marquardt, near Potsdam, was given and slides shown of some of the work done.

Dresden, the speaker said, contained many interesting things, but the one attractive engineering feature was a large water storage and pumping plant being erected to look after peak load conditions there. This plant when completed will have 240,000 h.p. in eight water turbines, and during off-peak hours, will lift the water from a lower reservoir to an upper one, and during the peak hours the water will flow back through the turbines developing power. The electric power for pumping is produced by steam at power stations about sixty miles away.

At Prague, mention was made of the well-known Skoda works and at Vienna the engineering laboratories of the university, as well as those of the government water power development were described.

A water power plant at Pernegg on the Mur river near Graz was next described, this being one of the many low-head plants visited on the tour. Following through Austria, the Achensee power plant near Innsbruck was shown, this plant having a total capacity of 117,000 h.p. Pumping is also used here to get some of the water which would otherwise go away from the storage lake.

Returning to Germany, the Deutsches Museum at Munich and the fine engineering school were described in some detail, and from this point the large turbine building shop of Voith in Heidenheim was visited and also a low head water power plant at Donaustetten on the Danube where four Kaplan wheels have been installed for a head of 21 feet and with a specific speed of 172.. Another plant visited from Munich was at Walchensee, where 144,000 h.p. is being produced, with a head of about 630 feet, and close to this plant there has been established a fine hydraulic research laboratory at a cost of about $200,000 in which all sorts of river flow and open channel flow problems may be studied, the water available for the purpose being 140 cubic feet per second. These were all illustrated by slides.

In addition to the other points, the plants on the Middle Isar adjacent to Munich were also of importance, these producing a total of about 135,000 h.p. at four different power houses.

Passing through into Switzerland, the fine engineering shops of Escher Wyss and Company and the excellent Engineering University at Zurich received some attention, and from Zurich the extensive shops of Sulzer Bros. at Winterthur were visited, these containing many Diesel engines and pumps under construction.

From Zurich the power plants at Wäggital were also visited, there being two stations, an upper and lower, with a total of 160,000 h.p. There was nothing unusual about the turbines the speaker said except the high head of 805 feet on the Francis turbines in one of the stations, but pumping is also resorted to here during the off peak hours, and four pumps of 5,000 h.p. each have been installed for this purpose.

Passing on next to Lucerne, the large turbine shops of Theodor Bell with its testing flume were described, and from this point the power station at Amsteg for the Swiss Federated Railroads was also visited. This plant is on the Reuss river and contains six 14,000 h.p. turbines under a head of 905 feet

The Lake Lungern plant near Brunig Pass, and in addition a very large low head plant at Eglisau on the River Rhine were also illustrated. The next place of engineering interest was Berne, from which several plants were visited, the most extensive one being that at Muhleberg on the River Aar where 65,000 h.p. is being produced under a head of 56 feet.

Passing on next to Geneva, where are located the shops of Ateliers des Charmilles, the plant at Chancy-Pougny was described, this plant being on the Rhone river, the transformer station being in France and the power house itself in Switzerland. The head here is only 29 feet and the horse power developed 43,000.

Leaving Switzerland Professor Angus visited Italy and a stop was made at Milan to see some of the plants of the Edison Electric Company and the shops of the Riva Construction Company, this latter company making many large turbines. It was here that the original turbines at De Cew falls were constructed.

At Rome the chief engineer of the State Railways kindly gave information about the work being done in Italy on electrifying railways. Many of the lines use three-phase current and the state owns about one third of the power plants used in operating its lines.

Returning from Rome through Switzerland the last plant described was that at Ryburg-Schworstadt on the Rhine near Rheinfelden. This plant is now being built and will contain four of the largest Kaplan turbines yet constructed, these having a capacity of 35,000 h.p. each, under 35 feet head and with a runner diameter of 23 feet.

Very brief mention was made of the work being done in the Engineering University at Karlsruhe, and time did not permit anything but a bare mention of what was seen in Great Britain, but which is quite familiar to people in Canada.

At the close of this very interesting and educative lecture a very hearty vote of thanks was rendered to the speaker for his splendid lecture which was so well illustrated by lantern slides.

Planning and Development Act of Ontario

On the evening of Thursday, November 21st, the Toronto Branch of The Engineering Institute were privileged to hear a lecture on "Planning and Development Act of Ontario and its Operation in Toronto" by Mr. Tracy D. Le May, M.E.I.C., the city surveyor.

In this lecture Mr. Le May gave a very complete explanation of the subject of town planning, explaining the fundamental features of the subject and describing the ideals which were desirable but which in a city already grown up are exceedingly difficult to apply. In his lecture Mr. Le May dealt with the skyscraper and its effect on the occupants of adjacent buildings; the report of the Advisory Town Planning Commission; the obligation of the provincial governments in town planning and the need of a central bureau in each province for the co-ordination of town planning and the dissemination of town planning spirit.

The question of streets and traffic was dealt with by the speaker and he also explained the City and Suburban Plans Act and its application in Toronto and suburbs, at the same time taking up the subject of street widths and jogs where streets intersect.

The lecture was illustrated by lantern slides and at its conclusion a hearty vote of thanks was tendered to Mr. Le May for his lucid explanation of this important subject.

Toronto Waterworks

On the evening of Thursday, December 5th, the members of the Toronto Branch were privileged to hear a lecture on "Toronto Waterworks" by William Gore, M.E.I.C., of Gore, Nasmith and Storrie, consulting engineers.

Mr. Gore in his lecture dealt with the subject in a general way, emphasizing more particularly the works now in course of construction. The speaker traced the history of the Toronto waterworks from 1841 when the first pumping station was erected and opened down to the present time when there is under construction additions to the present system capable of insuring a supply of pure and palatable water for the needs of over 1,000,000 persons and eventually 1,500,000 persons.

The extensions are being designed so that construction will be carried out in two stages, providing in each stage for an additional supply of 75 million gallons daily, but wherever it is more economical to do so, provision is made in the first construction for the complete scheme. The speaker then described in detail the layout of the new work and described the different parts, namely the submerged intakes, the intake tunnel, the filter plant at Victoria Park to eventually have a capacity of 200 million gallons daily of which one half is being put in at the present time, a pure water reservoir of 12,000,000 gallons at Victoria Park, the pumping stations, the distributing tunnels, the St. Clair Avenue reservoir which will be 23 feet deep contain 50,000,000 gallons in two equal compartments, the ornamental overhead expansion tank in district No. 3 which will contain at normal water level 300,000 gallons and the various other parts incidental to the work.

In conclusion the speaker stated that the estimated cost of the works to be constructed is $14,317,000.00 and that the work is being carried out under the direction of R. C. Harris, Commissioner of Works, with G. G. Powell as deputy. James Milne is in direct charge of water works with A. U. Sanderson as assistant. H. G. Acres and Co. Ltd. of Niagara Falls, Ont., and Gore, Nasmith and Storrie, Toronto, are the consulting engineers.

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Preliminary Notice

of Applications for Admission and for Transfer

December 23rd, 1929

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in February 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BENT—EDGAR DELAP, of Montreal, Que., Born at Paradise, N.S. May 28th, 1906; Educ., B.Sc., Acadia Univ., 1928; June 1928 to Mar. 1929, junior engr., Atlantic Divn., Hydrographic Service of Canada; 1929 (Mar.-Oct.), Physical Testing Lab., Ottawa; at present, cable engr., cable engrg. lab., Northern Electric Co. Ltd., Montreal.
References: A. Sutherland, N. L. Dawson, W. G. Tyler, F. H. Peters, F. Anderson.

BRIDGES—FREDERICK, of Sorel, Que.. Born at London, England, March 1st, 1868; Educ., 1884-1888, Kings College, London. 1886-1890, private tuition, naval arch'ture and maths.; 1884-89, articled pupil, 1889-1892, dftsman., Samuda Bros., Poplar, shipbldrs. and engrs.; 1892-94, seagoing engr. (and B.O.T. Cert.); 1895-1908, chief dftsman., Edwards & Co., Millwall, shipbldrs. and engrs., becoming asst. mgr. and later manager and secretary; 1908-1918, chief hull dftsman., Govt. Shipyard, Sorel, Que.; 1918-22, mgr. and naval arch't. to Leclaire Shipbldg. Co., Sorel, and their successors, The Transportation & Shipping Co. Ltd.; 1922-24, independent ship surveyor at Montreal; 1924-28, govt. steamship inspr., Montreal; 1928 to date, supt., Govt. Shipyard, Sorel, Que.
References: H. W. B. Swabey, V. W. F. Forneret, I. J. Tait, H. R. McClelland, D. McArthur, L. E. Cote, F. Newell, H. A. Terreault.

COOKE—NORMAN LOGAN, of 13 Sherwood Street, Halifax, N.S., Born at Lexington, Mass., Aug. 27th, 1877; Educ., B.Sc., N.S. Tech. Coll., 1922; 1904 (summer), leveler on prelim. and location, Broughton Coal & Railway Co.; 1905-6 (summers), instr'man., Dominion Coal Co.; 1918, instr'man., i/c of party, replanning devastated area, Halifax; 1919-21, asst. engr., on heavy constrn., Nova Scotia Construction Co., Halifax; 1926 to date, teaching dfting and woodwork, St. Patrick's Mechanic Science School, Halifax, N.S. (rank of principal).
References: F. R. Faulkner, A. F. Dyer, R. R. Murray, W. P. Morrison, H. W. L. Doane.

D'AOUST—JOSEPH GILBERT, Port Alice, B.C., Born at Vancouver, B.C., June 14th, 1905; Educ., B.A.Sc., Univ. of B.C., 1927; 1928-29, dftsman, and at present junior engr., B.C. Pulp & Paper Co. Ltd., Port Alice, B.C.
References: R. Ford, W. L. Ketchen, G. A. Walkem, E. A. Wheatley.

DAVIDSON—JOHN KNOX, of 1944 Tupper Street, Montreal, Born at Stranraer, Wigtownshire, Scotland; Educ., B.Sc. (Honours in Civil Engrg. and Hydraulics), University of St. Andrews, Scotland, 1926. April 1928, passed all qualifying exams. for A.M.I.C.E.; 10 mos. (vacation periods), asst. in Dundee Corpn. Waterworks, Engr's office, surveying, levelling, plotting and dfting.; 1926-28, asst. to waterworks engr., Dundee, Scot.; 1928, asst. field engr., Sir Robert McAlpine & Sons, Public Works contractors, London, England; 1929, temporarily with Robert Gibson, consltg. civil engr., Dundee, on steel and reinforced concrete design of jute mill; asst. constrn. engr. with the Dock Commnrs. of the Port of Leith, Scot.; at present, dftsman. and asst. engr., Dominion Bridge Co. Ltd., Lachine, Que.
References: A. Peden, C. S. Kane, L. H. Burket, N. Cageorge, A. E. McNicoll.

FELLOWS—HOWARD, of Halifax, N.S., Born at Stellarton, N.S., Aug. 3rd, 1894; Educ., B.Sc. (E.E.), McGill Univ., 1921; 1911-13, machine shop ap'tice; 1915-19, machine shop and dfting room; 1921 to date with Nova Scotia Power Commission as follows: 1921 (July-Nov.), elect'l. equipment erection; 1921-24, power house operator; 1924 (Feb.-Oct.), erection supervision, power plant (generating station); 1924-27, chief operator, hydro-electric system, Sheet Harbour; 1927-29, elect'l. engr. with charge of elect'l. design and operation of all systems, and at present, asst. chief engineer.
References: H. S. Johnston, E. Brown, C. V. Christie, C. M. McKergow, K. L. Dawson, C. H. Wright, R. R. Murray.

HUMPHRIES—GEORGE EDWARD, of Toronto, Ont., Born at Wolverhampton, England, Dec. 31st, 1904; Educ., 1923-27 (part time course), Wolverhampton and Staffs. Tech. Coll. National Cert. in mech. engrg. from Inst. of Mech. Engrs., 1927. Corr. course in civil engrg.; 1920-23, ap'tice., erection dept., Steam and Water Main Engrs.; 1923-25, clerk-dftsman., Accuracy Works, Ltd.; 1925-27, dftsman., steam power plant, Foster Bros. Lt'l.; 1927-29, dftsman. (struct'l), Hamilton Bridge Co. Ltd.; at present struct'l. designer, H.E.P.C. of Ontario, Toronto.
References: E. E. H. Hugli, F. H. Mason, J. W. Falkner, H. E. Brandon, E. B. Dustan.

LeBOURVEAU—HOMER BENJAMIN, of Edmonton, Alta., Bornat Cookshire, Que., May 24th, 1900; Educ., B.A., 1923, B.Sc., 1924, Univ. of Alta.; 1923-25, gen. elec. constrn. on power plant and substation equipment, Can. Westinghouse Co., Calgary; 1925-27, constrn. foreman, 1927-28, asst. engr., and Dec. 1928 to date, prelim. engrg. work for 400 miles transmission lines including substations, etc., also design of town distribution systems, for Calgary Power Company, Ltd., Calgary, Alta.
References: G. A. Gaherty, G. H. Thompson, H. J. McLean, R. W. Boyle, R. S. L. Wilson, C. A. Robb.

LEE—WILLIAM STATES, Jr., of Charlotte, N.C., Born at Columbus, Ga., May 5th, 1902; Educ., Civil Engr., Princeton Univ., 1924; 1924-25, on constrn. and later in office, Isle Maligne Stn.; 1925-27, designing dftsman., Duke Power Company, Charlotte, N.C.; 1927 to date, in charge of design, and at present, vice-president, W. S. Lee Engineering Corporation, New York, N.Y.
References: T. H. Hogg, F. B. Brown, W. S. Lee, F. H. Cothran, F. Newell, R. O. Sweezey, K. M. Perry, J. W. McCammon.

McDOUGALL—JAMES LYLE, of Kenogami, Que., Born at Kintore, Aberdeenshire, Scotland, July 9th, 1906; Educ., 1922-28, Robert Gordon's Tech. Coll. and Aberdeen Univ.; Passed Exam. for A.M.I.M.E., 1929; 1922-28 (3 yrs. shop and 3 yrs. drawing office), Alex. Wilson, Aberdeen, Ltd.; 1928-29, employed in drawing office of C. F. Wilson & Co. Ltd., and John M. Henderson & Co. Ltd., Aberdeen; at present, mech'l. engr. and dftsman., Price Bros. & Co. Ltd., Kenogami, Que.
References: N. M. Campbell, A. B. Gates, N. D. Paine, W. L. Yack.

REGAN—FRANCIS EDWARD, of Montreal, Que., Born at Darwen, Lancs., England, Nov. 3rd, 1905; Educ., Higher National Diploma, Royal Salford Tech. Coll., 1926. 1st Class City and Guilds Final in elect'l. engrg., 1926; 1924-27, training in elect'l. engrg., Lancashire Dynamo & Motor Co., Manchester, England, and 1927, field engr. with same company; 1927, asst. lecturer, advanced E. E. Testing Lab., Royal Salford Tech. Coll.; 1928 to date, engr. for prov. of Quebec, Lancashire Dynamo & Motor Co. of Canada, Montreal.
References: J. A. Busfield, F. A. Combe, K. O. Whyte, J. A. Kearns, A. Wilson, H. F. Finnemore.

REID—ALEXANDER MacLAREN, of 9931-107th Street, Edmonton, Alta., Born at Glasserton, Whithorn, Wigtownshire, Scotland, Dec. 21st, 1895; Educ., Whithorn Higher Grade School (Matric. Standard). 3 years, private tuition and evening classes in tech. subjects; 1911-14 and 1919-21, served articles in County Road Surveyor's Office; 1914-19, Lieut., King's Own Scot. Borderers; 1921-27, asst. surveyor engr., civil engrg. dept., Anglo-Persian Oil Company, Masquid-i-Suleiman, Persian Gulf, South Persia; 1927 (June-Sept.), asst. on engrg. staff, E. G. M. Cape & Co., Montreal; Jan. 1928 to date, instr'man. on highway survey and constrn. work, main highways branch, Dept. Public Works, Alberta.
References: E. V. Collier, E. H. Harrison, J. W. S. Chappelle, J. M. Forbes, J. M. Anderson.

RUSSELL—JOHN ARTHUR, of 15 Catherine Street, Glace Bay, N.S., Born at Birmingham, England, Aug. 12tn, 1904; 1919-24, Birmingham Tech. School, passed all exams.; 1919-25, ap'tice to M. B. Wild & Co., Birmingham, drawing office and shop (fitting and machine) experience; 1925-29, with same company designing and detailing heavy colliery and coke oven mach'y. After end of 1926 assumed full responsibility for design, detailing, comparing of tenders and ordering materials, etc.; at present, on design and install'n. of mining mach'y., mech'l dept., Dominion Coal Company, Glace Bay, N.S.
References: W. C. Risley, H. C. Chipman, S. C. Mifflen, E. L. Martheleur.

STUART—KENNETH, D.S.O., M.C., Major, R.C.E., of Ottawa, Ont., Born at Three Rivers, Que., Sept. 9th, 1891; Educ., Diploma, R.M.C., 1911. 1913, Pass., Sch. of Military Engrg., Chatham, Eng. Passed two year course, Royal Staff College, Camberley, England, 1925-27; 1913-15, 1919-25, and 1927-29, employed on the normal engineer work of Corps; 1915-19, with Can. Engrs., France; at present, on General Staff, National Defence Headquarters, Ottawa, Ont.
References: A. G. L. McNaughton, E. J. C. Schmidlin, J. Houliston, F. R. Henshaw, A. C. Caldwell.

STUEWE—WILLIAM LAFAYETTE, of Sydney, N.S., Born at Helena, Montana, U.S.A., June 5th, 1888; Educ., E.M., Montana School of Mines, 1910; 1910-14, dfting., surveying and shop practice; 1914-17, designing engr. on cement plants, Hunt Engrg. Co.; 1918-19, War Service, U.S. Army, 1st Lieut. Engrs.; 1919, contracting on rld. work, Oregon; 1920-22, struct'l. engr. for Oregon, Washington and Idaho, for Minneapolis Steel & Mach. Co.; 1922-23, designing engr. on hydro-electric plants, Washington Water Power Co.; 1923-25, metal mining, private venture; 1925-26, designing engr., 1926-27, asst. mech. supt., 1927-29, ch. dftsman. and asst. mech. supt. in charge of constrn., Anaconda Copper Mining Co.; Nov. 1st, 1929 to date, mech. supt. of coal mines, for British Empire Steel Corporation.
References: R. L. Hay, S. C. Mifflen, W. C. Risley, E. L. Martheleur, J. A. Fraser, J. Kalbhenn.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

McCANNEL—DONALD ALEXANDER ROY, of Regina, Sask., Born at Burgoyne, Ont., May 10th, 1890; Educ., B.Sc. (Civil), Queen's Univ., 1914; 1911-17, rodman, instr'man., and asst. engr., city of Regina, 1917-29, city engr., and May 1929 to date, city commissioner, Regina, Sask.
References: L. A. Thornton, R. N. Blackburn, C. J. Mackenzie, H. S. Carpenter, J. R. C. Macredie, H. R. MacKenzie, M. B. Weekes.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

CRATCHLEY—REGINALD HENRY, of Hawkesbury, Ont., Born at Stroud, England, Nov. 1st, 1896; Educ., 3 years, Stroud Technical School; 1917-18, R.A.F. Sch. of Aeronautics for Officers; Complete Struct'l. Engrg. Course, I.C.S.; 1910-14, ap'ticeship in mech'l. engrg., G. Waller & Sons Phoenix Ironworks, Stroud; 1914-19, overseas, 2nd Lieut., R.A.F.; 1919-21, jig and tool designer, The Hampton Engrg. Co., Stroud, latterly responsible for plant mtce.; 1921-22, steam pumps design, Whitehead Torpedo Works, Weymouth, England; 1924-25, grain elevator work in design office and inspection staff during constrn., C. D. Howe & Co., Port Arthur, Ont.; 1925 to date, plant layout and design, constrn. dept., Canadian International Paper Co., Hawkesbury, Ont.
References: C. B. Shaw, S. Wang, H. P. Beaudoin, S. H. Wilson, L. S. Dixon, P. N. Libby.

INGS—JASPER HAROLD, of Ottawa, Ont., Born at Charlottetown, P.E.I., July 15th, 1902; Educ., B.A.Sc., Univ. of Toronto, 1925; Summer work: 1920, chainman, C.N.R.; 1921, asst. mechanic, Dominion Shipyards Ltd., Toronto; 1922, rodman, Frank Barber & Associates, Toronto; 1923, 24, 25, rodman and instr'man., Duke-Price Power Co., Isle Maligne, Que.; 1926 (Mar.-Dec.), res. engr. (rly.), Dec. 1926-June 1927, asst. engr. (hydro), Morrow & Beatty, Ltd.; 1927 (June-Sept.), engr., Spruce Falls Power & Paper Co., Kapuskasing; Sept. 1927 to date, engr., Gatineau Power Company, Ottawa, Ont.
References: H. A. Morrow, J. A. Beatty, G. B. Dodge, W. E. Blue, R. H. Reid, A. C. D. Blanchard, F. H. Cothran.

KNAPP—EDWARD WINSLOW, of Montreal, Que., Born at Sackville, N.B., Oct. 31st, 1894; Educ., B.Sc. (E.E.), McGill Univ., 1923; 1923-24, student test course, Can. Westinghouse Co., Hamilton, Ont.; 1924 (May-Oct.), with same company at LaGabelle, on elec. installn. of power plant; 1924-25, elec. demonstrator, Queen's Univ ; 1925 (Apr.-Oct.), power plant operation, St. Maurice Power Co., LaGabelle; 1925-26, with Shaw. Water & Power Co., at Shawinigan Falls, on gen. engrg. problems and dfting., and from Feb. 1926 to date, with same company at Montreal in operation dept.
References: C. V. Christie, E. Brown, F. S. Keith, P. Ackerman, J. A. McCrory.

VON ABO—CECIL VIVIAN, of Johannesburg, South Africa; Born at Kroonstad, Orange Free State, S.A., Oct. 10th, 1895; Educ., B.A., Univ. of Cape of Good Hope, 1913. M.A. (Pure Maths.), 1918. M.A. (App. Maths.), 1919, B.Sc. (Hons.), 1917, Univ. of Cape Town. Ph.D in Civil Engrg., 1922, McGill Univ.; 1923-25, lecturer in mech'l. engrg. and maths., Cape Technical College, Cape Town; 1925-27, asst. engr., chief civil engr's dept., South African Railways and Harbours, and with same concern to date as follows: 1927-28, research engr.; 1928-29, research engr. and asst. chief dftsman., and May 1929 to date, research engr. and district engr. (bridges.)
References: H. M. MacKay, E. Brown, R. DeL. French, G. J. Dodd, R. S. Eadie.

WATERHOUSE—GEORGE KERBY, of 1290 Bernard Ave. West, Outremont, Que., Born at Montreal, July 7th, 1897; Educ., B.Sc., Queen's Univ., 1919; 1916 (summer), shopwork, Can. Locomotives Co. Ltd.; 1917 (summer), No. 5 Field Co., Can. Engrs., road constrn.; 1919-20, instructor in steam and gas engrg., D.S.C.R., Kingston; 1920-21, mech'l. dftsman., Brompton Pulp & Paper Co. Ltd.; 1921-24, pulp mill supt., Can. Paperboard Co. Ltd., Frankford, Ont.; 1924-27, asst. engr., on design and process studies and specifications for new equipment, Howard Smith Paper Mills, Ltd.; 1927-28, engr. on constrn. for location of mach'y., and 1928-29, district purchasing agent and supt. of supplies for mill mtce. and alterations following constrn., Lake St. John Power & Paper Co. Ltd.; July 1929 to date, asst. purchasing agent, gen. purchasing dept., preparation of specifications and ordering of mech'l. and elect'l. equipment with special attention to all technical problems, Aluminum Co. of Canada Ltd., Montreal, Que.
References: T. S. Scott, H. G. Thompson, V. W. MacIsaac, J. C. Day, R. J. McClelland, J. G. G. Kerry.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BAIN—ARCHIBALD MARCUS, 4274 Dorchester St. West, Montreal, Born at Rounthwaite, Man., Nov. 15th, 1902; Educ., B.Sc., Univ. of Man., 1928. M.Sc., McGill Univ., 1929; D. L. S. Prelim. 1926; 1924 (5 mos.), recorder, Geod. Survey; 1925-26 (5 mos. ea.) asst. observer, Geod. Survey; 1927 (5 mos.), 1927-28 (5 mos. ea.), engr. in charge of party, highway location, Manitoba Good Roads Board; 1929 (1 mo.) demonstrator, geod. field school and practical astronomy, McGill Univ.; June 1929 to date, structural designer and estimator, Dominion Bridge Company, Montreal.
References: J. L. Rannie, N. H. Smith, G. H. Herriott, D. C. Tennant, H. M. MacKay, J. N. Finlayson.

BUZZELL—HENRY WALTER, of 1315 Linwood Blvd., Kansas City, Mo., Born at Abbotsford, Que., June 19th, 1901; Educ., B.Sc., McGill Univ. 1924; 1915-16, lab. asst., physics bldg., McGill Univ.; 1924-25, detailer and checker, Can. Bridge Co. Ltd., Walkerville, Ont.; 1926-27, checker, and 1927-28, asst. to res. engr. on bridge across Mississippi River at Cape Girardeau, Mo., for Harrington, Howard & Ash; 1928 (3 mos.), designer, for Ash-Howard-Needles & Tammer, Kansas City; 1928 to date, designer, for Harrington & Cortelyou, Consltg. Engrs., Kansas City, Mo.
References: H. T. Barnes, H. M. MacKay, R. DeL. French, G. F. Porter, J. L. Harrington.

COLLINS—GEORGE EDWARD, of Belmont, Man., Born at Clearwater, Man., June 3rd, 1902; Educ., B.Sc. (C.E.), Univ. of Man., 1928; Summer work: 1925, concrete inspr. on city pavement; 1926, asst. engr., pavements, etc.; 1927, bridge inspr., Man. Good Roads Board; April 1928 to date, res. engr., Man. Good Roads Board, Belmont, Man.
References: J. N. Finlayson, G. H. Herriot, B. A. Johnston, E. C. Cowan, R. J. McKenzie, N. M. Hall.

FINLAYSON—ARCHIE WALLACE, of Montreal, Que., Born at Montreal, May 29th, 1900; Educ., B.Sc., McGill Univ., 1924; 1924-25, dftsman., Power Engrg. Co., Montreal; 1925-26, field engr., Belmont Construction Co., Montreal; 1926 (Feb.-July), concrete and gen. bldg. design for mill extension, St. Maurice Valley Corpn., Shawinigan Falls, Que.; 1926-27, concrete and gen. mill designing, Lake St. John Power & Paper Co.; 1927-29, designing, estimating, etc. in connection with large hydro-electric power developments, Fraser Brace Engrg. Co. Ltd., Montreal; July 1929 to date, with Power Engrg. Co., Montreal, squad leader in charge of Falls Rivers Power Development, B.C., layout, detailing design, etc.
References: H. S. Grove, G. H. Kohl, J. B. D'Aeth, G. M. Wynn, J. H. S. Wurtele.

HOLDEN—JOHN HASTIE, of 530 Lansdowne Avenue, Westmount, Que., Born at Westmount, Que., May 20th, 1902; Educ., B.Sc., McGill Univ., 1923; 1922 (summer), dftsman., Shawinigan Engrg. Co. Ltd.; 1923-24, asst. to plant engr., Northern Electric Co. Ltd., Montreal; 1924 to date, asst. to head estimator and chief dftsman., Geo. W. Reed & Co. Ltd., Montreal.
References: W. G. Scott, C. K. McLeod, J. H. Hunter, J. S. Brisbane, C. M. McKergow, J. A. McCrory.

KATZ—MORRIS, of Ottawa, Ont., Born at Kiev, Russia, April 6th, 1901; Educ., B.Sc., 1926. M.Sc., 1927. Ph.D., 1929. McGill Univ.; 1918-19, and summers 1920, 22, 25, asst. chemist, Ogilvie Flour Mills Co.; 1926-29, demonstrator, chemistry dept., McGill Univ.; at present, chemist in charge of the sulphur dioxide determination project of National Research Council of Canada to determine damage due to smelter smoke from Trail, B.C. (Lab. at Northport, Wash.)
References: H. M. MacKay, C. M. McKergow, E. Brown, R. DeL. French.

KINGSTON—GEORGE HAROLD, of Arvida, Que., Born at Prescott, Ont., May 3rd, 1903; Educ., B.Sc. (E.E.), McGill Univ., 1927; Summer work: 1924, Grand River Rly.; 1925, H.E.P.C. of Ont., Queenston power house; 1926, Canadian Comstock Co., Three Rivers; 1927-28, student course, Montreal Light, Heat & Power Cons.; 1929, elect'l. designer on Island Falls P.H., for Fraser Brace Engrg. Co.; at present, elect'l. designer on Chute a Caron P.H., for Alcoa Power Co., Arvida, Que.
References: C. P. Dunn, J. H. Wilson, G. O. Vogan, J. A. Knight, R. M. Carmichael, J. B. D'Aeth.

MITCHELL—WALLACE MURRAY, of Sudbury, Ont., Born at Westmount, Que., Sept. 5th, 1902; Educ., B.Sc., McGill Univ., 1924; 1921, rodman, Mount Royal Cemetery Co.; 1924, carpenter shop work, Ottawa River Power Co.; 1925, rodman and quantity surveyor, constrn. of International Paper Co.'s mill at Three Rivers; 1923, res. engr., prov. county highway 105, Wentworth County, Ont.; 1926-27, cost engr., constrn. of Gatineau paper mill and associated bldgs.; 1927-28, quantity engr., constrn. of mill for International Fibre Board Ltd.; 1928, contractor's engr., constrn. of Frood Mine surface plant bldgs.; 1928 to date, contractor's engr., constrn. of smelter at Copper Cliff, Ont., for International Nickel Co. of Canada, for Fraser Brace Engineering Co. Ltd., Montreal.
References: J. H. Brace, C. E. Fraser, F. S. Keith, A. I. Cunningham, W. P. Murray, J. S. Brisbane, W. M. Ogilvie, W. S. Lea, H. A. Lumsden.

NICHOLL—HENRY ILTYD, of Regina, Sask., Born at Manitou, Man., Aug. 24th, 1895; Educ., B.Sc. (E.E.), Univ. of Man., 1928; 1927 (summer), electrician's helper, Winnipeg Electric Co.; 1928 to date, sales engr., Canadian Westinghouse Company for Province of Saskatchewan.
References: E. P. Fetherstonhaugh, R. N. Coke, E. I. W. Jardine, D. W. Houston, N. M. Hall.

OLEKSHY—MIKE DMYTRO, of 9344-103a Avenue, Edmonton, Alta., Born in Western Ukraine, Europe, Sept. 12th, 1902; Educ., To take one subject in April 1930 to obtain B.Sc. degree from Univ. of Alta.; 1921-22, Edmonton Normal School, 1st Class Teaching Cert.; 1927, rodman, and 1928 to date, instr'man., Alberta Main Highways, Edmonton, Alta.
References: J. W. S. Chapelle, R. S. L. Wilson, C. A. Robb, J. M. Anderson.

ORR—WILLIAM WINSTON, of Toronto, Ont., Born at Ottawa, Ont., June 26th, 1901; Educ., B.Sc., Queen's Univ. 1927; 1927, testing dept., 1928 to date, transformer design engr., Davenport Works, Can. Gen. Elec. Co., Toronto, Ont.
References: C. E. Sisson, A. L. Sutherland, W. M. Cruthers, L. M. Malcolm, D. S. Ellis.

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CONTENTS

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Water Power Resources of Canada

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In a programme designed to portray the development of Canada's natural resources special significance attaches to the utilization of the water powers of the Dominion, inasmuch as the low-cost energy derived therefrom is applied to and to a large extend renders possible the economic development of the other natural resources. Water power is the vital force behind the great and growing pulp and paper industry, the mining industry, electro-chemical and electro-metallurgical industries, and a multitude of others which are included in the extensive and rapidly expanding industrial life of the Dominion. Moreover, hydro-electric energy is utilized in Canadian homes to an extent unequalled in any other country, and its extension to rural areas is proceeding with marked rapidity in certain districts.

The resources which have made this development possible are ample in extent, are favourably distributed throughout the various provinces of the Dominion, and are fortunately located with respect to the principal industrial centres and the extensive mineral and forest resources. Development has proceeded from coast to coast on an orderly and well conceived basis with the object of providing an ever increasing flow of energy to meet the expanding needs of industry. Capital for this development has been readily secured on favourable terms and governmental control has been sympathetic and constructive. There is abundant evidence that the rate of growth in water power utilization witnessed in past years will not only be sustained but will be increased and the resources are ample to provide for such expansion for a considerable period of time.

Available and Developed Water Power

In a country of the extent of Canada and with great areas remote from ready means of communication a precise estimate of the water power resources is not possible. Nevertheless a systematic inventory has been under way for a number of years through the efforts of the Dominion Water Power and Reclamation Service of the Department of the Interior, in close co-operation with the various provincial organizations dealing with such matters. As a result, a fairly dependable estimate of the Dominion's resources has been made, which of course is subject to revision as more and more data are secured with respect to river flows and the physical features which govern the feasibility of water power concentrations.

In table No. 1 is given the most recent estimate of these resources. Figures for each province and for the Dominion, of available twenty-four hour power at developed and undeveloped sites, calculated at an efficiency of eighty per cent under conditions of ordinary minimum flow and ordinary six months flow are shown in columns 2 and 3 respectively. In column 4, figures of installation in horse power are given for each province and for the Dominion as at January 1st, 1930. These figures which were compiled in October 1929 anticipated the completion of a number of installations before the end of the year. Final figures compiled at the end of the year may therefore show the totals different in some respects. Columns 5 and 6 show figures of population and installed horse power per thousand of population respectively. For the Dominion it will be noted that the available power is estimated to total 20,347,000 h.p. under conditions of ordinary minimum flow or 33,617,000 h.p. for ordinary six months flow. On a commercial basis the available water power resources would probably warrant a total installation of about 43,700,000 h.p. The total installation of 5,710,802 h.p. therefore may be said to represent slightly more than thirteen per cent of the resources at present recorded. In installation per thousand of population column 6 indicates an average of 583 for the whole Dominion, a figure which places Canada in an outstanding position amongst world nations in the per capita utilization of water power.

Outline of Development 1900 to 1930

In table No. 2 are tabulated year by year the figures of installation at the end of each year from 1900 to 1929 for each province and for the Dominion as a whole.

Prior to 1900 water power was utilized to a comparatively small extent, the total for the end of that year being only 173,000 h.p. Developments up to 1895 were largely in connection with grist, saw, paper and other mills, the power being mechanically applied, although with the introduction of the electric generator in the late eighties,

Table No. 1—Available and Developed Water Power in Canada*

Province	Available 24-hour power 80 per cent efficiency		Turbine installation h.p.	Population June 1, 1929	Total installation per 1,000 population
	At ordinary minimum flow h.p.	At ordinary six months flow h.p.			
1	2	3	4	5	6
British Columbia	1,931,000	5,103,500	560,042	591,000	948
Alberta..........	390,000	1,049,500	70,532	646,000	109
Saskatchewan...	542,000	1,082,000	35	866,700	...
Manitoba........	3,309,000	5,344,500	311,925	663,200	470
Ontario..........	5,330,000	6,940,000	1,959,675	3,271,300	599
Quebec..........	8,459,000	13,064,000	2,572,418	2,690,400	956
New Brunswick..	68,600	169,100	112,131	419,300	267
Nova Scotia.....	20,800	128,300	108,406	550,400	197
Prince Edward Island........	3,000	5,300	2,439	86,100	28
Yukon and N.W. Territories....	294,000	731,000	13,199	12,400	1,063
	20,347,400	33,617,200	5,710,802	9,796,800	583

*The estimates of available power are based upon sites where the head is definitely known or well authenticated. They omit many falls, rapids or possible concentrations, regarding which information is not reasonably definite and reliable. The estimates may therefore be looked upon as representing the minimum power possibilities of the Dominion.

All estimates of available power represent continuous twenty-four hour power at an efficiency of generation of eighty per cent. The figures in column 2 are based on "Ordinary Minimum Flow" which is the average over all the years for which records are available, of the mean flow for the two lowest seven-day periods in each year. Six-month power in column 3 is based on the "Ordinary Six-month Flow" which is the average over all the years for which records are available, of the mean flow for the lowest seven consecutive days in the lowest of the six high months in each year.

The figures in column 4 represent the rated capacities of all water wheels and turbines installed throughout the Dominion. These figures should not be directly compared with the available power figures in columns 2 and 3. The actual water wheel and turbine installation throughout the Dominion averages about thirty per cent greater than the corresponding ordinary six-month figures calculated as in column 3. On this basis, therefore, the available water power resources of the Dominion as at present recorded would permit of a turbine installation of about 43,700,000 h.p. In other words, the present installation represents about thirteen per cent of the present recorded water power resources.

a few towns situated immediately adjacent to water falls secured electric power at generator voltage — as for instance, the city of Ottawa, where electric power was produced and sold about 1890. In 1895 the first high tension electric power transmission system in Canada and incidentally in the British Empire was completed. This was an 11,000-volt line carrying power from a 1,200-h.p. plant on the Batiscan river, Quebec, to the city of Three Rivers. Similar systems rapidly followed: Montreal received power from Lachine, Quebec city from Montmorency falls, Hamilton, Ont., from De Cew falls, Victoria B.C., from the Goldstream river, and Nelson, B. C., from the Kootenay river, all in the year 1898.

The introduction of high tension transmission thus accomplished, a decided stimulus was provided to the development of water power and the ten year period 1900-1910 witnessed a very substantial increase in installation, the total at the end of 1910 having reached a figure of 977,000 h.p. This was a net increase for the period of 803,848 h.p., more than a quarter of which, or 218,450 h.p., was installed in three hydro-electric developments at Niagara falls from whence power was first transmitted to Toronto in 1906. The Shawinigan Water and Power Company's development at Shawinigan falls was commenced in 1900 and in 1903 power therefrom was delivered to Montreal to supplement that from the earlier sources at Lachine and Chambly. Fort William, Ontario, received power from the Kakabeka falls plant of the Kaministikwia Power Company in 1906 and in the same year the Winnipeg Electric Railway Company brought hydro-electric power to Winnipeg from its plant on the Winnipeg river. Vancouver received its first supply of hydro-electric power in 1904 from the first Coquitlam-Buntzen plant of the Vancouver Power Company and the mining district in and around Rossland, B.C., was supplied by the West Kootenay Power and Light Company from the Kootenay river in 1906. Many installations were also made during the period by manufacturing organizations but of the total increase more than 70 per cent was accounted for by central electric stations, this predominance being consistently increased in subsequent periods.

The next decade 1910-1920 showed a sharp increase in development for the first four years, when more than 974,000 h.p. was installed but war and post war conditions greatly retarded growth so that during the last six years the increase amounted to only 564,000 h.p. This period is chiefly notable as marking the commencement of power delivery by the Hydro-Electric Power Commission of Ontario, which took place in October 1910 with the bringing into operation of a line extending from Niagara to Kitchener. The commission secured its first supply by purchase from plants at Niagara falls, but in 1914 commenced the production of power by building a small plant at Wasdells falls which was quickly followed by others, and in 1917 construction was begun on the great Chippawa-Queenstown project. The installations in the period 1910-1920 included substantial additions to existing stations at Niagara falls, Shawinigan falls and elsewhere, while several large new developments were made such as that at Cedars rapids on the St. Lawrence river controlled by the Montreal Light Heat and Power Consolidated, at Grand'Mere on the St. Maurice river by the Laurentide Power Company, at St. Timothee on the St. Lawrence river by the Canadian Light and Power Company, in the Lake St. John district in Quebec by Price Brothers, at Point du Bois on the Winnipeg river by the city of Winnipeg and on the Jordan River, B.C., by the Vancouver Island Power Company.

Following 1920 a period of intensive development commenced which has continued up to the present time. In the past nine years 3,200,000 h.p. has been installed, a figure which exceeds the total installation at the end of 1920 by almost 700,000 h.p. To instance only a few of the large new developments which went to make up this total may be mentioned the 502,000-h.p. Queenston plant of the Hydro-Electric Power Commission of Ontario, the 495,000-h.p. plant of the Duke-Price Power Company on the Saguenay river, the three Gatineau river plants of the Gatineau Power Company with installations totalling 436,000 h.p., the 120,000-h.p. plant of the Shawinigan Water and Power Company at La Gabelle on the St. Maurice, the Great Falls plant of the Manitoba Power Company on the Winnipeg river with 168,000 h.p., and two new plants of the West Kootenay Power and Light Company on the Kootenay river in British Columbia totalling 135,000 h.p. Much of the power developed during this period went to supply the needs of the rapidly expanding pulp and paper industry. Mining operations in Ontario, Quebec and British Columbia required increasingly large amounts of power, while the demands of general manufacturing industries, coupled with steadily growing commercial and domestic consumption accounted for large blocks of new power.

Current Progress and Estimated Future Growth

That the substantial growth of recent years in water power development will not only be maintained but will be increased is indicated by the number of large undertakings at present under construction and others in active prospect. The initial installations of new undertakings now under construction, together with additions to existing developments, amount to 550,000 h.p., and when these have been completed to their ultimate designed capacities the total installation for the Dominion will be increased by more than 2,500,000 h.p. Much activity is also in evidence in connection with the investigation of other large developments, a number of which will undoubtedly materialize in the near future.

With this programme in view it is safe to predict that the rate of growth of the past six years will be maintained, and a reference to table No. 2 and figure No. 1 indicates that this rate was about 420,000 h.p. per annum. Accordingly if the curve on figure No. 1 is projected at this rate it shows that in 1940 the total installation for the Dominion will probably have reached a figure of 10,300,000 h.p. This is considered to be a conservative estimate and there is reason to believe that it will be considerably exceeded.

Capital Invested in Water Power

The capital invested in water power development in Canada inclusive of transmission and distribution systems is estimated to be $1,250,000,000 or more than that for any single manufacturing industry. Applied to the existing installation, this corresponds to an average of $219 per installed horse power. In view of the steady earning power shown by the industry even in times of industrial depression, it would appear that the capitalization is reasonable and one which the industry is well able to carry.

Based on the estimate of future growth and the present investment per installed horse power it would appear that new funds to the extent of at least $92,000,000 per annum will be required to provide for new development during the next few years. The stability of Canadian water power investments is widely known, securities have been marketed under most favourable terms and new capital required for future expansion should be readily secured.

Coal Equivalent of Developed Water Power

The extensive utilization of water power in Canada has had a pronounced effect in reducing the consumption of coal, but it is very difficult to assign a precise figure for the coal equivalent of developed water power, since the matter is comparative only and assumptions must necessarily be made dependent upon the conditions under which the power is developed. However, taking into account all present conditions surrounding water power development in Canada and comparing them with somewhat similar conditions of fuel power development elsewhere, it is reasonable to state that a saving of coal of six tons per annum is capable of being effected by each installed horse power. This means that the total present water power installation of 5,710,800 h.p. is capable of effecting a saving of about 34,000,000 tons of coal per annum.

The actual saving in any year is dependent upon the output from the installation, and for the year 1929 an approximate estimate of the output expressed in electrical units has been made which indicates a figure of 20,500,000,000 kilowatt hours. The average coal consumption of all public utility electric power plants in the United States is now 1.76 pound per kilowatt hour. Applying this figure to the estimated figure of output would indicate a saving for the year 1929 of 18,000,000 tons of coal.

Utilization of Developed Water Power

The present turbine installation of 5,710,802 h.p. is classified in table No. 3 under the headings, central electric stations, pulp and paper mills and other industries. It is difficult to make a more detailed classification of the

Table No. 2—Canadian Water Power Development—Total Turbine Installation by Provinces at the End of Each Year Shown

In Horsepower

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
British Columbia	9,366	9,366	13,266	20,346	26,396	29,334	45,816	58,570	58,610	63,048	64,474	119,393	165,838	224,680	252,690
Alberta	280	280	280	355	355	355	355	355	655	655	655	14,855	15,035	32,835	33,110
Saskatchewan											30	30	30	30	30
Manitoba	1,000	1,000	1,000	1,000	1,000	1,000	38,800	38,800	38,800	38,800	38,800	64,800	64,800	64,800	78,850
Ontario	53,876	62,788	77,022	79,909	111,697	202,896	279,028	345,404	410,079	437,613	490,821	634,263	659,190	751,545	858,534
Quebec	82,864	139,149	152,783	164,258	179,468	183,799	205,211	242,582	269,814	305,556	334,763	468,977	513,635	551,871	664,139
New Brunswick	4,601	4,601	4,636	7,427	8,459	8,594	10,134	10,172	10,407	10,507	11,197	13,635	15,185	15,185	15,380
Nova Scotia	19,810	20,132	21,944	23,518	26,228	26,563	26,952	27,977	28,419	29,381	31,476	32,226	32,773	32,964	33,469
Prince Edward Island	1,521	1,581	1,641	1,641	1,641	1,663	1,701	1,701	1,701	1,734	1,760	1,760	1,785	1,825	1,843
Yukon	5	5	5	5	5	5	5	2,085	2,095	3,195	3,195	13,195	13,195	13,195	13,199
CANADA	173,323	238,902	272,577	298,459	355,249	454,209	608,002	727,646	820,580	890,489	977,171	1,363,134	1,481,466	1,688,930	1,951,244

	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
British Columbia	254,265	288,330	297,169	307,533	308,364	309,534	310,262	329,557	356,118	360,492	443,852	463,852	475,232	554,792	560,042
Alberta	33.110	33,110	33,122	33,122	33,122	33,122	33,122	33,122	33,122	34,532	34,532	34,532	34,532	34,532	70,532
Saskatchewan	30	30	30	35	35	35	35	35	35	35	35	35	35	35	35
Manitoba	78,850	78,850	78,850	85,325	85,325	85,325	99,125	134,025	162,025	162,025	183,925	227,925	255,925	311,925	311,925
Ontario	871,309	921,158	955,955	981,313	1,036,550	1,057,422	1,165,940	1,305,536	1,396,166	1,595,396	1,802,562	1,808,246	1,832,655	1,903,705	1,959,675
Quebec	803,786	836,394	856,769	905,303	936,903	955,090	1,050,338	1,099,404	1,135,481	1,312,550	1,749,975	1,886,042	2,069,518	2,387,118	2,572,418
New Brunswick	15,405	15,480	16,251	16,311	19,126	21,976	30,976	42,051	43,101	44,521	42,271	47,131	47,131	67,131	112,131
Nova Scotia	33,596	33,656	34,051	34,318	35,193	37,623	48,908	49,142	50,331	65,572	65,637	66,147	68,416	74,356	108,406
Prince Edward Island	1,942	1,962	1,989	2,198	2,233	2,233	2,252	2,274	2,274	2,274	2,274	2,274	2,274	2,439	2,439
Yukon	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199	13,199
CANADA	2,105,492	2,222,169	2,287,385	2,378,657	2,470,050	2,515,559	2,754,157	3,008,345	3,191,852	3,590,596	4,338,262	4,549,383	4,798,917	5,349,232	5 710,802

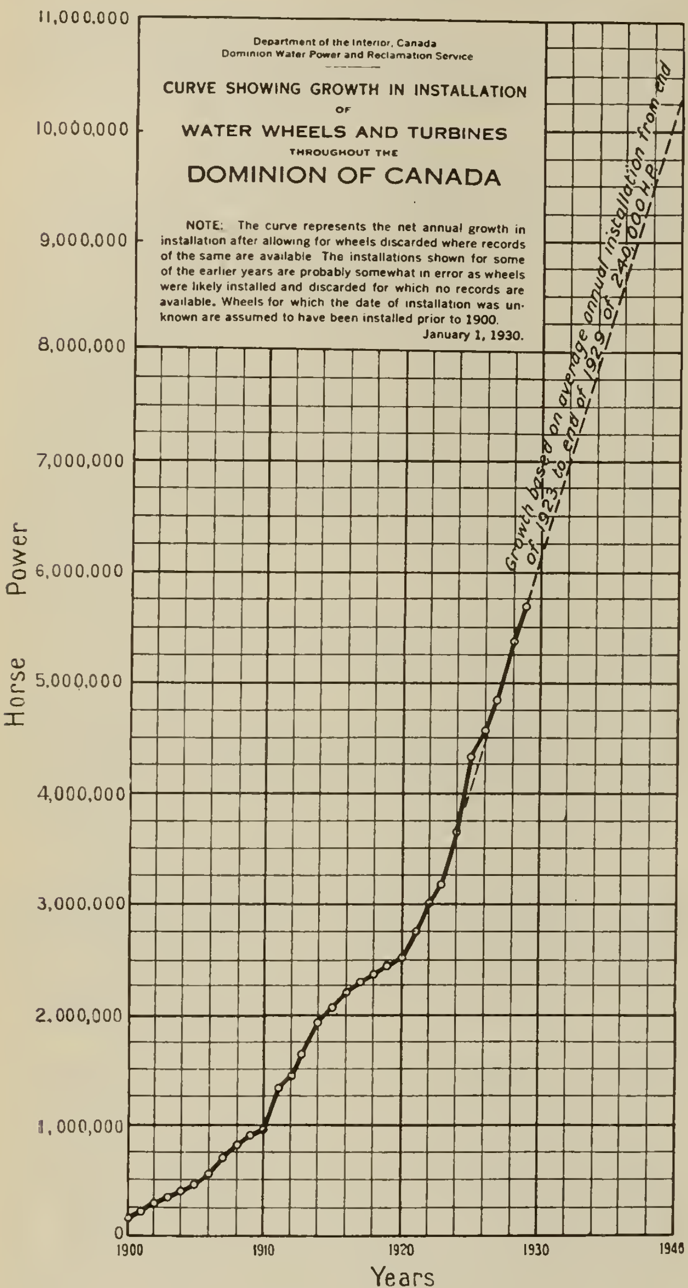

Figure No. 1.

ultimate use of power because of the large proportion in central electric stations from which power is sold for a multitude of uses.

The table shows that 4,802,263 h.p. or 84.1 per cent of the total is installed in central electric stations from which power is distributed for all purposes, 577,976 h.p. or 10.1 per cent is installed in pulp and paper mills, in addition to which these mills purchase some 860,000 h.p. of electrical energy from central electric stations, and 330,563 h.p. or 5.8 per cent is installed in other industries including mines, mineral reduction works, electro-chemical plants, saw, grist and textile mills, machine shops, municipal water supply stations and street railways; all of these industries also purchase power extensively from central electric stations.

Water Power in the Central Electric Station Industry

The central electric station industry has rapidly assumed an outstanding position in the social and economic life of the country and has had a very marked effect upon industrial conditions by the adaptability of electricity to utilization remote from its point of production. As already indicated the growth of hydro-electric central station installation, from 62,192 h.p. at the end of 1900 to the 4,802,263 h.p. estimated for the end of the present year, is largely due to this faculty of remote utilization, and the intensive research constantly being conducted to extend the radius of high tension transmission bids fair to keep pace with the development of our more accessible power sites by giving commercial value to those at present too distant for economic development.

As most of the larger central electric station installations have been actuated by the demand due to centres of population an outline of the sources of hydro-electric supply for the various cities of the Dominion may be of interest at this point. An analysis by provinces of the utilization of hydro-power in central stations is shown in table No. 4 and the same order will be followed in regard to the centres of population.

British Columbia

In British Columbia, the distribution of electricity in Vancouver and Victoria and the adjacent surburban areas is provided by the British Columbia Power Corporation Vancouver and district receive power from four plants, two on the North Arm of Burrard inlet deriving water from Lakes Coquitlam and Buntzen, and two on the Stave river, the first at Stave falls, 36 miles from Vancouver, and the second, 10 miles above Stave falls on the shore of Stave lake and operated by water drawn through a tunnel from Alouette lake whose natural flow was reversed by damming to provide the necessary power for the upper plant and to augment the power already in use at Stave falls. The Coquitlam-Buntzen plants are at the outlet of Buntzen lake whose flow is supplemented by water drawn by tunnel from Coquitlam lake reversed as in the case of Alouette lake by damming.

The Coquitlam-Buntzen plants operate under an average head of 395 feet and have an aggregate installation of 84,000 h.p. The Stave Falls plant operates under an average head of 113 feet and has an installation of 77,500 h.p. while the Alouette station which is automatically controlled from Stave Falls has an average head of 125 feet and an installation of 12,500 h.p. The extensive transmission system serving Vancouver and district is shown on figure No. 2.

The growing power demands of this district already necessitate further development and the British Columbia Power Corporation is now engaged upon two extensive installations. The first is situated at Ruskin near the mouth of the Stave river where the initial installation of 42,500 h.p. is expected to be in operation during the autumn of 1930. The ultimate designed capacity of the plant is 170,000 h.p. The second project is on the Bridge river, where by a series of dams the water is to be diverted through a tunnel 13,200 feet in length and thence through penstocks to a power house on Seton lake where under a head of some 1,300 feet 80,000 h.p. is expected to be in operation by 1932. Further stages of this development involve the construction of additional storage dams, and the enlargement of tunnel and power house capacities until an ultimate installation of 550,000 h.p., to 700,000 h.p. is reached.

Power for Victoria and district is generated in three stations, one on Goldstream river, 12 miles from Victoria, where under an average head of 670 feet, 3,400 h.p. is installed, and two at the mouth of the Jordan river, 36 miles from Victoria, where under an average head of 1,145 feet 25,000 h.p. is installed in one plant and 2,000 h.p. in a second recently completed automatically controlled plant drawing water from the same diversion dam. Figure No. 3, illustrates the transmission systems serving the Victoria area.

TABLE NO. 3—DEVELOPED WATER POWER IN CANADA—DISTRIBUTION BY INDUSTRIES

Estimated at January 1, 1930

Province	Turbine Installation in Horse Power			
	In Central Electric Stations	In Pulp and Paper Mills	In other Industries	Total
1	2	3	4	5
British Columbia	418,210	81,000	60,832	560,042
Alberta	70,320	....	212	70,532
Saskatchewan	....	....	35	35
Manitoba	311,925	....	....	311,925
Ontario	1,624,393	240,880	94,402	1,959,675
Quebec	2,216,150	220,810	135,458	2,572,418
New Brunswick	83,910	19,278	8,943	112,131
Nova Scotia	76,979	16,008	15,419	108,406
Prince Edward Island	376	....	2,063	2,439
Yukon and Northwest Territories	....	....	13,199	13,199
Canada	4,802,263	577,976	330,563	5,710,802

Column 2 includes only hydro-electric stations which develop power for sale.
" 3 includes only water power *actually developed* by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro power central electric stations totalled in column 2 approximately 860,000 h.p. A considerable amount of off-peak power is also purchased for use in electric boilers.
" 4 includes only water power *actually developed* in connection with industries other than the central electric station and pulp and paper industries. These industries also purchase power from the central electric stations totalled in column 2.
" 5 totals all turbines and water wheels installed in Canada.

Power for the Nelson and Southern boundary districts is at present supplied from four plants on the Kootenay river a few miles west of the city of Nelson. One of these, distributing power in Nelson and its environs and owned by the municipality of Nelson, is at Upper Bonnington falls and has an installation of 6,570 h.p. operating under a head of 60 feet. The West Kootenay Power and Light Company operates three plants, Upper Bonnington falls, Lower Bonnington falls and South Slocan. The first mentioned has an installation of 3,400 h.p. operating under a head of 70 feet; the second, replacing a former plant of 4,016 h.p. which was dismantled in 1925, has an installation of 60,000 h.p. and the third, completed in the fall of 1928, an installation of 75,000 h.p. under a head of 70 feet. This company now proposes to install an 80,000 h.p. plant on the Pend d'Oreille river and is considering a fifth development, one of 20,000 h.p. to 40,000 h.p. on the Adams river. The extensive transmission system operated by this company extends from Nelson on the east to Princeton on the west, south to the international boundary and north to Kelowna on Okanagan lake and is shown on figure No. 4.

The Fernie and Eastern boundary district receives power from two plants operated by the East Kootenay Power Company, one on the Bull river near Aberfeldie

TABLE NO. 4.—DEVELOPED WATER POWER IN CANADA—UTILIZED IN THE CENTRAL ELECTRIC STATION INDUSTRY

Estimated at January 1, 1930

Province	Commercial Stations					Municipal Stations				
	No. of Stations	No. of Turbines	Total Turbine Installation h.p.	Average h.p. per Station	Average h.p. per Turbine	No. of Stations	No. of Turbines	Total Turbine Installation h.p.	Average h.p. per Station	Average h.p. per Turbine
1	2	3	4	5	6	7	8	9	10	11
British Columbia	22	50	408,115	18,551	8,162	8	11	10,095	1,262	918
Alberta	6	19	69,360	11,560	3,651	1	2	960	960	480
Saskatchewan	...	...	......	.....	.....	...	...	......	.....	.....
Manitoba	3	17	206,800	68,933	12,165	2	17	105,125	52,562	6,184
Ontario	69	202	552,358	8,005	2,734	48	140	1,072,035	22,334	7,657
Quebec	90	256	2,189,490	24,328	8,553	14	23	26,660	1,904	1,159
New Brunswick	3	9	71,850	23,950	7,983	3	6	12,060	4,020	2,010
Nova Scotia	13	17	10,166	782	598	21	36	66,813	3,182	1,856
Prince Edward Island	5	6	376	75	63	...	...	......	.....	.....
Yukon and Northwest Territories	...	...	......	.....	.....	...	...	......	.....	.....
Canada	211	576	3,508,515	16,628	6,091	97	235	1,293,748	13,337	5,505

Commercial stations include all privately owned.
Municipal stations include all publicly owned.

NOTE.—Statistics in this table are based upon a census of the industry made by the Dominion Bureau of Statistics in co-operation with the Dominion Water Power and Reclamation Service. In addition to the central electric station organizations included above certain industrial hydraulic plants sell small amounts of electricity, i.e., the sale of electricity is only incidental to their main industries.

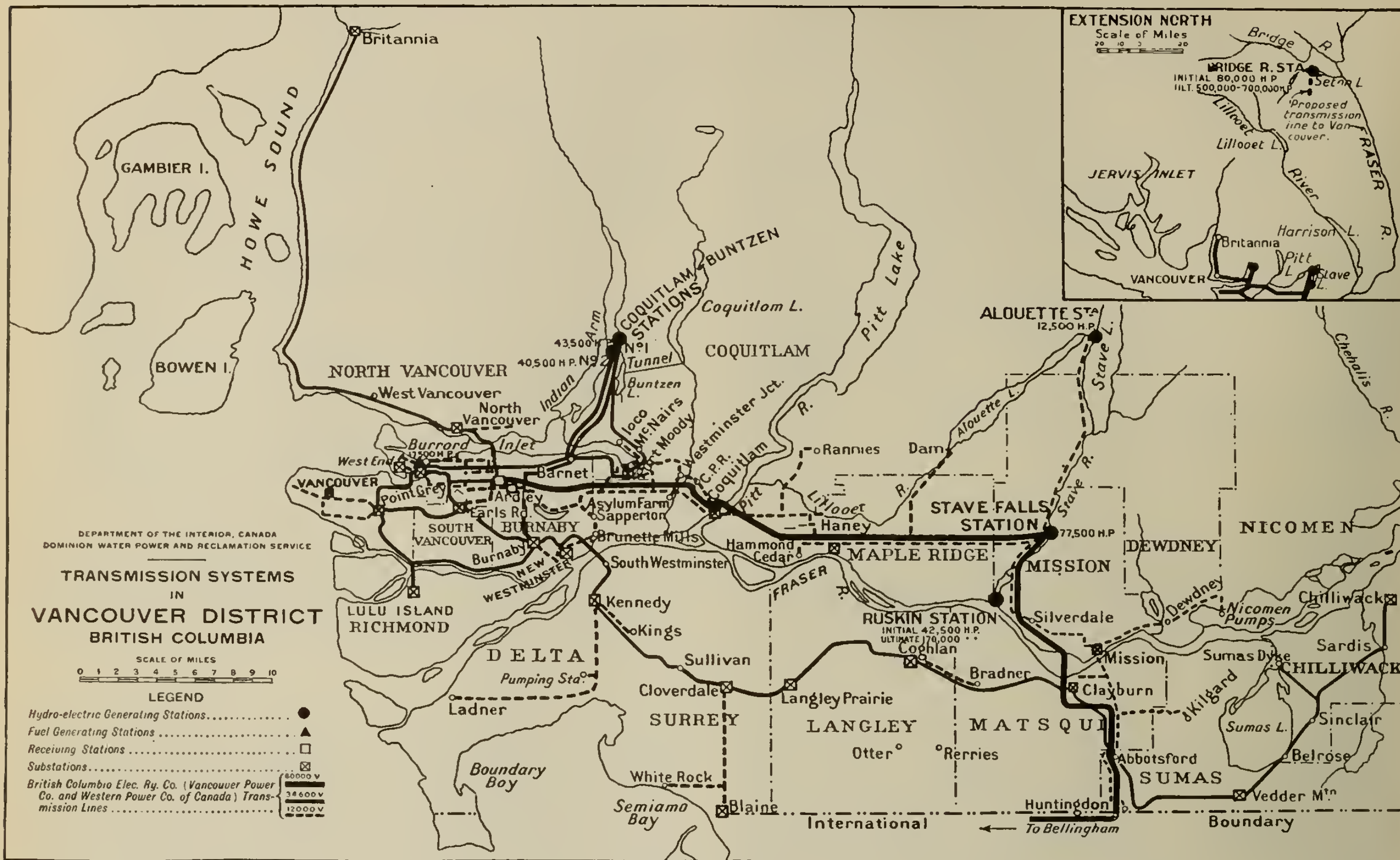

Figure No. 2.

where 7,200 h.p. is operated under an average head of 275 feet and one at Elko on the Elk river where 15,000 h.p. is installed and operated under an 85-foot head. The company operates a one hundred and thirty mile transmission system, (shown on figure No. 5), connecting its two hydraulic plants with its fuel auxiliary plant on the Alberta-British Columbia boundary and extending from Kimberley, British Columbia, through the Crow's Nest pass to Bellevue, Alberta, and is now investigating the possibilities of a further development of 15,000 h.p. on the Elk river at Phillips canyon.

In addition to the outstanding central electric stations described there are many smaller hydraulic developments operated by municipalities or private companies to supply electricity for public use.

Alberta

The City of Calgary and most of the western portion of the province of Alberta from Edmonton south to the international boundary receives power from three developments on the Bow river owned by the Calgary Power Company. The first of these, Kananaskis falls, has an installation of 11,600 h.p. operating under a head of 72 feet, Horseshoe falls, two miles east, an installation of 20,000 h.p. under a head of 71 feet and a recently completed station at Ghost falls where 36,000 h.p. has been installed. The company also controls the 780-h.p. development formerly operated by the Calgary Water Power Company in Calgary. The transmission systems in southern Alberta are shown on figure No. 6.

Manitoba

Winnipeg and environs, and the transmission system of the Manitoba Power Commission which covers the district from Winnipeg westerly to Boissevain and southerly to the international boundary, receive power from three plants on the Winnipeg river which include 310,800 h.p. or 99.6 per cent of the total water power installation of the province. The municipality of Winnipeg operates a plant at Point du Bois 77 miles northeast of the city where 105,000 h.p. is installed under a head of 46 feet and has recently commenced a new development at Slave falls on the same river of an ultimate designed capacity of 100,000 h.p. The Winnipeg Electric Company and a subsidiary, the Manitoba Power Company, have plants of 37,800 h.p. and 168,000 h.p. respectively, the first at Pinawa and the latter at Great falls. Another subsidiary of the Winnipeg Electric Company, the Northwestern Power Company, is now engaged on a 225,000-h.p. development at Seven Sisters falls which will necessitate the abandonment of the Pinawa development, the water being rediverted from the side channel at present in use to the main stream. Figure No. 7 shows the transmission system in southern Manitoba.

Ontario

The Hydro-Electric Power Commission of Ontario, the largest single distributor of hydro-electricity in the Dominion, serves the greater part of the populous portion of the province through eight systems. The largest of these, the Niagara system, embraces the thickly populated south western peninsula extending from Toronto to Windsor and is supplied with power from three developments at Niagara falls, supplemented by power purchased from the Gatineau Power Company in Quebec province. The three Niagara plants include the Queenston station constructed by the commission, and the Ontario Power Company and Toronto Power Company stations, both of which were acquired by purchase. The Queenston station has an installation of 502,000 h.p. which is now being enlarged to

560,000 h.p. and operates under a head of 305 feet. The Ontario Power Company station has an installation of 208,200 h.p. operating under an average head of 180 feet and the Toronto Power Company station has 164,500 h.p. under a head of 130 feet. In addition to these the contract with the Gatineau Power Company provides for a further supply of 260,000 h.p. of which 150,000 h.p. was being taken in October 1929, the contract calling for the delivery of the full amount in 1931. This power is carried over a 220,000-volt transmission line 230 miles in length extending from Paugan falls, Quebec, to Toronto.

The Georgian bay system embraces the territory adjacent to Lake Huron and Georgian bay extending from Kincardine on the west to Huntsville in the Muskoka district on the east, and including such centres as Owen Sound, Collingwood, Midland and Barrie. Power is supplied from six plants on the Muskoka, Severn and Beaver rivers having a total installed capacity of 25,050 h.p. Additional power is purchased from the town of Orillia and the system is interconnected with the Niagara system so that power may be interchanged as required.

The Nipissing system which includes the city of North Bay and adjacent municipalities is supplied from three plants on the South river with installations totalling 5,700 h.p.

The Central Ontario system embraces territory extending from Whitby on the west to Kingston on the east and northerly to Lindsay including other large centres such as Oshawa, Cobourg, Trenton, Belleville and Peterborough. Power is supplied from nine plants of the commission along the Trent waterway with installations totalling 57,980 h.p. and additional power is purchased from the town of Campbellford, and other organizations in the district.

The St. Lawrence system includes the territory bordering the St. Lawrence river from Brockville on the west to Lancaster on the east, thirteen municipalities being served. Power for the supply of this system is purchased from the Cedars Rapids Transmission Company and the Gatineau Power Company.

The Rideau system embraces a territory in Eastern Ontario chiefly in the county of Lanark. Five municipalities are served, the larger centres being Smiths Falls, Carleton Place and Perth. Power is generated in two plants on the Mississippi river totalling 4,449 h.p. and additional power is purchased from the Gatineau Power Company and the Rideau Power Company.

The Ottawa system, which includes the city of Ottawa and adjacent rural areas, is supplied with power purchased from the Gatineau Power Company. The commission also

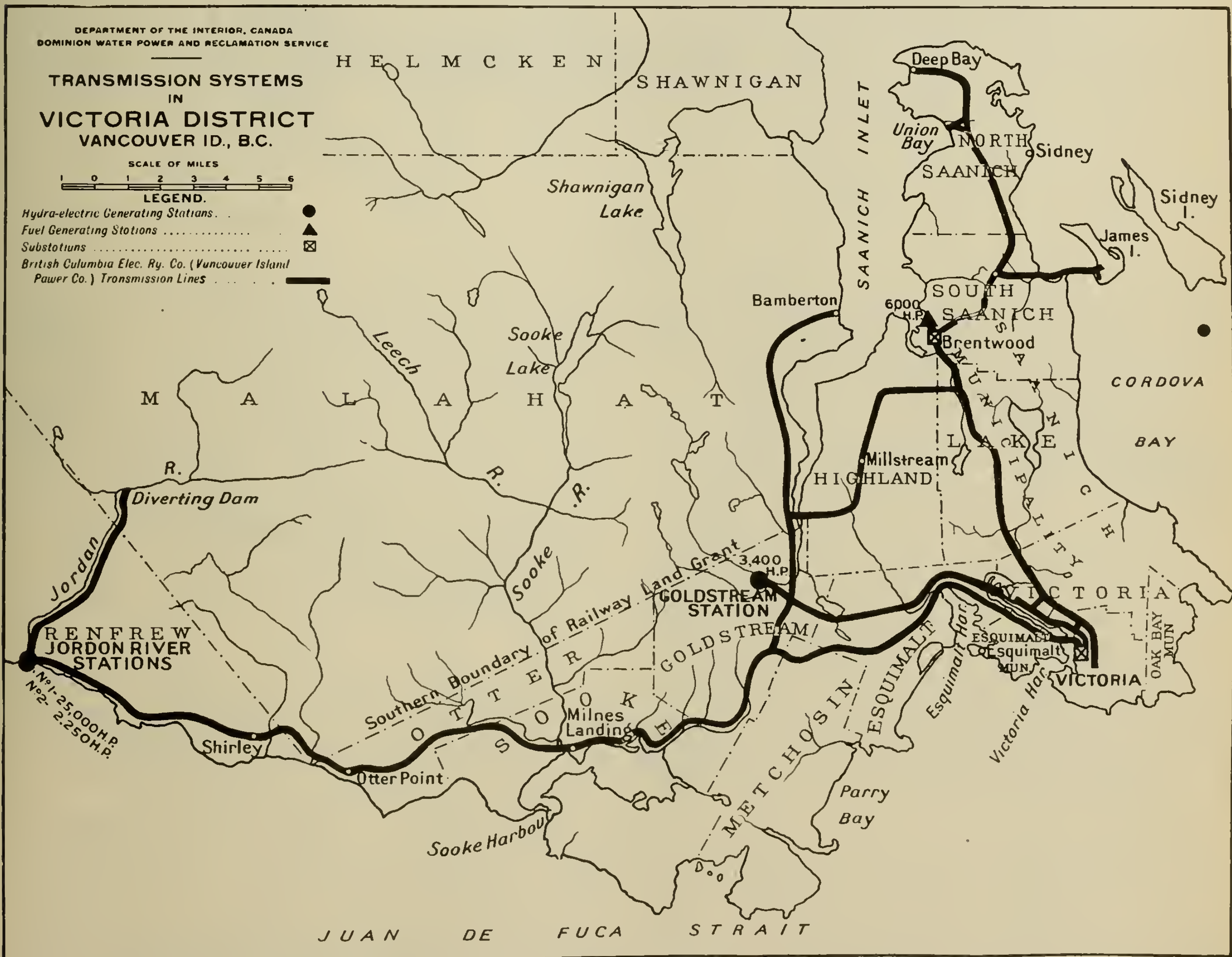

Figure No. 3.

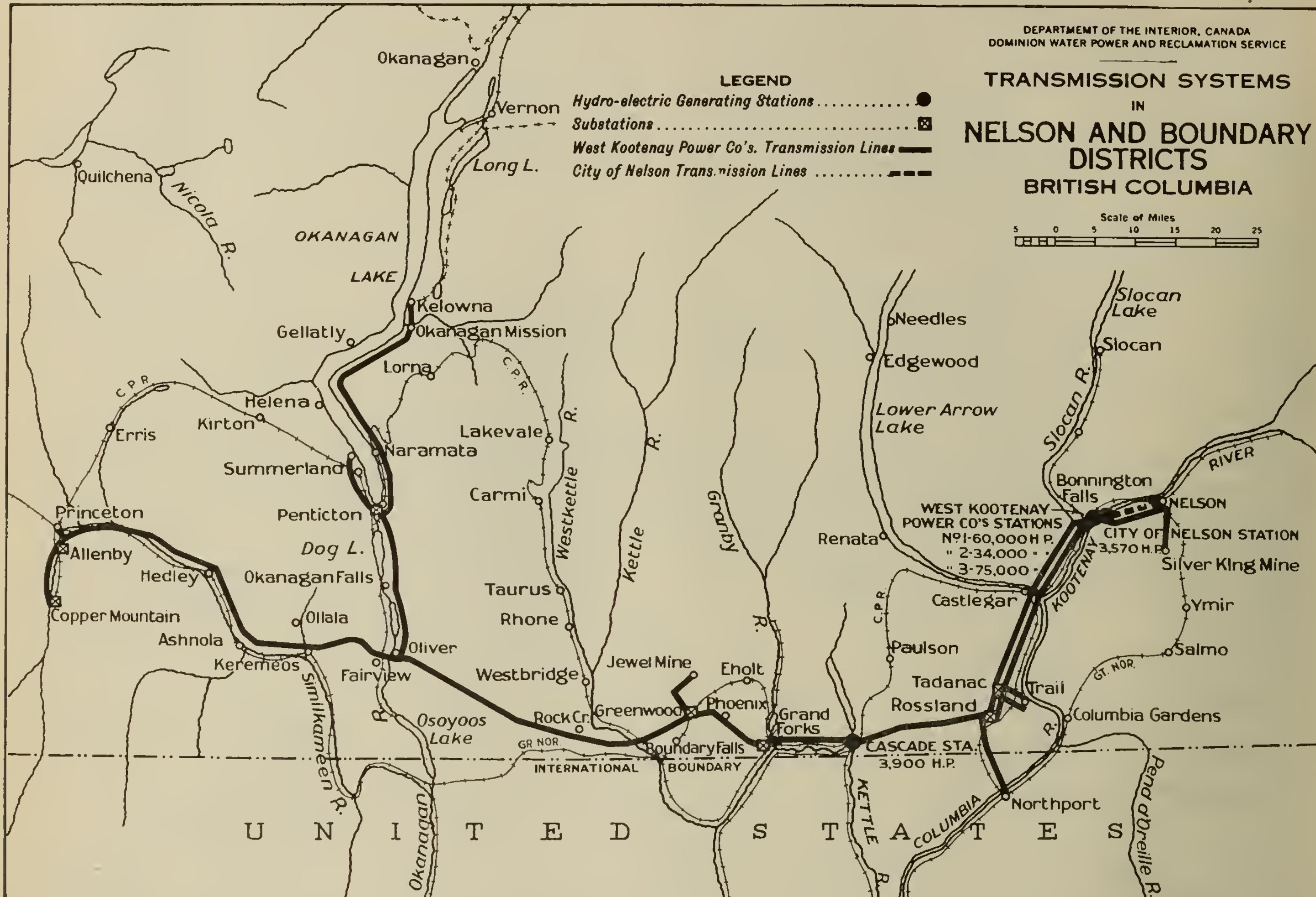

Figure No. 4.

acquired by purchase during 1929 the properties of the Calabogie Light and Power Company and the Galetta Power and Milling Company including two hydro-electric stations totalling 7,400 h.p. which serve Renfrew, Arnprior and other municipalities in the Ottawa river valley.

The Thunder Bay system includes the cities of Port Arthur and Fort William, power being supplied from the commission's 75,000-h.p. development at Cameron falls on the Nipigon river. A second plant of 54,000 h.p. is at present under construction at Alexander Landing on the same river.

Apart from the operations of the Hydro-Electric Power Commission, private power organizations provide service in certain districts. Hamilton, St. Catharines, Brantford and environs, in addition to receiving power from the commission's Niagara system, are supplied by the Dominion Power and Transmission Company from a 45,000-h.p. plant at De Cew falls on the old Welland canal. Ottawa is also served with power from plants of the Ottawa Electric Company. Sault Ste. Marie is supplied by the Great Lakes Power Company which operates a 28,000-h.p. plant on the St. Mary river and purchases power from the Algoma District Power Company's 11,000-h.p. plant on the Michipicoten river.

The heavy power demands of the gold and silver mining areas of northern Ontario are met from seven stations in Ontario with an aggregate installation of 53,340 h.p. and one in Quebec of 40,000 h.p., all controlled by the Canada Northern Power Corporation. The corporation has also commenced the construction of a new 13,000-h.p. plant on the Montreal river. The Sudbury mining area is served by the International Nickel Company of Canada which operates through subsidiary companies five plants on the Vermilion and Spanish rivers with installations totalling 62,500 h.p., while a further supply is secured from the Wahnapitae Power Company, (recently purchased by the Hydro-Electric Power Commission of Ontario), with three plants totalling 16,900 h.p. In the extreme western part of Ontario the town of Kenora is supplied with power by the Keewatin Power Company which operates two stations at the outlets of the Lake of the Woods where 30,875 h.p. is installed for public distribution and for supplying the mills of its parent company, Kenora Paper Mills, Limited.

The extensive transmission systems in the province of Ontario are shown on figure No. 8.

Quebec

The province of Quebec, in which 99 per cent of the total hydro-electric central station installation is owned by joint stock companies, has five major organizations which distribute over 90 per cent of the power sold in the province. The transmission systems of these four companies are interconnected for the exchange of power.

The city and district of Montreal is served by Montreal Light, Heat and Power Consolidated, which operates three plants on the St. Lawrence and one on the Richelieu river and purchases large amounts of power from the Shawinigan Water and Power Company. The company's largest plant, at Cedars rapids on the St. Lawrence river, operates under an average head of 30 feet and has an installation of 197,400 h.p. The other two plants on the St. Lawrence, the Soulanges and Lachine stations have installations of 16,050 h.p. under a 52-foot head and 15,800 h.p. under a 14-foot head respectively. The Richelieu river station at Chambly has an installation of 21,600 h.p. under a head of 31 feet. An additional supply of power for this system will be provided by the completion of the Montreal Island Power Company's 120,000 h.p. development on the Riviere des Prairies, Montreal Light, Heat and Power Consolidated having contracted to purchase the entire output of the plant.

The district south of Montreal to the international boundary, which in recent years has been rapidly changing from an agricultural to an industrial area, is served by the Southern Canada Power Company. This company operates two stations on the St. Francois river, one in Drummondville where 19,500 h.p. is operated under an average head of 30 feet and one two miles further upstream, at Hemmings falls where 33,600 h.p. is operated under a 50-foot head. A third plant is situated on the Magog river in the city of Sherbrooke where 4,050 h.p. operates under a head of 57 feet while two smaller stations, one of 1,130 h.p. on the Yamaska river in Farnham and one of 300 h.p. at the outlet of Brome lake, are also operated by this company. The districts along the north shore of the St. Lawrence from Montreal to Murray Bay, east of Quebec city and between the St. Lawrence and the international and New Brunswick boundaries are covered by an extensive transmission system owned by the Shawinigan Water and Power Company and subsidiaries and supplied with power from sixteen stations with an aggregate installation of 647,850 h.p. Four of these stations are on the St. Maurice river, two at Shawinigan falls, drawing water from the same headworks, of 58,500 h.p. and 221,500 h.p. respectively, one at Grand'Mere formerly owned by the Laurentide Company where 176,000 h.p. is installed, and one of 120,000 h.p. at La Gabelle. A fifth power house is situated on the Batiscan river near St. Narcisse. The present installation of 22,400 h.p. succeeds an earlier development of 1,600 h.p., from which power was transmitted to Three Rivers in 1898 over the first high tension transmission line in the British Empire. Further east on the Ste. Anne river near St. Alban a 4,000-h.p. plant is operated under a head of 65 feet. Close to Quebec city four power houses are operated, two on the Montmorency river with installations of 2,000 and 5,000 h.p. respectively, one on the Jacques Cartier of 3,000 h.p., and one on the Chaudière where 4,800 h.p. is installed. Thirty-five miles east of Quebec city near St. Fereol on the Ste. Anne river a 24,000-h.p. plant acquired from the Laurentide Power Company is operated, while opposite on the south shore, two plants of 4,500 h.p. and 400 h.p. respectively, acquired from La Corporation d'Energie de Montmagny, supply local demands and are also connected to the main transmission system. Some other smaller stations are also operated, all being connected to the main transmission system which includes a 135 mile 168,000-volt line from Quebec city to the Duke-Price Power Company's great station at Isle Maligne on the Saguenay.

The rapidly expanding power demands of the Lake St. John area are supplied by the Duke-Price Power Company which operates a 495,000-h.p. installation on the Grand Discharge from Lake St. John at Isle Maligne, and

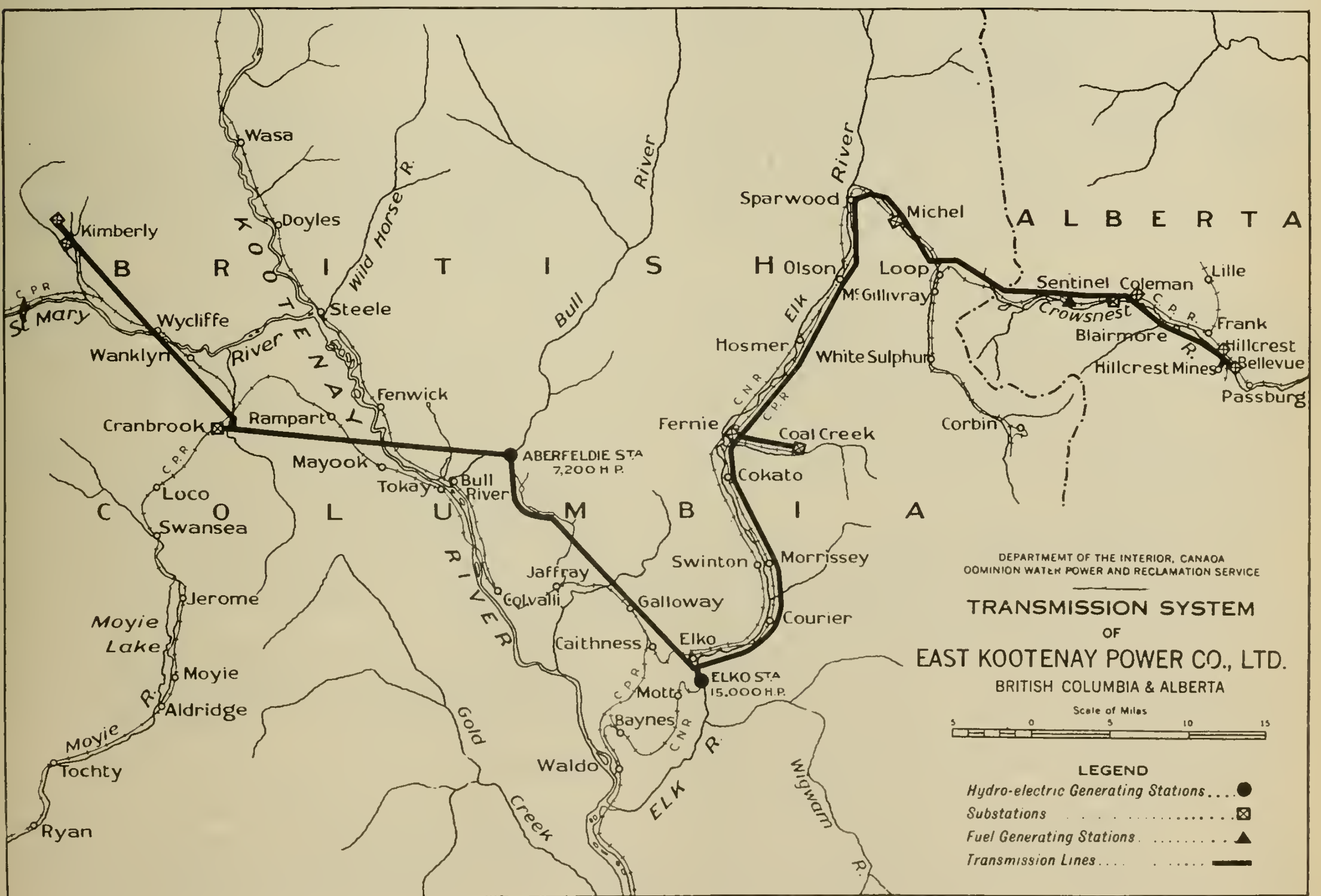

Figure No. 5.

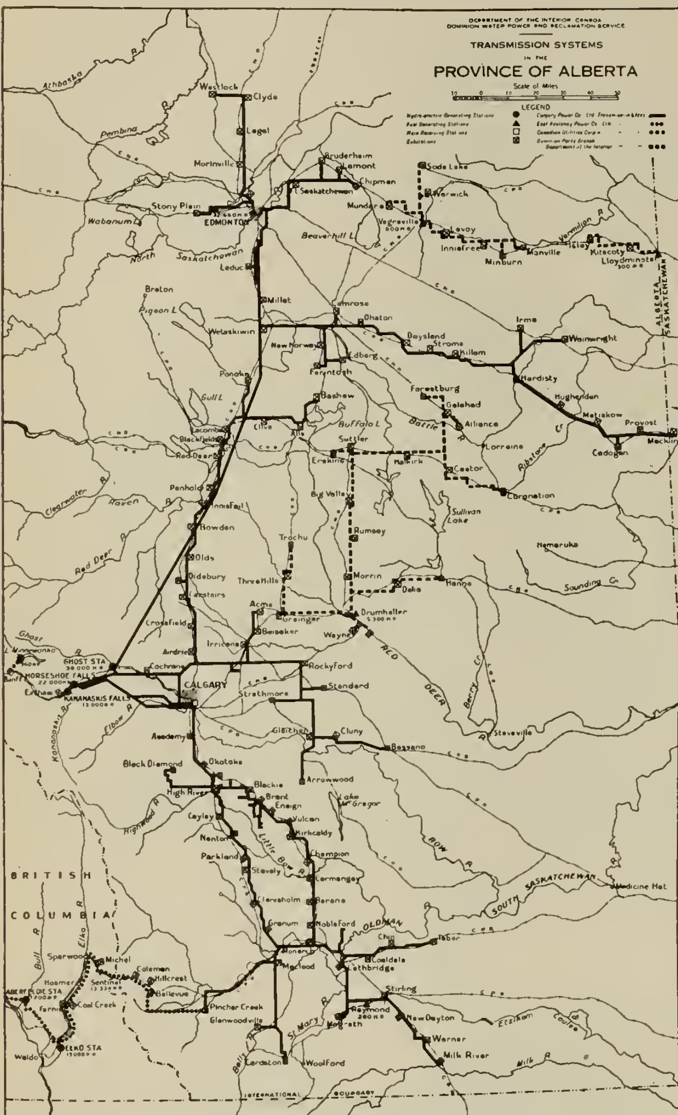

Figure No. 6.

by power generated in connection with its pulp and paper mills by Price Brothers and Company which operates five plants with an aggregate installation of 70,100 h.p. on the Au Sable, Shipshaw and Chicoutimi rivers. The Aluminum Company of Canada, at present buying power for its works at Arvida from the Duke-Price Power Company in which it has a substantial interest, has under construction an 800,000-h.p. development at Chute-à-Caron on the Saguenay river.

The newest entrant into the central station industry of Quebec, the Gatineau Power Company, already has an installation of 567,565 h.p. in twenty stations on the Gatineau and Ottawa rivers and tributary streams. The largest of these, built by the company, are the Paugan, Chelsea and Farmers stations on the Gatineau where 204,000 h.p., 136,000 h.p. and 96,000 h.p. respectively are installed. This company sells power to the Hydro-Electric Power Commission of Ontario, having completed a contract for the sale of 260,000 h.p. over a period of 30 years, delivery being made at 220,000 volts by a line from Paugan station connecting with the Commission's 220,000-volt line to Toronto at the Ontario-Quebec boundary opposite Quyon, Quebec. Power is also sold for the commission's Rideau, St. Lawrence and Central Ontario systems, delivery being made at Remic rapids on the Ontario-Quebec boundary. The mills of the Canadian International Paper Company at Kipawa, Gatineau and Hawkesbury, together with the distribution system of the Gatineau Electric Light Company, which retails power along the north shore of the Ottawa between Hull and Montreal and on the south shore from Alfred to Montreal, utilize the remainder of the power produced. The extensive transmission systems in the province of Quebec are shown on figure No. 9.

There are many other smaller central electric stations in Quebec each providing ample and efficient service in its particular field but space precludes mention of more than the five outstanding organizations referred to above.

New Brunswick

The city and district of Saint John, New Brunswick, and the area between Saint John and Shediac is served by the New Brunswick Electric Power Commission which operates a 11,100-h.p. station at the mouth of the Musquash river, the commission also purchasing power for distribution in Newcastle and Douglastown from the 14,000-h.p. plant of the Bathurst Company on the Nipisiguit river. In the western portion of the province along the Maine boundary the Maine and New Brunswick Electrical Power Company, (controlled by the Central Public Service Company of Chicago), operates a plant of 11,400 h.p. on the Aroostook river, while at Grand falls on the St. John river the St. John River Power Company, under the same control as the Gatineau Power Company, has installed 60,000 h.p. of an ultimate installation of 80,000 h.p., the power being sold for the operation of the newsprint mills of the Fraser Companies, Limited, and the New Brunswick International Paper Company, a stated portion being reserved for distribution by the New Brunswick Electric Power Commission and in the province of Quebec and the state of Maine.

Nova Scotia

In Halifax, Nova Scotia, the distribution of power is made by the Nova Scotia Light and Power Company from plants operated as the St. Margarets Bay system of the Nova Scotia Power Commission. This system comprises three plants on the Northeast and Indian rivers with an aggregate installation of 15,820 h.p. The commission also operates four other systems, the Mushamush system serving Riverport, Lunenburg, Mahone Bay and environs from an 1,155 h.p. plant on the Mushamush river; the Sheet Harbour system with two plants on the East River Sheet Harbour with an aggregate installation of 11,849 h.p., power from one of these stations, Malay falls, being sold in bulk to the Pictou County Power Board for distribution at various points in Pictou county; the Mersey river system comprising three plants totalling 31,050 h.p. on the Mersey constructed during 1929 for the supply of power to a newly constructed paper mill of the Mersey Paper Company near Liverpool and a fourth acquired by purchase from the town of Liverpool; and finally the Tusket system, comprising one plant of 3,000 h.p. on the Tusket river constructed in 1929 to supply the Western Nova Scotia Electric Company and Cosmos Imperial Mills Limited, both of Yarmouth.

In addition to the stations already described there are many smaller organizations serving local needs, the locations of generating stations and transmission systems in the Maritime provinces being shown on figure No. 10.

Water Power in the Pulp and Paper Industry

It has already been shown that in the utilization of developed water power, the pulp and paper industry affords a large market. An installation of 578,000 h.p. is directly maintained by the industry, about 860,000 h.p. is purchased from central electric stations, while considerable off-peak and surplus energy is also utilized to produce steam in electric boilers. As the production of newsprint requires an installation of approximately 100 h.p. per ton of daily output, it is apparent that the cost of power is a most important element in the economics of the industry and in this respect Canada is most fortunate in having large sources of low-cost hydro-electric energy in close proximity to her ample forest resources. As a result of these circumstances the output of newsprint in Canada for the past few years has exceeded that of any other country.

More than 90 per cent of the motive energy in the industry is derived from water power, and table No. 5 analyzes the water power installations in the various provinces and the Dominion devoted to this purpose. The figures in column 6 are of particular interest as showing the extent to which the electric drive has been adopted in the industry.

The sources of hydro-power for the principal mills of the country are briefly indicated in the following paragraphs.

British Columbia

There are seven pulp and paper mills in British Columbia using hydro-power, two of which operate with purchased power while the others have their own installations. The Powell River Company has a total turbine installation of 49,860 h.p. of which 35,460 h.p. is connected to electric generators, the remainder being used directly to drive mill machinery. The Pacific Mills, Limited, situated on the Link river at Ocean Falls, has a turbine capacity of 26,850 h.p. of which 17,250 h.p. is connected to electric generators. The British Columbia Pulp and Paper Company has pulp mills at Port Alice, Woodfibre and Swanson Bay and installations totalling 4,290 h.p., while the Sydney Roofing and Paper Company at Victoria and the Westminster Paper Company at New Westminster operate by purchased power.

Manitoba

In Manitoba the pulp and paper mill at Fort Alexander of the Manitoba Paper Company, a subsidiary of the Abitibi Power and Paper Company, operates with power purchased from the Manitoba Power Company.

Ontario

There are forty-eight pulp and paper mills in Ontario operated by hydro-power, more than half of which develop all or part of the power necessary for their operations. The mills producing their own power have an aggregate installation of 238,880 h.p., of which approximately 60 per cent is hydro-electric and the remainder directly connected to mill machinery. Much of the purchased power is secured from central electric stations controlled by the pulp and paper companies which they supply. The Abitibi Power and Paper Company with mills at Iroquois falls, Smooth Rock falls, Sturgeon falls, Espanola, Sault Ste. Marie and Fort William, owns or controls hydro-electric developments with an aggregate installation of 174,340 h.p. of which a comparatively small proportion is sold for public use. The Spruce Falls Company with mills at Kapuskasing has a 56,250 h.p. development at Smoky falls on the Mattagami river and 2,500 h.p. on the Kapuskasing river. The Backus interests, with mills at Kenora, Fort Francis and Fort William, control hydro-electric developments at the outlets of the Lake of the Woods and on the Rainy and Seine rivers with installations totalling 82,725 h.p. These are classified as central electric stations but most of the power is utilized in the pulp and paper mills. The J. R. Booth Company at Ottawa, has an installation of 28,789 h.p.; while numerous other lesser mills have installations of smaller capacities throughout the province.

Quebec

In the province of Quebec fifty-three pulp and paper mills utilize hydro-power, by far the greater proportion of which is purchased from central electric stations. The mills developing water power directly for their own operations have installations totalling 215,736 h.p. of which about 33 per cent is connected to electric generators. Of the companies maintaining their own installations Price Brothers and Company have 70,100 h.p. on the Chicoutimi, Shipshaw and Au Sable rivers, the Brompton Pulp and Paper Company 21,000 h.p. on the St. François river, the Quebec Pulp and Paper Company 27,500 h.p. on the Chicoutimi and Ouiatchouan rivers, the Canada Pulp and Paper Corporation 24,000 h.p. on the St. Maurice and

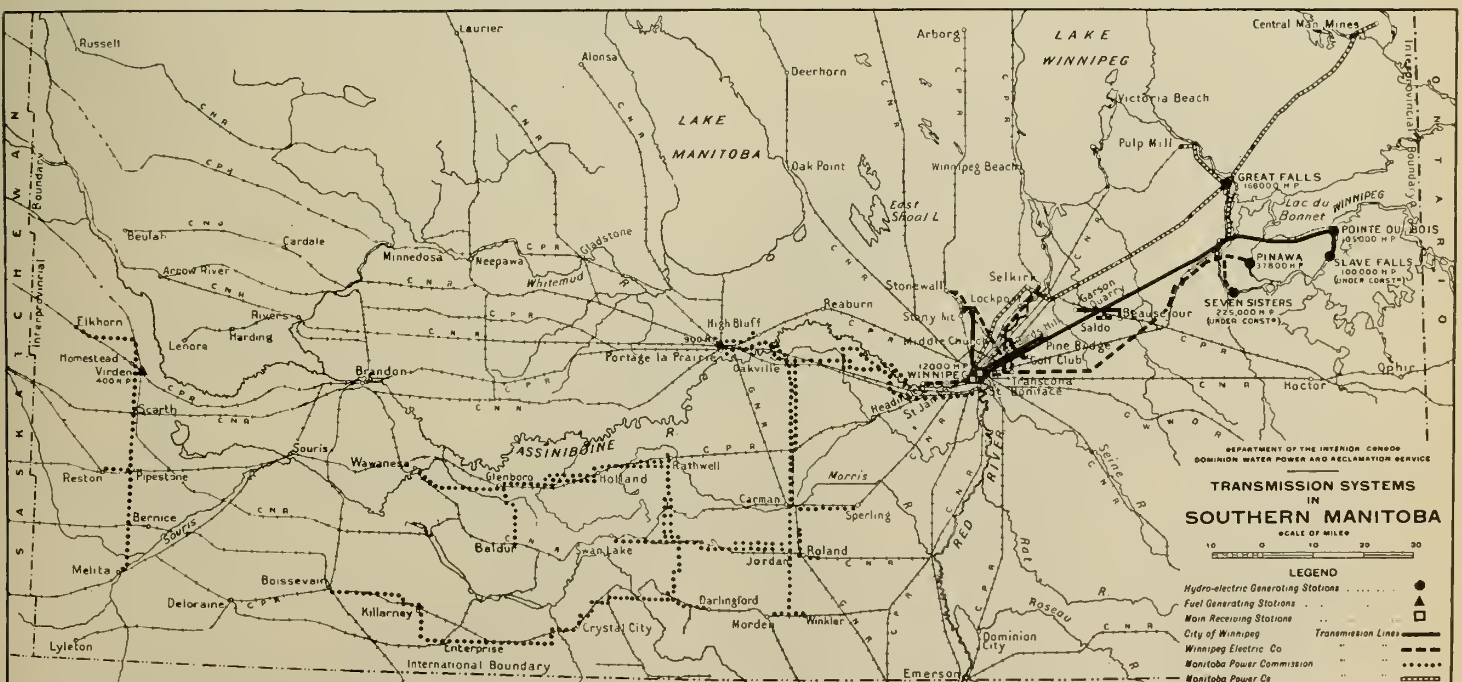

Figure No. 7.

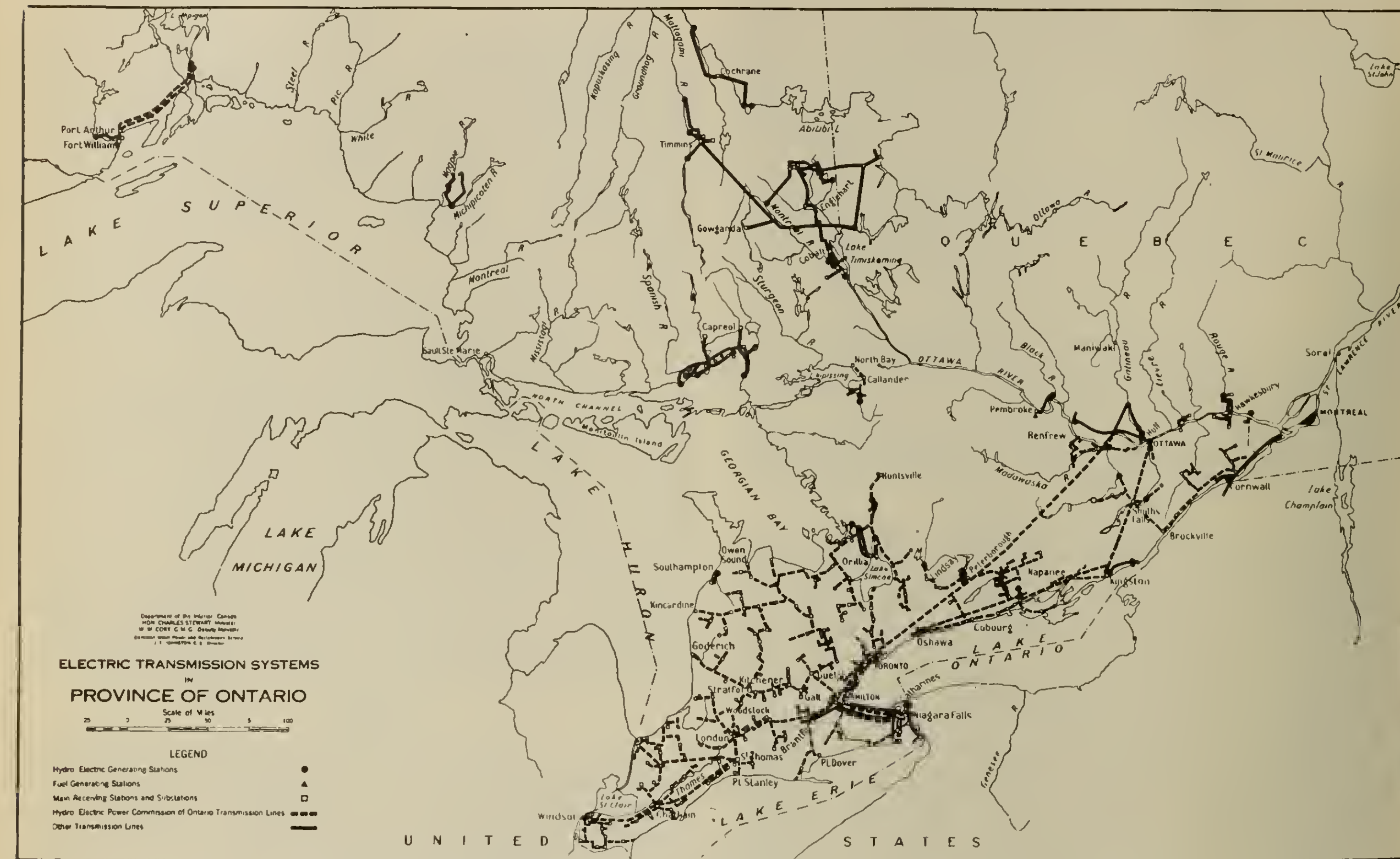

Figure No. 8.

St. François rivers, the Gulf Pulp and Paper Company 11,000 h.p. on the St. Marguerite river, the Abitibi Power and Paper Company 9,000 h.p. at Murray Bay and the E. B. Eddy Company 13,500 h.p. on the Ottawa river at Hull. Numerous other mills maintain installations of lesser amounts while practically all mills in the province purchase electric energy in large quantities from central electric stations.

New Brunswick

Of the six mills in New Brunswick three have water power installations, the Fraser Companies Limited at Edmundston with 2,060 h.p., the St. George Pulp and Paper Company at St. George with 2,668 h.p., and the Bathurst Power and Paper Company at Bathurst with 14,000 h.p. The mills of the New Brunswick International Paper Company now being completed at Dalhousie will receive power from the 60,000 h.p. Grand Falls development of the St. John River Power Company. Fraser Companies Limited also purchase power from this source.

Nova Scotia

In Nova Scotia the Clyde and Sissiboo Pulp Company, (sold to the Mersey Paper Company in 1929), has a total installation of 5,340 h.p. on the Clyde and Sissiboo rivers, the MacLeod Pulp and Paper Company 6,974 h.p. on the Liverpool river, the Lahave Pulp Company 1,500 h.p. on the Lahave river, and the Nova Scotia Wood Pulp and Paper Company 1,614 h.p. on the Medway river. The Mersey Paper Companies mills now under construction at Liverpool will be supplied with power from three developments being constructed on the Mersey river by the Nova Scotia Power Commission. The commission also supplies power to the mill of the A. P. W. Pulp and Power Company at Sheet Harbour. The Minas Basin Pulp and Paper Company, which commenced operating a new mill at Hantsport in March last, purchases its power from its parent company the Avon River Power Company.

Water Power in the Mineral Industries

Water power plays an important part in the mineral industries of the Dominion. In the mining of metals hydro-electric energy is almost wholly used, while even coal mines receive a part of the energy necessary for their development from hydro-electric developments. Low cost power in ample quantity makes possible the exploitation of large deposits of low grade ores which otherwise would have no commercial value, and it is a fortunate circumstance that water powers are widely and favourably distributed in the great pre-Cambrian shield which occupies so large a part of Canada and offers so many opportunities for mineral discovery.

The total installation in water power plants directly utilized in connection with the mineral industries amounts to about 100,000 h.p., while approximately 380,000 h.p. is purchased from central electric stations. This power is used for the extraction of ore, crushing, smelting, refining and other purposes.

In British Columbia the Granby Consolidated Mining, Smelting and Power Company has a water power installation of 13,200 h.p. and the Britannia Mining and Smelting Company 19,070 h.p., whilst on Vancouver Island there is a 12,000-h.p. plant on the Puntledge river supplying power to Canadian Collieries Limited for coal mining. The large mining and smelting operations of the Consolidated Mining and Smelting Company in the Rossland district are carried on with power supplied by the West Kootenay Power and Light Company from hydro-electric developments on the Kootenay river, and in the east Kootenay and Crow's Nest

Table No. 5—Developed Water Power Utilized in the Pulp and Paper Industry

Estimated at January 1, 1930

Province	Installed and Purchased Water Power in Horse Power					
	Turbine Installation in the Industry			Purchased Hydro-Electric Power	Total Hydro-Electric Power Col. 3 and Col. 5	Total Hydro-Power used in the Industry Col. 4 and Col. 5
	Direct Drive	Hydro-Electric Drive	Total			
1	2	3	4	5	6	7
British Columbia	26,155	54,845	81,000	2,550	57,395	83,550
Manitoba	..	..	..	*	*	*
Ontario	93,650	147,230	240,880	176,744	323,974	417,624
Quebec	145,270	75,540	220,810	622,388	697,928	843,198
New Brunswick	1,900	17,378	19,278	*	*	*
Nova Scotia	16,008	..	16,008	6,273	6,273	22,281
Canada	282,983	294,993	577,976	859,017	1,154,010	1,436,993

*The pulp and paper mills of Manitoba and New Brunswick purchase hydro-electricity totalling 51,062 h.p.
Column 2 includes all turbines actually installed in the industry directly driving mill equipment.
" 3 includes all turbines actually installed in the industry transmitting power through electric drive.
" 4 totals the turbine capacity actually installed in the industry.
" 5 includes only power purchased from central electric stations for the operation of pulp and paper mills.
" 6 totals the hydro-electric power used in the industry.
" 7 totals the water power used in the industry.

Pass districts coal mines are supplied with power from the East Kootenay Power Company's plants on the Bull and Elk rivers.

In Northern Manitoba and Saskatchewan the mines of the Hudson Bay Mining and Smelting Company at Flin Flon and the Sherrit Gordon mine at Cold lake will shortly be supplied with power from the Island falls development of the Churchill River Power Company on the Churchill river. In south-eastern Manitoba the mining area receives power from the plant of the Manitoba Power Company on the Winnipeg river.

In Ontario, which ranks first amongst the provinces in diversity and value of mineral production, practically all power requirements are met from water power plants. The nickel-copper mines of the Sudbury region are supplied from plants of the International Nickel Company of Canada on the Spanish and Vermilion rivers, also from plants of the Wahnapitae Power Company which has recently been acquired by the Ontario Hydro-Electric Power Commission. The silver mines of the Cobalt district and the gold mines of the Timmins, Kirkland and Larder Lake areas are supplied from plants of the Canada Northern Power Corporation on the Montreal and Mattagami rivers in Ontario and the Quinze river in Quebec. Power for mining in the Algoma district is supplied from plants on the Magpie and Michipicoten rivers, while the Ontario Hydro-

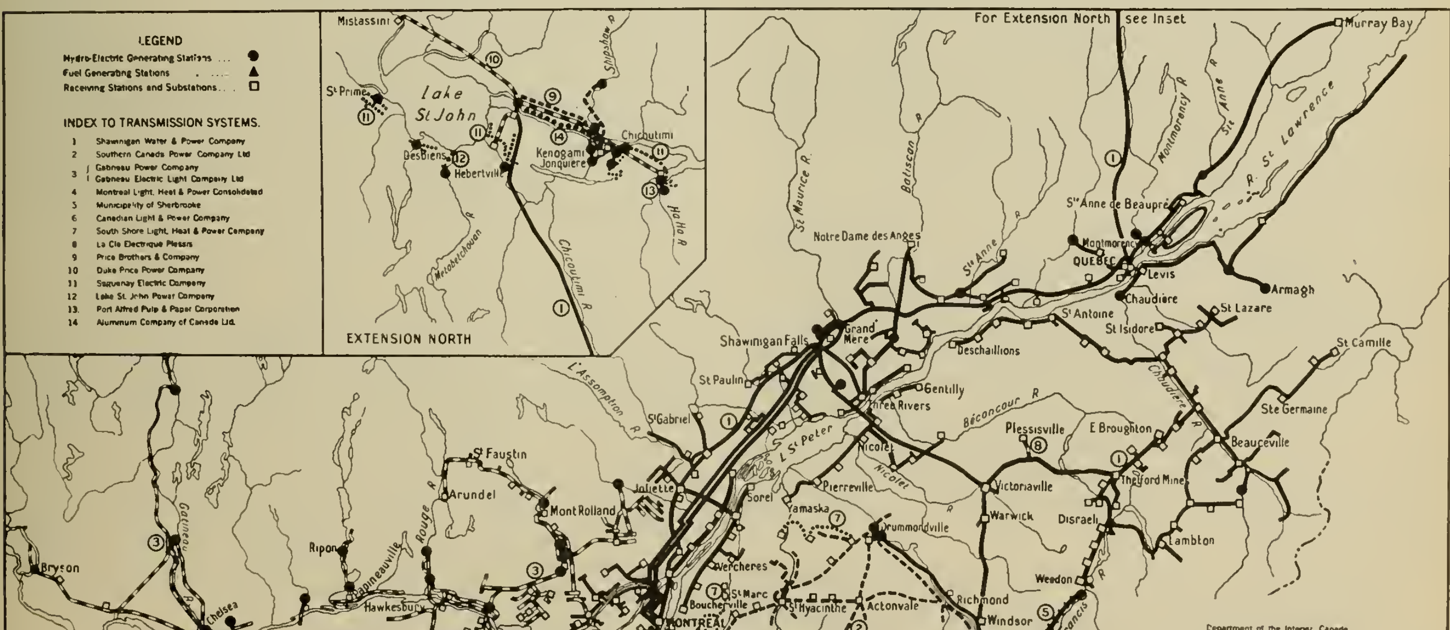

Figure No. 9.

Figure No. 10.

Electric Power Commission has recently completed a 5,000 h.p. installation at Ear falls on the English river for the supply of the Red Lake mining area.

In Quebec the copper-gold mines of the Rouyn and north-western district receive power from the Quinze river development of the Canada Northern Power Corporation, and the asbestos mines at Thetford Mines and Black Lake are supplied through subsidiaries of the Shawinigan Water and Power Company.

In Nova Scotia, where coal mining is the principal mineral industry, the power needs are largely supplied by fuel power plants, but in the Pictou area hydro-electric power is also utilized and other mining operations in various parts of the province are supplied from water power plants.

In the Yukon Territory water power plants have furnished energy for gold dredging operations for many years while new mineral discoveries being made in the Yukon and North West Territories will undoubtedly result in water power developments being made in the future in these great areas.

Water Powers Available for Future Development

In the comment following table No. 1 it was indicated that the present turbine installation represents about thirteen per cent of the total recorded water power resources of the Dominion. There is therefore a large reserve of undeveloped resources and while many of the rivers on which these are found are situated in districts remote from a ready market, there are, nevertheless, large resources awaiting development within reasonable transmission distance of existing centres of population.

British Columbia

In British Columbia large reserves are available, and the opportunities for storage combined with diversions from one watershed to another and the high heads offered by a mountainous region will undoubtedly greatly increase the estimates of available power already made. In the coastal region such rivers as the Nass, Skeena, Bulkley, Khatada, Falls, Madeline, Dean, Cheakamus, Eagle, Homathko and Klinaklini have powers totalling more than 1,000,000 h.p., a figure which will probably be greatly increased by storage. The Fraser river and its tributaries afford many power opportunities which it is estimated aggregate over 1,600,000 h.p. although development on the Fraser itself may be difficult to achieve on account of railways situated along its course. The Columbia and its tributaries have possibilities exceeding 1,250,000 h.p., some of which are marked for early development, such as the powers of the Pend d'Oreille river. On Vancouver Island powers of magnitude are found on the Campbell, Nimpkish, Kokish, Gold, Stamp, Nanaimo and other rivers aggregating more than 280,000 h.p., the Campbell river powers being now investigated for early development.

Alberta

Undeveloped power resources of Alberta are estimated as capable of yielding more than 1,000,000 h.p. Several sites still await development on the Bow river, whose capacities may be materially increased by the provision of storage. The larger resources are found in the northerly part of the province where powers of magnitude exist on the Peace, Athabasca and Slave rivers.

Saskatchewan

The resources of Saskatchewan are also estimated to exceed 1,000,000 h.p., all of which are found in the northerly part of the province. The Churchill is the most important power river with approximately 300,000 h.p. undeveloped. Other rivers with powers of magnitude are the Saskatchewan, Reindeer and Black.

Manitoba

Manitoba's undeveloped water powers are estimated to total about 5,000,000 h.p., of which almost 4,000,000 h.p. is accounted for by the powers of the Nelson river. The other large rivers are the Churchill and the Saskatchewan, while two sites still await development on the Winnipeg river at McArthur and Pine falls; Slave falls and Seven Sisters falls being at present in course of construction. Other powers of lesser magnitude are found on rivers tributary to Lake Winnipeg and the Nelson river.

Ontario

In southern Ontario the principal undeveloped water power resources are found on the International reach of the St. Lawrence river, where Ontario's share amounts to about 1,000,000 h.p., and on the Interprovincial reach of the Ottawa river where Ontario has about 500,000 h.p. still available for development. Further power from the Niagara river can only be secured by an enlargement of the permissible diversion by international treaty. Powers of lesser magnitude exist on tributaries of the Ottawa river such as the Madawaska, Bonnechere, Mississippi and Petawawa and on rivers tributary to Georgian bay such as the Musquash or Muskoka and Magnetawan.

In northern Ontario rivers flowing to James Bay offer many opportunities for development, those of greatest magnitude being found on the Abitibi with about 275,000 h.p., and on the Mattagami with about 170,000 h.p. still undeveloped. Of rivers flowing to Lake Huron the Mississagi and Aux Sables have the principal undeveloped powers, while in the Lake Superior drainage the Nipigon river has two sites of magnitude still available for development and the Michipicoten, White and Montreal rivers have undeveloped sites of importance. In the far western part of the province more than 100,000 h.p. may be developed on the English river, and good opportunities are also offered on the Winnipeg river, while lesser powers are found in abundance on the smaller streams of this district.

Quebec

The province of Quebec has the largest reserve of undeveloped water power resources of any of the provinces of the Dominion and although much of this is found in territory remote from an immediate market, large powers still await development on rivers immediately adjacent to the populous areas. The St. Lawrence river has more than 2,000,000 h.p. available, of which a part will shortly be harnessed by the Beauharnois development, while Quebec's share of the Ottawa river powers together with undeveloped sites on the Ottawa tributaries on the Upper St. Maurice and lower St. François rivers provide for a large future installation.

On the Saguenay river the remaining site at Chute-à-Caron is now being developed, but the tributaries of Lake St. John such as the Peribonka, Mistassini, Mistassibi and Ashuapmuchuan rivers have undeveloped powers of magnitude for the future supply of the district.

In the territory tributary to the lower north shore of the St. Lawrence river and gulf, undeveloped resources in excess of 2,400,000 h.p. are found, among the larger rivers being the Bersimis, Outarde, Manicouagan, St. Marguerite, Sheldrake, Magpie, St. John, Romaine and Natashquan.

In northern Quebec many large rivers flow into James, Hudson and Ungava bays with water powers estimated on meagre data to aggregate about 3,500,000 h.p., some of which on the Harricana, Bell and Megiskan rivers being adjacent to mining areas and railway communication may be of more interest for early development than those on other rivers in remote territory.

Maritime Provinces

While the undeveloped water power resources in the Maritime provinces are of lesser magnitude than those in the other provinces, there are a number of sites which are favourably situated and will undoubtedly be utilized within the next few years. There is also the possibility of developing power from the tides in the Bay of Fundy. In New Brunswick there are additional opportunities for development on the St. John river and its tributaries the Shogomoc, Pokiok and Eel rivers. Undeveloped sites are also found on the St. Croix, Lepreaux, Magaguadavic, Upsalquitch, Nipisiguit, Tetagouche and Miramichi rivers. In Nova Scotia undeveloped sites are found on such rivers as the Bear, Sissiboo, Nictaux, Paradise, Gaspereaux, St. Croix, Medway, Lahave, Gold, Ingram, Tangier, East River Sheet Harbour and Liscomb, while in Cape Breton Island there is a project at Lake Ainslie.

Yukon and North West Territories

Water power investigations in this vast territory have been very few, so that it is possible to make only a very provisional estimate of the resources, but it is safe to say that these exceed 730,000 h.p. Opportunities are offered on rivers tributary to Great Slave lake such as the Hay, Lockhart, Taltson and Tazin, while on many others which traverse the territory rapids and falls have been noted which if market should offer, would provide ready sources of power.

Recent Improvements in Mechanical Transport Vehicles

With Particular Reference to Multi-Wheeled Cross-Country Commercial Types

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Department of National Defence, Ottawa.

Paper presented at the Annual General Meeting of The Engineering Institute of Canada at Ottawa, February 13th, 1930

It is intended in the first place to outline the salient factors which have affected the evolution of mechanical transport in general and of multi-wheeled vehicles in particular since the conclusion of the Great War. In 1918 there remained as a residue of the war a large number of mechanical transport vehicles fitted in the most part with solid tires. These vehicles had been produced to meet the requirement of the Services in the various theatres of war but many of them were never used, and were therefore available for absorption into commercial life. It might be reasonably expected that the presence of so large a number of these vehicles would have accelerated the development of mechanical transport for heavy-load carrying as well as passenger carrying. In point of fact their presence actually retarded the development of mechanical transport because they first had to be absorbed commercially, thus delaying the demand for an improved type of vehicle, and the incentive to manufacturers to produce something new was not nearly so strong as it would have been had these vehicles not been available.

Action by British War Office

In view of the continued development of tanks, aeroplanes, and other military machines, it was realized that the transport services would have to be speeded up. A definite move was, therefore, made by the War Department to supersede the solid-tired type vehicle and what later became known as the "1½-ton subsidy type" lorry was as a result introduced.

The Light 1½-ton Subsidy Lorry

This vehicle possessed the increased mobility sought for together with a greater radius of action than that of the ex-war-solid-tired vehicle, and was produced to the specifications of the War Department. Its chief features being,—

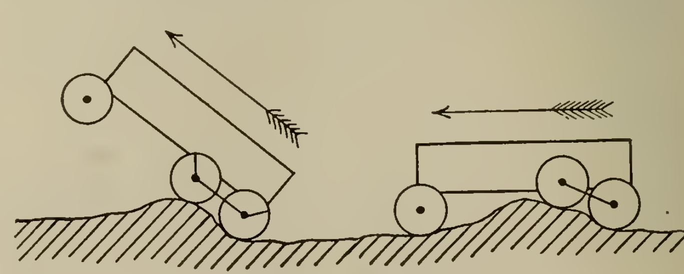
(1) Weight as low as possible
(2) High torque-weight ratio
(3) Comparative high speed
(4) Special cooling.
(5) Large pneumatic tires
(6) Standardization of various features and design, control and equipment, and the use of British Engineering Standards Association standards as far as possible; and
(7) Suitability for commercial use.

The service for which the War Department required this vehicle was the mechanization of the second line transport of the army. It was, however, only by reducing the useful-load-carried to 1½ tons, by most careful design eliminating all non-essential material, and by employment of pneumatic tires, that a design of vehicle could be achieved which would give a fair cross-country performance. It is of interest to note that at the time of the introduction of this vehicle there was a prejudice against the use of pneumatic tires for heavy-load carrying purposes, but this was very largely overcome by the general adoption of cord tires as opposed to canvas,—the cord having a much longer life.

Also, in order to overcome the reluctance on the part of the manufacturers to produce this class of vehicle and the potential user to purchase it, the War Department in 1923 introduced a subsidy of £40.0.0., (approximately $200.00), per annum, payable for a maximum period of three years, to the purchaser of every vehicle of the approved type. This subsidy had the desired effect and in a comparatively short time the subsidy roll, which had a maximum membership of 1,000, was filled, and the pneumatic-tired load-carrying vehicle came into common use. This class of vehicle did not satisfy the War Department entirely, however, because still further developments in aircraft, high-speed tanks and tractors necessitated the production of a vehicle possessing even greater cross-country mobility than that possessed by the light 1½-ton pneumatic-tired lorry. Further, since the 3-ton lorry had been the previous standard in the supply service, in some respects this vehicle had been retrograde, in that its useful-load was reduced to 1½ tons. This meant more vehicles, more men and more road space to move a given tonnage,—all being undesirable from a military point of view. With such considerations in mind, a new vehicle was now visualized which should possess the following improved features:

(*a*) Lower intensity of pressure on the ground.
(*b*) Increased useful-load capacity.
(*c*) Higher speed.
(*d*) Higher torque-weight ratio.
(*e*) Greater powers of adhesion to make use of the tractive effort available.
(*f*) Increased flexibility in construction, giving ability to traverse rough ground without setting up undue stresses in the chassis.
(*g*) Reasonable initial cost.
(*h*) Economy in running and manufacture.
(*i*) Commercially attractive.

At this time there was sharp division of opinion as to the type of vehicle which would embody the maximum number of these desirable features. On one hand, there was a strong advocacy of the semi-track machine; on the other hand, an equally strong school in favour of the multi-wheeled machine. In respect to the features outlined above,



Figures Nos. 1 and 2.

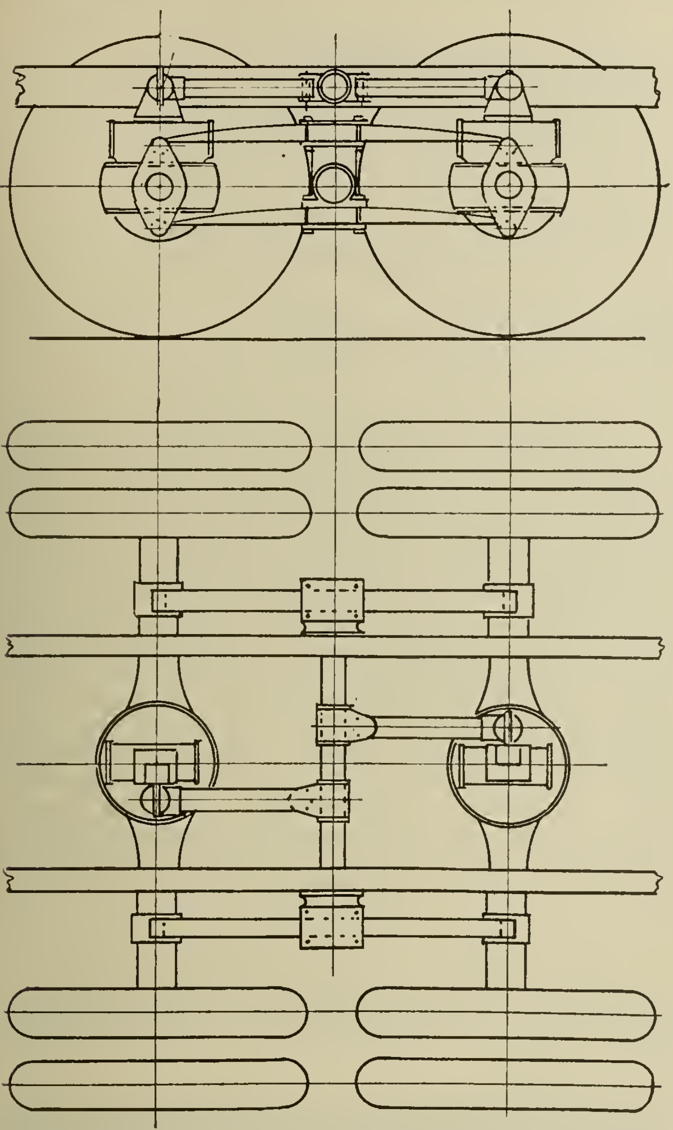


Figure No. 3.—Principle of War Department's Rear Suspension.

the semi-track machine meets the requirements of (*a*), (*b*), (*e*), and (*f*), only. Again, the great drawback to the adoption of the semi-track machine for military purposes is the fact that it is not commercially attractive, has a comparatively poor speed performance and is noisy. The commercial attractiveness of a vehicle is very important because, in emergency, the military authorities have to depend on the vehicles in commercial use to fill their establishments. On the other hand, however, since there is a great commercial demand for multi-wheeled vehicles, it is desirable that as many military features as possible should be embodied in these types.

The Rigid Six-Wheeled Vehicle

As a result of the decision of the military authorities to pursue the development of the multi-wheeled vehicle, the rigid six-wheeler was produced. The provision of the additional wheels increased the area of contact with the ground and thus, in addition to preventing sinkage on soft ground, provided means for applying tractive effort over greater ground area, hence securing better adhesion.

After much experimenting, it was decided that the essential factors on which the success of the rigid six-wheeler depends are,—

(1) That the suspension of the driving axles must be such that the exertion of driving torque shall not disturb the distribution of weight of the four driving wheels on the ground in any way.

(2) That the suspension must also permit of free articulation of the driving axles within as wide limits as is practicable in such a way that the springs are not distorted, nor the weight distribution of the four wheels disturbed. This enables the wheels to conform to rough ground without affecting the drive whilst causing the minimum of chassis displacement and distortion.

(3) High tractive effort being on occasions essential it was decided, in order to obtain this, to encourage producers to gear down a moderately sized engine rather than to provide a large engine. This is particularly important in England where vehicles are taxed at £1.0.0. per horse power per annum.

(4) There should be a low intensity of pressure between the driving wheels and the ground to reduce sinkage; and in addition, some form of non-skid arrangement is essential in order to make use of the maximum tractive effort available when negotiating soft and pliable ground.

War Department Patented Suspension

It should be noted in connection with this suspension that it was patented by the War Department in order to prevent its monopoly by any one maker, but it was not intended in any way to retard its development,—in fact, its use is permitted free to all British manufacturers and under certain conditions this has now been extended to include manufacturers in Canada, and other parts of the Empire.

There are three axles. The foremost axle,—the wheels of which do not drive,—is provided with the Ackermann type steering and is connected to the chassis by semi-elliptic springs. The two rear axles,—carrying the load,—are situated close together. These are live axles capable of independent relative movement with certain limits, and the necessity for this movement in the rear bogie will be readily seen from figure No. 1.

Take a vehicle with three wheels on each side practically rigidly fixed to the chassis, they will behave, as shown, when the machine meets an obstacle. If, on the other hand, two rear axles are allowed to articulate about a common point, (figure No. 2), they will lift in turn to overcome the obstacle without affecting the longitudinal stability of the vehicle. In this connection, however, one point needs very careful consideration and that is, unless properly designed, the suspension will permit the rearmost driving wheel to sink in soft ground with an accompanying tilt of the leading driving-wheel which in effect renders the vehicle a two-wheel drive for the moment. These disappointing and undesirable points were met with when trying out certain foreign types of rigid six-wheelers in the early experiments of 1924. They were overcome, however, by the introduction of the War Department's rear suspension.

Principle of the War Department's Rear Suspension

The principle of this suspension is shown diagrammatically in figure No. 3. The special features of this design are described below,—

(1) It will be seem from figures Nos. 3 and 4 that the axles are free to rise and fall independent of each other within certain limits.

(2) To avoid uneven weight distribution over the four driving wheels caused by the application of driving torque, the torque reaction is taken from

each axle to the main frame of the vehicle (figure No. 3)and not from axle to axle. In certain types tried out in Canada during the last two years the torque reaction is taken from axle to axle, and thence to the chassis frame. With this type of reaction gear, the tendency of the vehicle is to convert itself into a two-wheel drive when the drive from all four rear wheels is most needed.

(3) The rear bogie assembly permits an action which ensures that the worm shafts remain parallel over all relative positions of the driving axles. On this account the instantaneous angular velocity of the worm shafts and wheels are unaffected; the transmission stresses are, therefore, kept to a minimum; maximum adhesion is obtained between driving tires and the ground; and tire-wear is much reduced.

(4) In order that the two driving axles may be given lateral articulation, that is, horizontal movement without distorting the road spring leaves, the members carrying the spring ends are mounted by means of a universal or spherical joint. This action can be clearly seen in figure No. 4. To keep this horizontal movement within certain limits steel straps are provided, (figure No. 4), which are bolted to side chassis members.

(5) The tractive effort is transmitted to the chassis through the road springs which are of the duplex inverted semi-elliptic type and which, in addition to carrying out their normal functions, are used to locate the two driving axles by means of four master leaves.

Transmissions

In the War Department rigid six-wheeler the standard transmission units have been utilized as far as possible, and the low gear ratios have been obtained by fitting an auxiliary gear box immediately in the rear of the main gear box unit. The auxiliary gear box, being usually of the sliding gear type, is controlled by a lever from the driver's seat and gives a further reduction in the normal gear ratios of approximately one-third. (Details of gear ratios and other particulars of a typical "light" and "medium" six-wheelers are given in appendix 1.)

The fitting of this auxiliary gear box in the rear of the main gear box has the advantage of keeping the extra torsional stresses, caused by the increased gear ratios, behind the main gear box. Further, this design gives additional tractive effort without having to resort to high powered engines—a most important feature in countries where vehicles are taxed on horse power.

The rear axles are generally of the normal worm type and, as previously stated, the worm shafts are permitted to remain parallel during all relative movement to rear axles. Both propeller shafts are universal-jointed at both ends. However, owing to the wide angle through which they have to work, particular attention has been paid to their design and to their lubrication.

Tire Equipment

The War Department, in conjunction with the Dunlop Rubber Company, (England), has recently introduced a new type of "bar-tread" tire. The object of this tire is to give maximum adhesion to the ground, and also to give maximum adhesion between tire and the overall chain when used. It has a helical design tread which is supposed to be self-clearing. The appearance of this "bar-tread" tire is shown in figure No. 4.

In Canada, during the last two years, considerable experience has been had with this form of tire and its superiority over the normal tread is well established. In all six-wheeler tests carried out during the past two years with vehicles having tires of ordinary tread, one of the chief difficulties has proved to be the securing of sufficient driving adhesion between the ground and the tires when negotiating soft and boggy surfaces. This is equally true even when overall chains are fitted, the mud or snow,—as the case may be,—simply packs between the tire and the chain and adhesion is completely lost,—the wheels merely spinning inside the overall chain. When the "bar tread" tires are used this trouble does not occur.

Overall Non-Skid Chains

Experiments showed that some form of device to increase the area of contact with the ground, to give increased adhesion and to make use of the tractive effort available when traversing particularly bad surfaces, was needed. For this purpose, what is now known as the "War Department overall chain" was designed. It is made up of a number of rolled steel shoes connected by links made of very cheap stampings. The terminals of the bases of the shoes project inwards to form a tongue, and so act as a guide to ensure the chains centralizing in the space separating the twin tires. The chain can be fitted in approximately two minutes, and the vehicle is then to all intents and purposes a semi-track machine. It should be noted that since both wheels drive, the chain is not normally in tension—the drive being obtained through the weight of the driving wheels running over the chain in contact with the ground. Also, on the inner surface of the shoes, are small studs so placed as to engage between the treads of the tires, and increased adhesion between the chain and tire is therefore obtained.

The Department of National Defence has carried out several experiments in Canada with the present type of War Department overall chain under varying conditions of weather, temperature and terrain, and from these experi-

Figure No. 4.—View showing Extent of Flexibility of Rear Suspension without affecting Level of the Chassis Frame.

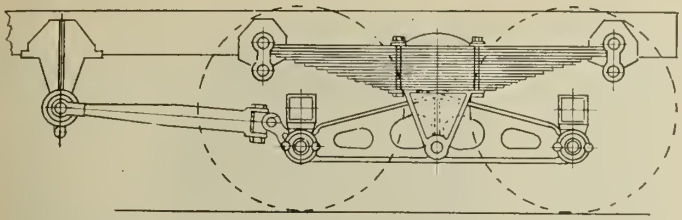


Figure No. 5.—Typical American Rear Axle Mounting for Six Wheel Truck.

ments it would appear that several improvements could be made and, indeed, if the chain is to be used successfully in mud, clay, sand and snow in Canada, will be absolutely necessary. The present type gives admirable results when traversing all natures of ground in summer time, but in the winter—at temperatures when snow will bind—results in snow were not at all satisfactory. It was found that the snow packed solidly on the inner surface of the shoes and either increased tension on the chain to such an extent as to reduce seriously the vehicle's tractive effort, or raised the chain so far off the tires that the tongue of the connecting links, which normally rests between the twin tires, mounted the tire, resulting in the chain coming off. In order to overcome this difficulty, holes approximately one half-inch in diameter, were drilled through the shoes and it was found that a considerable quantity of snow worked through these holes with the result that clogging did not take place nearly so soon. This did not completely eliminate the trouble, however, and it is intended during the coming winter to experiment with shoes which are merely skeleton in form and which will allow the easy passage of snow from the inner surface of the shoes to the exterior.

Types of Rigid Six-Wheeler in Production

Many manufacturers of motor trucks in England to-day are manufacturing the rigid six-wheeler, and the War Department has issued specifications for a "light" and a "medium" type for their guidance. The manufacturers have, therefore, with a few exceptions, confined their attention to manufacturing these two types—the load-carrying capacities of which are, as follows:—

The "light" six-wheeler has a useful load-carrying capacity of 1 ton across country, and 1½ tons on good roads; and

The "medium" six-wheeler has a useful load-carrying capacity of 2 tons across country, and of 3 tons on good roads.

Another type visualized by the War Department is the "heavy" six-wheeler, the role of which will be the carrying of laboratories and other technical loads in the back areas. This machine will, in all probability, drive on all six wheels but specifications have not, up to the moment, been prepared.

In addition to the production of six-wheelers which is going on in England, other makes of six-wheelers are being produced throughout the United States. From information on hand, however, the rear suspension of these six-wheelers does not possess the flexibility or the performance of the War Department design, and the British manufacturer of the six-wheeler has on this account a great initial advantage in Canada, which, if he were alive to the potentialities, could be exploited with considerable success.

Comparison Between War Department's Rear Suspension and Other Forms in General Use Throughout America

At this point it would be of interest to compare the rear suspensions of American and British six-wheelers in order that the main advantages and disadvantages may be seen. The construction of the British rear suspension has been already explained in detail, and it now remains to explain the common type of suspension as used in the United States.

Taking the rear axle six-wheel Hendrickson mounting for example, (see figure No. 5), it will be seen that certain articulation of the rear wheels is possible and that the axles are free to move independently within certain limits. The torque reaction, however, is taken from axle to axle, and thence to chassis frame, instead of being taken from axle direct to chassis frame, and is, therefore, not balanced between axles. As previously pointed out, the tendency of this construction when a gradient or other obstacle is being negotiated is for the leading wheel to rise off the ground and the rear wheel to dig itself in. An advantage claimed for this type of suspension, however, is that the driving stresses are spread over a larger section of the chassis, a large powerful semi-elliptic spring being anchored at its front and rear, direct to the chassis, instead of in its centre, through a bracket, as is the case with the War Department suspension. This, in the writer's opinion, is a good point about this suspension as the driving stresses are distributed more evenly over a large area of the chassis frame, but its one big disadvantage is that the torque reaction between the two rear axles is unbalanced and the unit, therefore, lacks real flexibility.

Use of Skis with Six-Wheelers

During the past year certain trials were carried out to ascertain the serviceability of the six-wheeler in snow, and it might be of interest to relate briefly the results of one of these trials.

When fitted with the overall chain, (the shoes of which had previously been drilled to allow the escape of snow), the factor limiting the performance of the six-wheeler when operating across country in deep, virgin snow was that the front wheels cut their way into the snow thus allowing the radiator to foul the surface and to pile up in front of it an unsurmountable barrier which very quickly stopped all progress. This was especially so when the driving wheels were turned out of the direct-forward position. To overcome this limiting factor, it was decided to fit skis on the front wheels. Experimental skis were made, and eventually those shown in figure No. 6 proved to be successful. Before this design was arrived at, several disappointing results were experienced, the main one being the difficulty in steering the vehicle over ice, or hard snow, in the desired direction—the tendency being for it to continue in a straight line irrespective of the angle at which the steering gear was set. This was overcome by fitting a fin of increased depth and length on the under-surface of the main ski. With this, it was found that steering was quite satisfactory whether

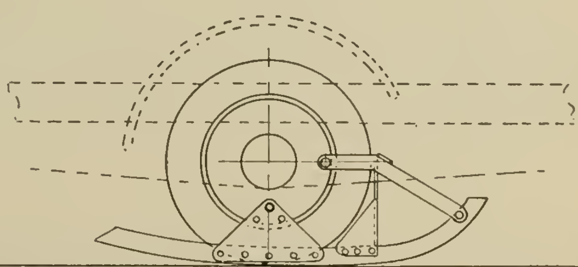


Figure No. 6.—Diagram of Ski for Lorries, 4-6 Tons, Mark I.

traversing deep or shallow snow, in fact, even when passing over ice the fin made the steering of the vehicle almost as easy as when driving under normal conditions.

The mobility of the six-wheeler across country, over mud, sand, clay and snow, is infinitely superior to that of any other type of load-carrying wheeled-vehicle. At the same time its performance on good roads is not impaired. In other words, it has the advantages of the semi-track machine with none of the latter's disadvantages.

The initial cost of the six-wheeler is reasonable; its maintenance cost is low on account of its easy riding qualities; and, owing to the low intensity of pressure, between the tires and the ground the legal load is greater than that allowed to the four-wheel vehicle.

In Canada, under certain mud, sand and snow conditions the four-wheeler is often unable to operate. The six-wheeler on the other hand, with its skis and overall chains for extreme conditions, can operate economically the whole year through.

Improved Form of Front Axle Springing

Experiments have been made recently in England with a new form of front axle springing. Instead of the normal semi-elliptic springs, a transverse semi-elliptic inverted spring has been designed. This is secured to the centre of the chassis front cross-member and it is mounted at this point on a trunnion joint, and at either end by means of shackles to the front axle. The advantage of this form of springing will be immediately apparent as with this arrangement not only now will the rear wheels be capable of independent horizontal movement but the front wheels also will be capable of independent action in similar manner. This arrangement reduces the chassis distortion and stresses to an absolute minimum, and is likely to become standard equipment on at least the "light" six-wheeler.

Factor of Performance

During the preliminary experiments and investigations carried out by the War Department, it was found necessary to introduce a formula which would give the comparative cross-country potentialities of the various vehicles under consideration. This formula later became known as the "factor of performance." This is taken from the War Department's specification for six-wheeled vehicles, and is as below,—

$$\text{Factor of performance} = \frac{A \times 2S \times N \times R}{W \times T}$$

Where A = area of piston in square inches.
S = stroke in inches.
N = number of cylinders.
R = overall gear reduction (engine to roadwheels) in lowest forward gear.
W = gross weight of vehicle ready for the road.
T = effective circumference of tire in inches.

The figure arrived at represents cylinder volume swept per unit of advance of the vehicle in its lowest gear per ton of gross weight. For example, the specification under consideration which is for a "medium" six-wheeler calls for "factor of performance" of 55.

Conclusion

It is hoped that the foregoing has given a fair idea of multi-wheeled vehicle development, and the position in which it stands at the present time. In the writer's mind, there is no doubt that the rigid six-wheeler provides a field of very profitable research. It combines the dual qualities of being able to travel over good surfaces at a speed equal to any other four-wheeled vehicle and at the same time has cross-country performance equal,—if not superior,—to many semi-track vehicles. Its use, at the moment, is spreading rapidly throughout India, Egypt, South Africa and Persia where good roads are comparatively few; and also in Europe and America where roads are for the most part good.

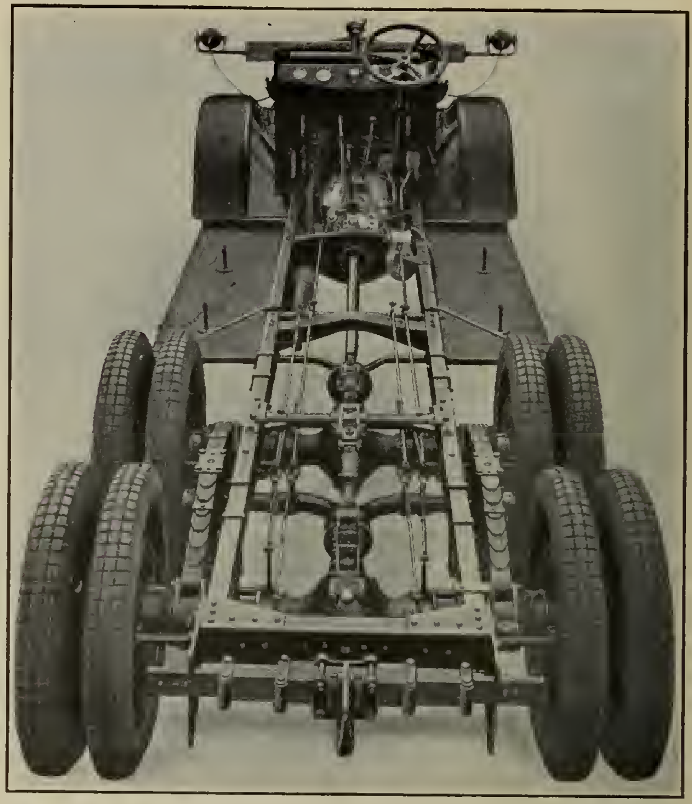


Figure No. 7.—General Layout of a Six-Wheeler Chassis.

Canada is behind so far as the production, and employment, of the six-wheeler is concerned. It is of interest to note that the largest user, at the moment, is the Department of National Defence, for the simple reason that this vehicle embodies a greater percentage of desirable military features than most vehicles and, at the same time, is commercially attractive. Some idea of the six-wheeler's commercial value can be gathered from the variety of uses to which it is being successfully put in various parts of the world.

Among these are:—

(1) Work in connection with railroad and road construction.

(2) As feeders to railways in districts where roads do not exist.

(3) For logging in virgin country. Its special winch equipment, when fitted, makes it particularly well suited for this class of work.

(4) For general farm work.

With the lead given by the Department of National Defence to this type of vehicle in Canada, its use is gradually becoming more general, and it is considered that in the comparatively near future the outstanding qualities of this vehicle will be appreciated and a correspondingly greater demand will result.

APPENDIX I

Schedule of Technical Details

1. Type of vehicle...	"Light" six-wheeler.		"Medium" six-wheeler.	
2. Weight with body and equipment ready for the road	4,536 pounds.		6,496 pounds.	
		X		X
3. Useful loads..... (Military loads)	On road.	country.	On road.	country.
tons	1.5	1.	3.	2.
4. Engine	4 cyl.		4 cyl.	
Bore	3⅛″		3¾″	
Stroke	5″		5″	
Treasury rating..	15.9 h.p.		22.5 h.p.	
		X		X
5. Gear Ratios.....	Road use.	Country.	Road use.	Country.
Engine to road wheels.	21.56	69.0	46.1	95.4
	15.04	48.4	22.8	47.3
	10.8	33.2	13.8	28.6
	6.25	20.0	8.75	18.1
	R. 27.87	R. 89.25	R. 72.00	R. 148.9
6. Road speed miles per hour....	35-40		25-35	
7. Average gasoline consumption miles per gallon	15		11	

Note:—In commercial life these vehicles are sold to carry greater loads than those for which they are used in the army.

The Aeronautical Laboratories of the National Research Council of Canada

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Paper presented at the Annual General Meeting of The Engineering Institute of Canada, at Ottawa, February 13th, 1930

The dependence of national development and progress on transportation is nowhere more marked than in Canada. The settlement and development of the Dominion first followed the natural waterways, later the railways, and may now be said to be following the airways. Regions formerly regarded as inaccessible and doomed to remain forever undeveloped are now not only being explored but are actually in process of development practically wholly by means of aircraft.

In perhaps no other country are aircraft being put to as great a variety of useful and practical tasks as in the Dominion. Immediately following the war Canada set about making use of aircraft and taking advantage of their characteristics in everyday peacetime pursuits with such success that aircraft have now become an important factor in the life of the country.

In the use of aircraft for exploration, reconnaissance and surveying, Canada has taken a leading part and has brought the practice of aerial surveying to a high state of development. The value of aircraft in developing and protecting the timber wealth of the country was quickly appreciated in the Dominion, and great strides have been made in the use of aircraft for the detection and suppression of bush fires, for timber cruising and forest sketching. In the last few years aircraft have played an important part in development of the mineral resources of the Dominion and have been intensively and successfully employed for prospecting, geological exploration, and in development work, particularly in the great north country known to be geologically favourable but hitherto practically inaccessible. Aircraft are also being employed in the warfare being waged against different pests and blights attacking the forests and crops. The air mail lines are being steadily extended and improved and the use of aircraft for the carriage of express and passengers is continually increasing. For customs and fisheries patrol and many other everyday civil and commercial tasks aircraft are being employed with success in the Dominion.

The success with which aircraft have been used in Canada is remarkable when it is remembered that the operations were in many cases commenced using military types of aircraft and that even now few of the aircraft are specially designed for the service and conditions under which they are operating. The success of the few machines designed for specific purposes indicate what can be accomplished. To make fullest use of aircraft in the country, machines suited to Canadian requirements and conditions must be developed.

In developing aircraft suited to the special services and peculiar conditions, an aeronautical laboratory is essential. Recognizing this fact and the national importance of aviation in Canada, the National Research Council has undertaken, with the approval of the Sub-committee of the Privy Council on Scientific and Industrial Research, the establishment at Ottawa of completely equipped aeronautical laboratories. The laboratories planned will compare favourably in extent and capacity with the best in other countries.

Scope and Nature of the Work of the Laboratories

While the whole field of aeronautical research embraces most branches of engineering activity as well as many other sciences, the three principal divisions are aerodynamics, hydrodynamics and power plant. Accordingly, the National Research Council is installing a wind tunnel for aerodynamic research, a test tank for the study of problems connected with floats and hulls and power plant equipment for the testing of aircraft engines, fuels, etc.

The work of the laboratories will be principally aeronautical research for the purpose of improving the performance of aircraft, developing new types and solving problems arising in connection with the design, construction and operation of aircraft in Canada. Aeronautical testing will also be undertaken for designers, constructors and operators, and the laboratories will be found very useful for many investigations of a non-aeronautical character.

Not the least important work of the laboratories will be the facilities offered for training in aeronautical research. The experience gained by young men in one or two years of research will be of material benefit not only to them but to the Canadian aircraft industry and aviation.

Figure No. 1.—Exterior—Wind Tunnel Building.

Figure No. 2.—Interior—Wind Tunnel Building.

Aerodynamic Laboratory—Wind Tunnel

Aeronautical Research

The information forming the basis for the development of aircraft has been derived in different ways. The pioneers in the art generally employed direct methods and worked with full scale complete machines, with power driven models, with gliders and with kites. The obvious advantages of conducting experiments on machines and models under somewhat definite control lead to the use of the carriage and track and of the whirling arm. These devices suffer in turn from difficulties inherent in making observations on a moving object and to overcome these troubles the wind tunnel was introduced. While free flight testing still forms a well recognized and much employed method of investigation for certain types of aeronautical problems, the wind tunnel at the present time is the most generally used, and most important source of information on which the design of aircraft is based.

Historical

It appears that the wind tunnel was first used by Phillips in England, in 1893, in determining the most suitable form for the wings of his multiplane. Later, in 1900, Maxim used a wind tunnel in developing the design of his huge machine. The first tunnel in America was that designed and built by Dr. A. F. Zahm at Washington in 1901. The Wrights, whose experiments with gliders had shown existing data to be unreliable, employed a small tunnel in the winter of 1901 to secure the information on which was based the design of their successful aeroplane, and Stanton in England in the same year employed a wind tunnel in certain researches. In Canada, a small tunnel was used by Mr. W. R. Turnbull, of Rothesay, N.B., about 1902, for experiments on wing sections. Between 1904 and 1909 several tunnels were built in Europe including those of Riabouchinsky at Moscow 1904, Finzi and Sodati 1905, Prandtl at Gottingen 1908, Rateau and Eiffel in France 1909, and the National Physical Laboratory in 1909. In 1917, the University of Toronto installed a 4-foot tunnel

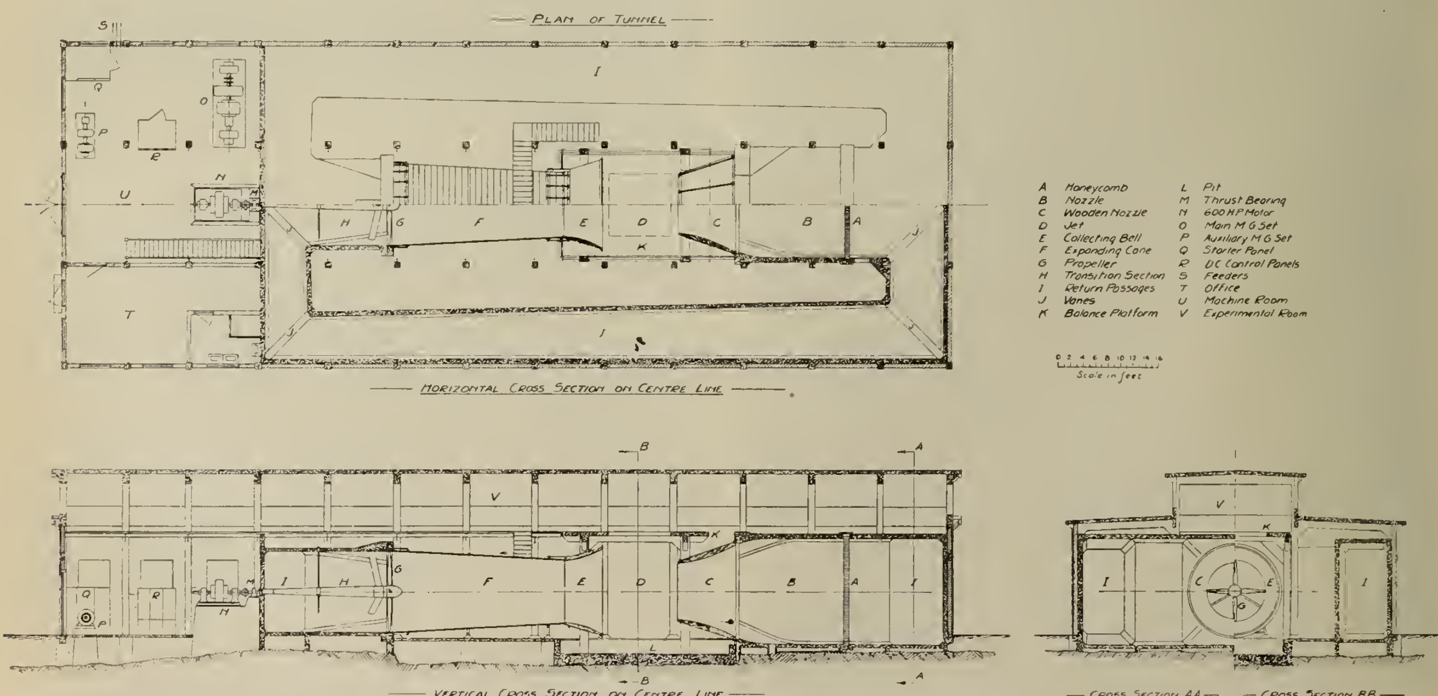

Figure No. 3.—Arrangement of Wind Tunnel.

which was, up to the present time, the only tunnel in Canada.

The Wind Tunnel in Aeronautical Research

The use of the wind tunnel in aerodynamics is based on the principle of relative motion. Instead of moving a model through still air, the air is moved past a stationary model. Under these circumstances the reactions on the model are the same as though it were in motion and the difficulty of properly supporting a moving model is avoided. In the wind tunnel, a uniform steady current of air is drawn at known speed past an exact replica or model of the aircraft to be studied, mounted on a sensitive balance, by means of which the forces on the model are measured. From these measurements the performance or characteristics of the full scale machine in free flight can be accurately predicted at much less cost, in less time and without the inconvenience, difficulties and hazard of free flight testing, while, at the same time, the exact conditions can be readily duplicated.

Requirements for Wind Tunnel Testing

In order that the results of model tests may be applicable to full scale aircraft, it is necessary that the conditions of flow about the model be the same as about the full scale machine. To secure such similitude of flow, not only must the model be geometrically similar to the original, even to surface roughness, but the ratio $\frac{Vl}{\nu}$*, known as Reynolds' number, must have the same value in both model test and full scale flight.

As in atmospheric tunnels, the kinematic viscosity ν of the air is the same as for the outside air, it is only necessary to maintain Vl the same in both cases. To satisfy this requirement, however, necessitates impossible air speeds in the wind tunnel, since, with say a 1/5 scale model the air speed must be 5 times full scale speed. Hence wind tunnel tests are ordinarily carried out at values of Vl less than those for full scale and an experimentally determined "scale correction" applied.

In an endeavour to reduce the uncertainty due to this correction, the size and air speed of wind tunnels has been progressively increased, the usual size at present ranging from 6 to 10 feet in diameter, with speeds from 125 to 200 or more miles per hour.

Full scale values of Reynolds' number can be attained in wind tunnel tests by reducing the kinematic viscosity ν, thereby increasing Reynolds' number. Thus, in the compressed air wind tunnel, air compressed to as high as 300 pounds per square inch is employed and the value of $\frac{Vl}{\nu}$ thereby brought up to full scale values.

* V—velocity, l—linear dimension.
ν—kinematic viscosity.

It is the endeavour in wind tunnel practice to make conditions as nearly as possible ideal, not because such conditions are easy of attainment or are met with in actual flight but largely because of difficulty in properly defining any other conditions and uncertainty as to the effect of departures from the ideal. Besides, if the tunnel air stream is ideal, it is relatively easy to render the stream otherwise, but the reverse cannot so readily be accomplished. The requirements of the air stream in a wind tunnel are therefore:

(1) Velocity of flow uniform throughout.
(2) Velocity of flow constant, i.e., non pulsating.
(3) Direction of flow constant.

These requirements, if fully met, would result in laminar flow in the air stream with complete absence of turbulence. This cannot be attained in practice, but by careful design and construction an air stream of remarkable smoothness and steadiness can be secured in a wind tunnel.

Types of Wind Tunnel

Depending upon their form, modern wind tunnels are classified as (*a*) free or closed return, depending upon whether the air after being drawn past the model by the propeller or fan passes back to the nozzle through the room quite unconstrained, or is returned through closed passages. Free return tunnels, while more efficient from a power standpoint, require very large buildings to house them if satisfactory steadiness of the air stream is to be secured. The small building required to house a closed return tunnel is one of its greatest advantages. (*b*) Open or closed tunnels depending upon whether the air stream in which the model is placed is a free unconfined jet issuing from a nozzle or is confined in a closed tube. The open jet is generally more convenient to work with since the model is readily accessible and troubles with pressure seals, etc., are obviated. The open tunnel is, however, somewhat less efficient than the closed tunnel.

Elements of Wind Tunnel

All wind tunnels, while differing in form, comprise the same main elements, namely:—

(1) Nozzle in which velocity of the air is increased.
(2) Straightening devices (honeycomb).
(3) Experimental room or test chamber in which the tests are made.
(4) Expanding cone in which the air is decelerated before reaching the propeller.
(5) Propeller or fan for moving the air.
(6) Motor or other means for driving the propeller.
(7) Means for controlling the air speed.
(8) Balance for measuring reactions on the model.

The Wind Tunnel of the National Research Council

An open jet closed return form of tunnel has been adopted for the National Research Laboratories. The

Figure No. 4.—South Elevation—Test Tank Building.

Figure No. 5.—North Elevation—Test Tank Building.

tunnel has a 9-foot diameter jet, two return passages and a 13-foot diameter propeller driven by a 600-h.p. motor which it is anticipated will develop a maximum air speed in the jet of over 125 miles per hour. Provision will be made for enclosing the jet should this be desirable for certain work or to improve the efficiency.

An existing building, see figures Nos. 1 and 2, on the site of the laboratories was used to house the wind tunnel. The building is of reinforced concrete and brick construction, 142 feet long by 51 feet wide, 25 feet high at centre and 18 feet high at the sides. The cross section of the building in size and form was such as to accommodate a tunnel 9 feet in diameter, with double return passages, while the length enables a separate motor room and office to be provided at one end.

The tunnel will permit aeroplane models of span up to 5 feet to be tested at a speed of 125 m.p.h. or say 200 f.p.s. corresponding to a *Vl* of 150 as compared with a full scale value of from 500 for a small aeroplane to 1,500 for a large machine.

The general arrangement of the tunnel is shown in figure No. 3 and a somewhat detailed description of the elements is given in the following:

Nozzle

The form of nozzle is one that has been found very satisfactory in practice. In the whole nozzle there is a change of section from a 17-foot square to a 9-foot diameter circle. Part of this is accomplished in a concrete section and part in a wooden nozzle proper.

This form of nozzle possesses several important advantages. It permits the honeycomb to be located in a region of low velocity and the power lost in the honeycomb is consequently much reduced as compared with that resulting if the honeycomb is placed in a high-speed region.

Vortices produced by the honeycomb have a relatively long way to travel and are hence much reduced before reaching the experimental region.

In the nozzle the area is reduced from 289 square feet to 63.6 square feet and the velocity increased therefore in the ratio 4.54:1 while the kinetic energy is increased over 20 times. This increase is produced by the pressure difference between the inside of the tunnel and the experimental region. The pressure difference being constant and responsible for 95 per cent of the kinetic energy, it follows that variations of kinetic energy due to velocity fluctuations in the air entering the nozzle cannot exceed 5 per cent and normally will be much less than 2 per cent corresponding to 1 per cent velocity variation. The nozzle thus ensures a very uniform distribution of velocity throughout the cross section of the jet. Velocity variations of less than $\pm$ 0.5 are not uncommon with nozzles of this form.

As is seen in figure No. 3, the entrance section of the nozzle of the Ottawa tunnel is constructed in heavy reinforced concrete, the section changing here from a 17-foot square to a 14 feet 9 inches diameter in a length of 11 feet. The nozzle proper is constructed of cedar staves, and the diameter here changes from 14 feet 9 inches to 9 feet diameter in 9 feet.

The wooden nozzle is supported from the concrete portion by eight tie rods running to shackles bolted to a steel ring anchored in the face of the concrete. The tie rods enable the nozzle to be adjusted slightly to properly align the jet. The joint between the wooden and concrete sections is of special design to permit this being done.

Honeycomb

The honeycomb is made of 20 gauge metal, in the form of 2-inch cells, 9 inches long parallel to the air flow. The cells are fabricated in strips and suspended from steel beams in the roof of the square section of the nozzle.

Jet

The jet leaves the nozzle and traverses the experimental room to enter the expanding cone. The free length of the jet is 12 feet. It is in this jet that the models are suspended for test. Since the velocity in the jet is 4½ times that at the entrance to the nozzle, the pressure at the jet and hence in the experimental room is much less than that at the entrance to the nozzle or anywhere else in the air circuit. Hence if the pressure in the experimental room is atmospheric, that elsewhere in the tunnel and passages is above atmospheric. For a jet speed of 125 m.p.h. the pressure in the 17-foot square entrance to the nozzle will be over 50 pounds per square foot.

While it is possible by bleeding at suitable points in the air circuit to adjust the pressure in the experimental room to any desired pressure between atmospheric and a suction of 50 pounds per square foot, it is probable that the experimental room will be kept at atmospheric pressure for sake of convenience of manipulation.

Since the friction of the air in the jet on the air in the experimental room is higher than that of the air on a smooth solid surface, the efficiency of a tunnel can be improved by enclosing the jet. It is proposed to provide a nine-foot diameter section to be fitted between the nozzle and expanding cone of the Ottawa tunnel so that it may be converted into a closed tunnel should this be desirable for any special work.

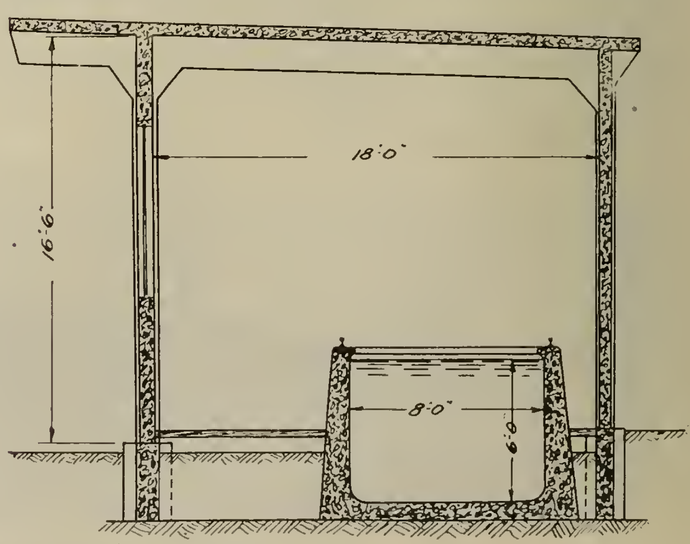

Figure No. 6.—Cross Section of Tank and Building.

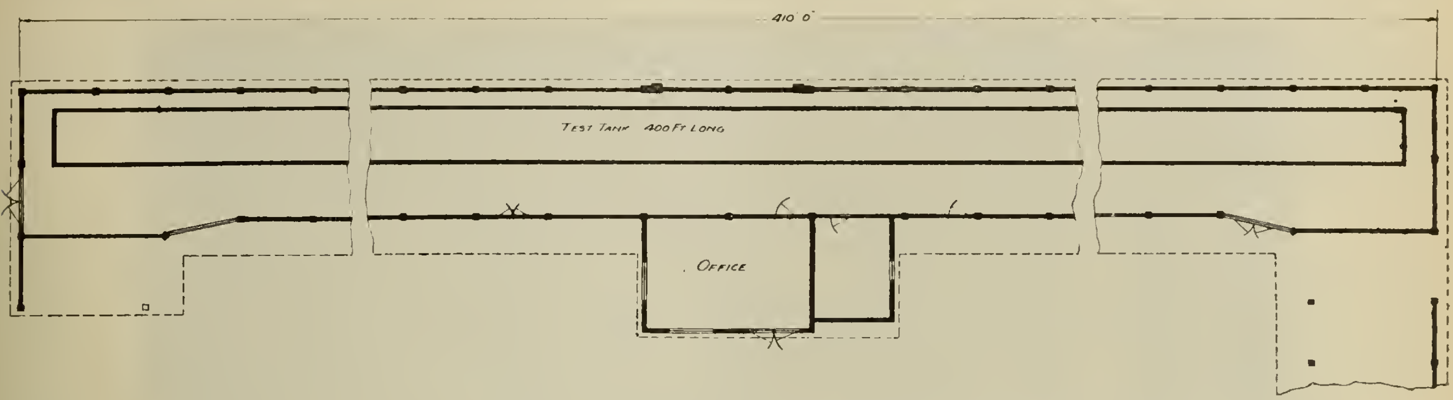

Figure No. 7.—Plan of Tank and Building.

Collecting Bell

The air jet from a nozzle such as this, in passing across the experimental room suffers a certain amount of dispersion. The outside periphery of the jet intermingles with the surrounding air setting up a boundary region of eddies which increases in thickness with distance from the nozzle. The inner core of air with a velocity constant in magnitude and direction throughout, and initially of diameter about 85 per cent the diameter of the nozzle, grows gradually smaller in diameter, the included angle being about 9°, while the overall diameter of the jet including the boundary vortex region increases in diameter. The velocities in the boundary region decrease rapidly from that of the jet to zero at the periphery.

In order that there may be little spilling of the jet, with consequent setting up of undesirable air currents in the experimental room, the small end of the expanding cone leading to the propeller is made larger in diameter than the nozzle (10 feet) and is provided with a flared collecting bell with a maximum diameter of 14 feet. The collecting bell is of wood constructed in a similar way to the nozzle.

Expanding Cone

Entering the collecting bell the air passes into the expanding cone in which its velocity is decreased before reaching the propeller rotating in a cylindrical ring at the end of the cone. The expanding cone acts in the same way as the draft tube in an hydraulic turbine. Its function is to reduce the velocity of the air and permit a large diameter slow speed propeller to be employed. Such a propeller is somewhat more efficient than a small diameter high-speed propeller. It is also desirable to decelerate the air as rapidly as possible after the experimental region is passed in order to reduce power loss in friction on the walls of the passages. Care must be taken that the expansion in the cone does not take place too rapidly, however, as otherwise the air will leave the surface and vortices will be set up with consequent power loss. The cone of the Ottawa tunnel is of wood stave pipe construction and is supported on structural steel cradles. The joint between cone and collecting bell is such as to accommodate shrinkage and contraction.

Propeller Assembly

A four-blade metal propeller, 13 feet in diameter, is used. The propeller will have blades of duralumin anchored in a nickel steel hub in such a way as to permit adjustment of the incidence of the blades for the finer tuning up of the tunnel.

The propeller is mounted on a shaft extending through the end wall of the tunnel to the motor. At the propeller end the shaft is carried in a roller bearing supported on three cast-iron stream line radial arms extending from a cast-iron ring set in the concrete of the tunnel. The arms are inclined backward from the propeller to avoid as far as possible interference with the blades and three arms are used to avoid synchronization with the blades that might result if two or four arms were used. The cast-iron ring surrounding the propeller is machined inside to 13 feet 0 inches $\pm \frac{1}{16}$ inch. The accurately turned ring permits operation of the propeller with only ¼-inch clearance between blade tips and ring.

A steady bearing, (roller), held by three tie rods supports the shaft midway between propeller and wall.

The propeller is fitted with a spinner and the two bearings are enclosed in a tapering sheet metal casing, the whole forming a neat housing offering little resistance or obstruction to the air.

At the wall the shaft passes through a sealing plate to prevent air leakage from the tunnel.

On the motor side of the wall the shaft is carried in a third roller bearing mounted in a pedestal bolted to the motor foundation. This bearing takes up the propeller thrust. The propeller shaft is thus in tension. The shaft beyond the bearing is coupled through a flexible coupling, (to permit motor armature to float), to the motor.

The maximum speed of rotation of the propeller, when absorbing 600 h.p. is 1,000 r.p.m. At this speed the tip velocity is only about 680 feet per second.

Return Passages and Vanes

Behind the propeller there is a short transition section in which the section changes from a 13-foot circle to a 13-foot square. At this point the air divides and returns via two return passages to the nozzle.

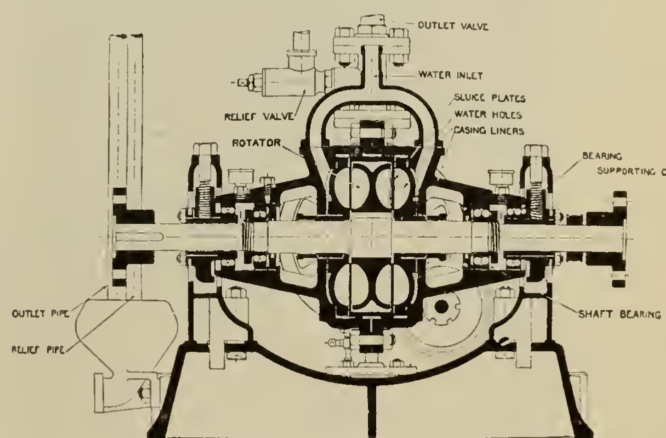

Figure No. 8.—Section of Dynamometer.

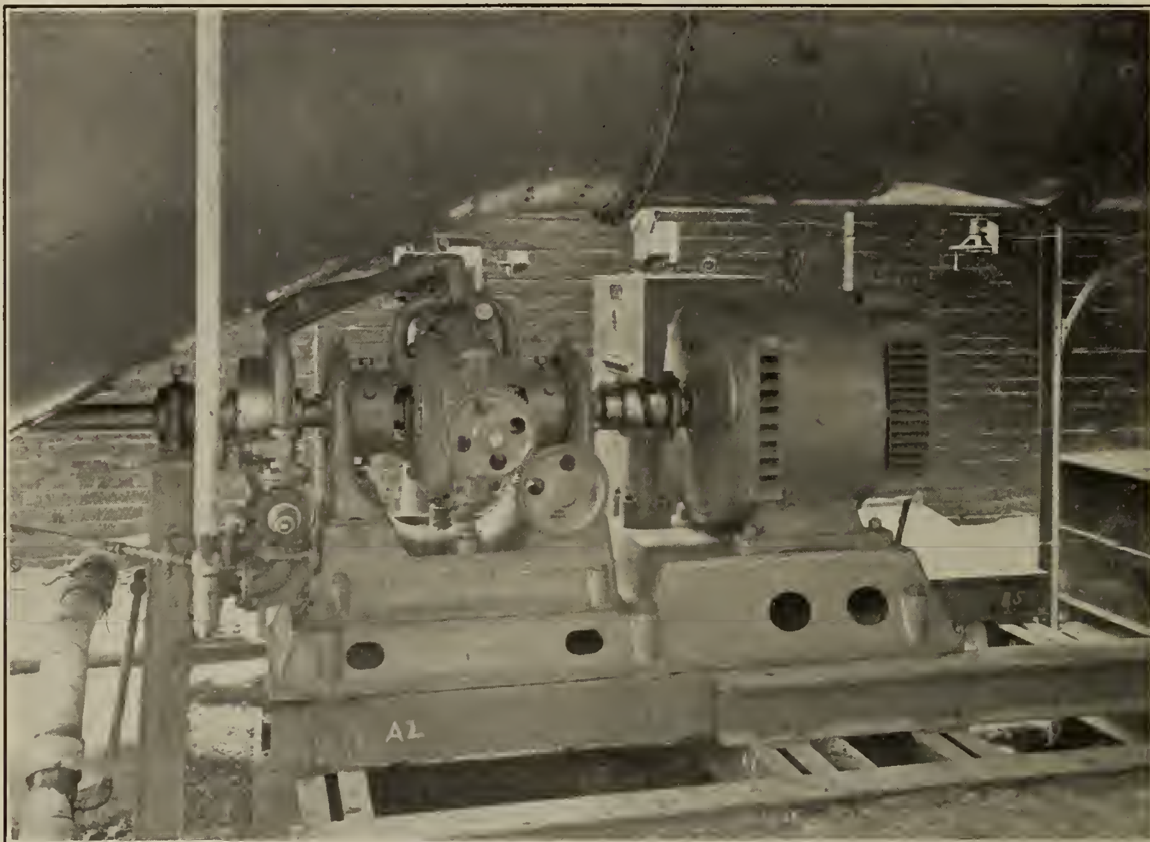

Figure No. 9.—Dynamometer.

The return passages are rectangular in section with height everywhere twice the width. In each passage there is a gradual enlargement from the initial 6 feet 6 inches by 13 feet 0 inches section to the final 8 feet 6 inches by 17 feet 0 inches where the passages join in the nozzle.

Because of the pressures on the walls of the return passages these have been made of reinforced concrete and are quite independent of the building proper. The footings for walls, foundations, etc., all extend to bedrock, see figure No. 3, which fortunately is here close to the surface.

The directing of the air around the corners in the passages with a minimum of loss and turbulence and without disturbing the uniformity of velocity is a matter of some difficulty. In certain tunnels the bends are of large radius with one or two large radius guide vanes to keep the air from sliding to the outside of the bend. Prandtl employs a large number of relatively small aerofoil shaped vanes made of concrete and metal, (similar vanes of welded sheet steel have also been used). The proper form, arrangement and construction of vanes to use at Ottawa is the subject of a research now in progress at the laboratories. It is hoped to improve on existing constructions.

Electrical System and Speed Control

It is not feasible at this time to describe in detail the electrical installation and control equipment being installed and a brief description only is therefore given.

The propeller motor is of the shunt type with commutating poles, a continuous rating of 600 h.p. at 1,000 r.p.m. with 40°C. rise of temperature and a 2-hour 25 per cent overload at about 1,075 r.p.m. A speed range from under 100 r.p.m. to the overload maximum is provided.

The propeller motor is supplied from a motor generator set consisting of 2,200 volt, 3-phase, 60-cycle synchronous motor and a 250-volt variable voltage d.c. generator, together with necessary exciters. The starting of the set is by semi-automatic starter and the set may be stopped by push button from a number of operating stations.

Speed control of the propeller motor initially is manual from any one of three control stations. An automatic control, actuated directly by the air is being developed.

Complete protective devices, rheostats and meter equipment are provided.

The synchronous motor is supplied from a 1,000-kw. alternator in the hydraulic plant of the Council on the site of the laboratories. The plant develops the power of the Rideau falls.

The electrical machines and control panels are installed in a machine room in one end of the wind tunnel building as shown in figure No. 3.

There is also installed in the machine room a smaller motor generator set comprising a 50-h.p. induction motor and variable voltage d.c., generator, complete with control panels. This set is used to supply the motor of the aircraft propeller testing dynamometer.

Cooling

When the tunnel is operating at maximum capacity some 600 h.p. will be dissipated as heat in the air in the tunnel. As this quantity of heat cannot pass through the walls to the outside air, there will be a rise in temperature of the air circulating in the tunnel which may prove excessive, particularly in summer. Hence provision has to be made for removing artificially some of the heat. Two methods have been considered: (1) By bleeding a portion of the heated air from the tunnel at a suitable point and drawing in a corresponding quantity of cooler air at another point, or (2) By use of auxiliary water cooled surfaces. Satisfactory means of putting each of these methods into practice for the Ottawa tunnel have been developed. One or the other will be employed as a safety measure although it is probable that the temperature rise will not be excessive except in the case of a run at full capacity extending over a considerable time.

Balances

The balances for the tunnel are now being designed. They are to be of the wire suspension type supported on a rigid concrete platform carried on concrete posts extending from a massive concrete block resting on bedrock. The balances will be made in the shops of the Council now being erected and equipped.

Balance Room

A floor has been built in the upper portion of the building at the level of the balance platform over the motor room and expanding cone and a room thus provided from which the balances are operated. The balance room is reached by stairs from the motor room and a stair extends down to the floor of the experimental room.

Hydrodynamic Laboratory—Test Tank

Because of the large water areas present in most sections of the country, aircraft of the flying boat type or equipped with floats are much used in Canada. There is perhaps a larger proportion of marine aircraft in use in the Dominion than in any other country. The improvement of the type is therefore of great and immediate importance to the Dominion.

Efforts made up to the present in Canada to develop new types of marine aircraft for special services have been seriously handicapped by the complete lack of experimental facilities in the country. The National Research Council, realizing the need of such facilities, is providing suitable experimental and research facilities. A towing tank for the testing of floats and hulls is being built at Ottawa. This tank will be the only one in Canada, and will be invaluable in improving the water performance of aircraft floats and hulls.

In marine practice the towing basin or test tank has proved of inestimable value to the naval architect and ship builder. No important vessel is now built without first making model trials in a test tank. By so doing, not only is the performance very often much improved, but in many cases failure to attain the anticipated performance is prevented. Most recent developments have been due to systematic work in test tanks.

The ship test tank has been used for many years for testing models of aircraft floats and hulls, but, as the conditions in marine and in aeronautical work differ materially, such ship test tanks are not altogether satisfactory for testing aircraft models. In spite of the handicaps, however, a great deal of aeronautical testing is done in the ship tanks and much valuable information secured. A few tanks of small size, built for aircraft work, are in successful operation, and larger ones are projected, if not already under construction. In a test tank, unlike a wind tunnel, the model, attached to a dynamometer or balance, carried on a towing carriage, is drawn through still water. As in the wind tunnel, the test conditions are made as nearly ideal as possible, largely because of the difficulty of adequately defining any other conditions. Hence, the water in the tank is perfectly still, free from waves, surface dust, floating matter, etc.

To secure these conditions the water is skimmed daily and special devices installed for quickly suppressing waves to reduce the time lost in waiting for the waves to subside between test runs.

The information derived from a model test in a towing tank includes:

(1) Resistance at different speeds, attitudes and drafts.

(2) Attitude and behaviour under different conditions.

(3) Cleanness and wave formation.

(4) Influence of air control surfaces on behaviour.

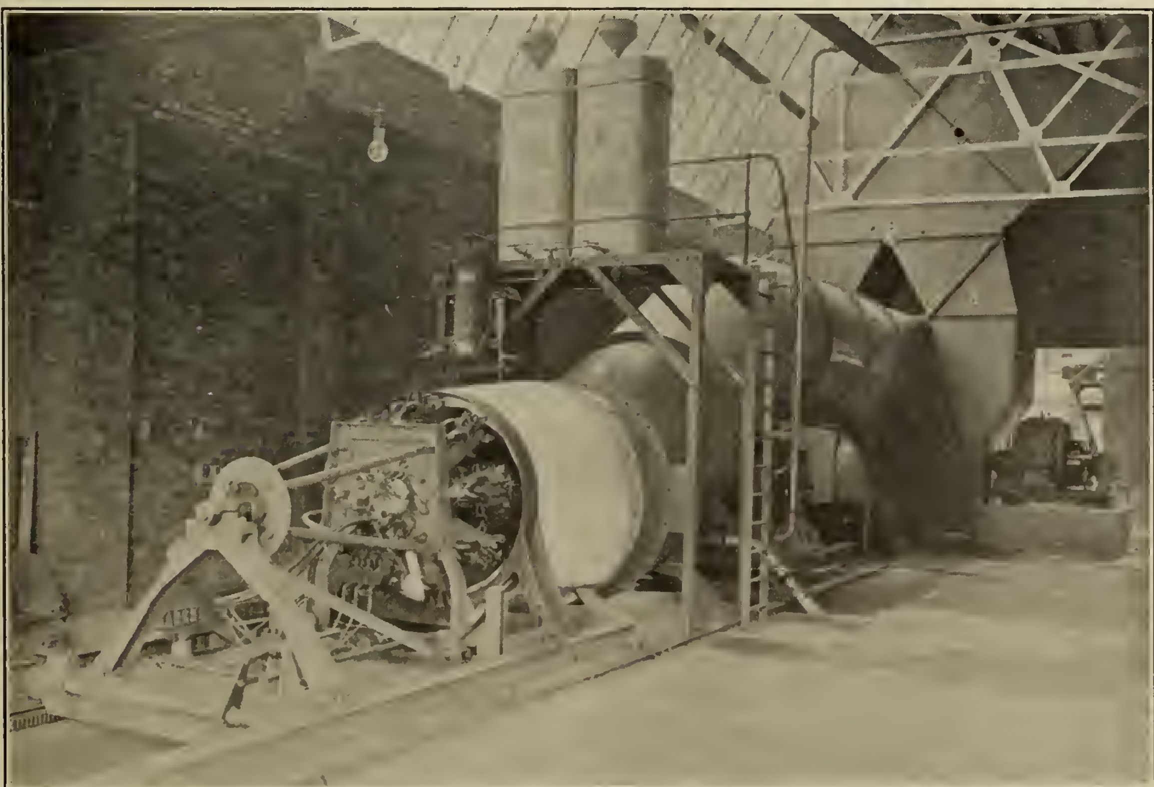

Figure No. 10.—Dynamometer showing Nozzle, Air-duct, etc.

Conditions Governing Tank Tests and Size of Tank

The conditions to be satisfied in making a hydrodynamic test of a model float or hull are different to those in the case of an aerodynamic test. In the hydrodynamic test Froude's Law is applicable. This law states that for similarity of conditions, enabling model results to be applied to corresponding full scale craft $\frac{v^2}{lg}$ must be the same for both model and full scale. $\frac{v^2}{lg}$ is the so-called "wave-making term" of the general equation for the reaction on a body moving in a fluid, derived by application of the theory of dimensions.

It follows from Froude's law that if results of tank tests on a model of dimensions l are to be applicable to a full size hull of corresponding dimension L at a full scale speed of V, the model must be tested at a speed v such $\frac{v}{\sqrt{l}} = \frac{V}{\sqrt{L}}$ or $v = \sqrt{\frac{l}{L}}\,V$. In other words, if a 1/9 scale model is used, it must be tested at ⅓ full scale speed; if ¼ scale, at ½ full scale speed. As the model size increases, the speed of test also increases. The problem thus appears simpler than in the case of aerodynamic tests in a wind tunnel, since, by reducing the scale of the model, quite low speed can be used. There are, however, serious disadvantages in using a small model. Not only is it difficult to secure the necessary accuracy in form, but the forces to be measured become so small as to render their accurate measurement difficult, and the effects of dust, etc., on the surface, become serious. If a model sufficiently large to overcome these difficulties is employed, the test speeds must be high. The low speed is one of the chief handicaps encountered in using existing ship tanks for aeronautical work. No existing ship tank is capable of testing a model of usual scale up to flying speed.

Test tanks for aeronautical work are hence designed for high speed. This, in turn, involves a tank much longer than ship tanks since the carriage has to be accelerated to this high speed and later decelerated. In Canada, unless the tank is to be useless during a large part of the year, a test tank must be sheltered in a heated building, and the cost of the building necessary to house a tank of adequate length is prohibitive.

There are also definite restrictions on the ratio of model size to tank cross section to avoid boundary effects. Lamb has deduced theoretically that for a model of usual proportions, if the tank width is twice the length of the model, the resistance measurements will be in error 1 per cent and 6 per cent in error if tank width equals the length of the model. These deductions have been confirmed experimentally.

To avoid wall interference effects, the bow wave must meet the wall aft of the model. This means that the higher the speed the narrower may be the tank for a given model size.

Dimensions of the National Research Council Tank

In deciding on the dimensions to be adopted for the tank of the National Research Council it was necessary to compromise. Fortunately, the decision was somewhat simplified in that a building or rather two buildings (see figures Nos. 4 and 5) were available on the site of the laboratories, which, with comparatively little alteration, could be converted into a single building 410 feet long. The cross section is 18 feet wide by 16 feet high. This building also is of reinforced concrete and brick construction and bedrock, most important in the case of a tank, is but a few feet below the surface. Accordingly, the tank at Ottawa is 400 feet long, 8 feet wide and 6 feet deep. Of the length, 150 feet will be used for acceleration, 150 feet for the constant speed run and 100 feet for deceleration. The 8-foot beam of the tank will permit the testing of models 4 feet long.

Construction of Tank

The tank is constructed of heavy reinforced concrete with tapered walls, heavy base, and rounded corners. A cross section of the tank and buildings is shown in figure No. 6, and a ground plan of the tank and building in figure No. 7. The carriage runs on rails laid on top of the tank sides. The rails are planed level on top, welded together, and will be ground to bring the top surface parallel to the water surface. The head of one rail will, in addition, be ground on the two sides to as nearly a straight line as possible to serve as a guide rail.

Carriage

The carriage of the tank is constructed of structural steel. It is carried on four cast iron wheels, turned accurately to the same diameter, mounted on shafts carried in roller bearings. There is, in addition, a pair of guide rollers at each end of the carriage on one side, each pair consisting of one rigidly mounted roller running in contact with the machined outside of the rail head and one roller mounted on a swinging arm held in contact with the inside of the rail head by a stiff spring. Two similar devices, but provided with shoes operating on the other rail, are used for decelerating the car. The use of shoes acting in this way provides more positive braking, little affected by water on the rails, and without danger of wearing flats on the track wheels or damaging the ground rail surface due to slipping. The shoes are applied automatically with the cutting off of the power at the end of the constant speed portion of the run.

A 25-h.p. shunt motor provides the motive power for accelerating and driving the carriage. As the greater the acceleration, the longer will be the period of the constant speed or testing part of the run, a high rate of acceleration is desirable provided the balance and model can be arranged to withstand the large inertia forces resulting from the high acceleration. Relying on the traction between turned metal wheels on smoothly machined rails, often wet from the waves thrown up by the model, the maximum acceleration possible will likely be low, hence other methods of drive are under consideration. At this time a decision has not been reached regarding the type of drive to be used.

A speed of at least 20 feet per second (about 12 knots per hour) will be secured. With a constant speed run of 150 feet, the period for measurement will be not over 7½ seconds. Any attempt to adjust the speed to an exact figure of say 20 f.p.s. in this short time is thus futile and the runs will be made by adjusting the rheostats to give a speed near that desired and the run made without any attempt at speed control during the run.

The carriage is also provided with a side outrigger for carrying an observer in a position convenient for observing wave formation and also a camera for photographing the wave formation.

Towing Balance of Dynamometer

Owing to the very short time available for measurement at constant speed, the balance must be made self-recording. Further, it must permit the model to assume its natural attitude in the water (under the applied forces) without restraint. It must permit of the application to the float of forces representing the dead weight of the machine and lift of the wings and of adjustment of the centre of gravity of the float assembly to a position corresponding to that in the full scale machine. It must also permit of the application of moments to the model corresponding to those due to propeller thrust and control surfaces of the aircraft.

A balance fulfilling all of these requirements is now being designed. It will record on a drum, automatically, attitude, draft, resistance, distance and time.

Distance will be recorded electrically through accurately spaced contacts along the rail. Time will be electrically recorded by accurate chronometer on shore. These two records will enable the velocity to be determined with precision.

Power Plant Equipment

There are now, in Canada, three firms assembling aircraft engines primarily to supply the Canadian demand, but already Canadian assembled engines are being exported. Under Air Regulations 1920, the Dominion Government is required to carry out tests to establish the airworthiness of aircraft engines for export. At the present time, there is no equipment in the country for this purpose.

The testing of engines for this purpose is very properly a function of the National Research Council and the Council is accordingly installing equipment for the performance testing of aircraft engines. The equipment, due to its flexibility and range will enable much research work to be carried on in connection with internal combustion engines. Being the only equipment of its type and size in the country, investigations of a character not otherwise possible may be made.

A complete engine testing plant is being installed capable of accommodating aircraft engines of any type, air or water-cooled, tractor or pusher, right or left hand rotation, and of absorbing powers up to 1,000 h.p. at speeds up to 2,500 r.p.m.

The equipment is unique in that provision is made for applying thrusts to the crankshaft corresponding to propeller thrusts up to 6,000 lbs. This is accomplished by means of weights acting through a bell crank on the carriage on which the dynamometer is mounted.

The dynamometer is of the hydraulic type, built by Messrs. Heenan and Froude of Worcester, England. A section through the dynamometer is shown in figure No. 8. In this dynamometer the shaft carries a rotor, in the faces of which are formed semi-elliptical pockets. The internal faces of the casing are similarly recessed. The pockets in rotor and casing together form elliptical chambers around which water courses at high speed, the vortices thus formed absorbing the power developed by the engine. The water circulated through the casing not only provides the hydraulic resistance but carries away the heat generated thereby.

The load applied by the dynamometer is regulated by a handwheel which controls the radial position of diaphragms between rotor and casing by which the power absorbing cups may be masked to any desired extent.

For testing air-cooled engines, a large, centrifugal fan, driven by a 250-h.p. motor, discharges a blast of air through a cylindrical duct and adjustable nozzle, past the engine cylinders. Air-speeds up to 130 m.p.h. are obtainable.

Complete auxiliary apparatus is provided such as starting motor, tachometer, flow meters, oil coolers and heater.

Equipment similar to that of the National Research Council is shown in figures Nos. 9 and 10.

There is also in the laboratories, a small single cylinder unit for testing engine fuels in which routine tests of fuels are made, and investigations of detonation carried on.

Conclusion

It will be apparent from the foregoing that the aeronautical laboratories being installed by the National Research Council of Canada, satisfy a national need in providing research and testing facilities that exist nowhere else in the Dominion. The aeronautical researches rendered possible and the training afforded young men by the laboratories will do much to improve Canadian aircraft and extend their usefulness.

Thus aviation in Canada will be advanced, the development of the country accelerated and the Dominion rendered independent and self-supporting in aeronautics.

Rigid Airships

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Men have always had an ambition to fly and the folk lore of practically all nations is full of myths relating to flight through the air.

Phrixos and his sister Helle flew over the sea on the ram with the golden fleece. Daedalus and his son Icarus attempted to escape from the Isle of Crete by making wings of feathers, but Icarus flew so near the sun that the heat melted the wax which fixed the wings to his body, and he fell into the sea.

We have read of Bellerophon who, mounted on the winged horse Pegasus, killed the dragon; and also of Hermes the messenger of the gods. Abaris travelled around the world on a golden arrow, while Gellius tells of a wooden pigeon which flew by means of a mechanism of balancing weights.

In the realm of legendary history we are told that Xerxes was given a winged throne, (figure No. 1), which flew by the aid of four tame eagles.

The Chinese are reported to have sent up a balloon on the day of the coronation of Emperor Fo-Kien in 1306. Sketches of flying machines by Leonardo de Vinci still exist. Cyrano de Bergerac fastened air bags to his body, and allowed them to heat in the sun with the idea that the heated air would lift him.

Francisco de Lana seemed to have some sound ideas upon airship construction by his assumption that a body lighter than air would rise. He proposed to construct four metal spheres attached by ropes to a boat, and to exhaust the air from the spheres, thus creating a vacuum to supply the necessary lift. (figure No. 2). He finally came to the conclusion that his scheme could scarcely hope to be successful as God would prevent such a revolution in human affairs.

Probably the first really successful navigation of the air was that done by the Montgolfier brothers, who constructed a hot air balloon in 1783. (Figure No. 3). From then the development of the balloon as we have it today and of the dirigible balloon was largely a matter of detail.

In this paper it is intended to deal only with that type of lighter-than-air craft now known as the rigid airship.

Lighter-than-air craft can be described as aircraft which depend upon a lifting gas for support, thus distinguishing them from heavier-than-air craft which depend upon the lifting force produced by the motion of a plane surface through the air, and which will not remain in the air when the relative motion between the lifting surface and the air is diminished below a predetermined figure.

Lighter-than-air craft have all been developed from the free balloon, which is usually a gas tight envelope containing coal-gas or hydrogen, and to which is suspended a basket for carrying personnel.

The *dirigible balloon* is evolved from the free balloon by the addition of a motor and propeller for propulsion and means for steering in a desired direction.

When ballooning had reached a stage where it could be carried out with comparative safety, men soon became ambitious to travel in a desired direction rather than be dependent on winds. It was, therefore, natural that they should fit an engine and propeller to a balloon. The envelope of a free balloon is approximately spherical in form, but this shape is not at all suitable for a dirigible balloon which has to be driven through the air, so that as a result streamlined shaped envelopes were developed.

The desire to carry larger loads at higher speeds led to increases in size, which brought new problems, such as,

Figure No. 1.
Xerxes on his Winged Throne.

Figure No. 2.
Francisco de Lana's Airship.

Figure No. 3.
Montgolfier's Hot Air Balloon.

Figure No. 4.—Schwartz' Balloon after the Accident.

maintenance of the shape of the envelope itself, and the proper method of carrying rudders or other steering devices. This development divided the dirigible balloon, now known as the airship, into three distinct classes:—

(*a*) The *non-rigid airship*, which is practically the same thing as the original dirigible balloon.

(*b*) The *semi-rigid airship*, in which the fabric gas bag together with the carriage for power plants and the stabilizing surfaces are all connected by a rigid frame, but in which the shape of the envelope depends upon the gas pressure, and

(*c*) The *rigid airship*, in which the outside shape of the envelope is maintained by a rigid frame, which also carries all the machinery, passenger cars, stabilizing devices, etc. The lifting gas is contained in cells placed inside this rigid framework. It is this latter type of airship that will be dealt with in the present paper.

History

The history of the development of airships from the time of the first hot air balloon is full of interest, and it is with considerable regret that this period is omitted in the present paper.

The first rigid airship bearing any resemblance to those used today was built by David Schwartz in St. Petersburg in 1893. It was composed of aluminium plates rivetted to an aluminum framework, but this collapsed during inflation. In 1895 Schwartz designed a second airship, which was built in Berlin. The whole framework was made of aluminum, 155 feet long, elliptical in cross-section, having a volume of 130,500 cubic feet.

This airship hull had a pointed nose and a rounded stern. It had twelve main transverse frames, sixteen longitudinal girders and numerous intermediate members. Steering was carried out by a propeller, which could be turned about a vertical axis.

The car was rigidly attached to the hull by a lattice framework, and the whole structure was covered with aluminum sheeting 0.008 inch thick. The airship was equipped with a 12 h.p. Daimler motor, driving two aluminum propellers by means of a belt.

In 1897 the airship was inflated by placing a number of bags within the balloon, then filling them with hydrogen. These bags were then torn allowing the hydrogen to escape into the interior of the airship hull. During the first trials with a wind of about 17 miles per hour the airship ascended, but the belt slipped off the pulleys and the airship floated at the mercy of the wind. Very little damage was done on landing, but the hull began to break up by deflation, and it was completely destroyed by the spectators, (figure No. 4).

In 1898 Count Von Zeppelin conceived the idea of constructing a large rigid airship, and for this he built a large floating shed near Friedrichshafen on Lake Constance. His first airship was 420 feet long and 38.3 feet in diameter, made up of an aluminum framework of lattice girders. There were twenty-two longitudinal girders running from the nose to the stern, and these were drawn together at the ends. Sixteen rings or transverse frames reinforced with diagonal wires joined these girders, thus dividing the hull into seventeen compartments containing fabric gas bags. Between the gas bags and the outer covering there was an air space, which served to protect the gas from undesirable variations of temperature. Below the hull was a long external girder, or keel, to which the two motor gondolas were attached. The capacity was approximately 400,000 cubic feet. A sliding weight was used for changing the trim. The two gondolas each contained a 16 h.p. Daimler motor, driving propellers situated on the side of the hull through a transmission of steel tubes and universal joints. The airship had a speed of about 13½ miles an hour. During the years 1900 to 1902 it made three flights, but lack of funds and lack of public support or interest forced the dissolution of the company, (figure No. 5).

In 1905, with the assistance of King William of Württemberg, Zeppelin started on his second airship. This ship was of much the same size as the previous one, but the engines were now of 85 h.p. instead of 16 h.p. This ship was wrecked by storms under circumstances which had nothing to do with the construction of the ship, but which were mainly due to trouble in keeping the power plant running.

In April, 1906, Zeppelin commenced a third ship, which was completed in October. This ship was very much like the second, but had stabilizers added, (figure No. 6). Experiments with this ship were very successful, and resulted in considerable recognition by the public. The German Government also showed its interest by providing a new floating shed. On October the 1st, 1907, an eight hour flight of 218 miles was carried out.

Zeppelin No. 4 was probably the most notable of the early ships. It was built in 1908 and had a capacity of about 530,000 cubic feet. It was equipped with two Mercedes engines of 110 h.p. each.

In July 1908 the ship was taken over the Swiss Alps to Lucerne and back again, a journey which was acclaimed throughout the whole of Germany. On October 4th Zeppelin planned to travel down the Rhine valley, but on the return flight motor trouble caused a forced landing, and during a storm the ship was blown away and destroyed by fire.

Public sentiment was so great that an endowment fund was raised by providing $1,500,000 to be turned over to Count Zeppelin to be used as he saw fit in carrying out his experiments. From this fund the Zeppelin Endow-

Figure No. 5.—Zeppelin L.Z.1 First Ascent July 2nd, 1900.

Figure No. 6.—Zeppelin L.Z.3.

ment was formed for the propagation of air navigation. This became a holding company which was the exclusive shareholder of the airship construction company and controlled a number of subsidiary companies.

The endowment fund provided the money for the construction of the new sheds and workshops at Friedrichshafen. The great war later gave an opportunity for greatly improving the methods of construction and the performance of these airships. A total of over 100 airships were constructed at Friedrichshafen and other factories in Germany during the war period. Two airships constructed towards the end of the war are illustrated in the photographs, (figures Nos. 7 and 8).

Zeppelin L. 59 made a non-stop flight over 4,000 miles to Khartum in Africa and back during the war period.

Figure No. 9 shows the inside of one of the early airships dating about 1913.

Figure No. 10 shown the Bodensee, a comparatively small airship constructed for passenger carrying after the war and used for trips between Friedrichshafen and Berlin.

Figure No. 11 illustrates the construction of the Bodensee.

Figure No. 12 shows an inside view of the Bodensee, and figure No. 13 shows the power gondolas of the Bodensee.

By 1912 the success of the Zeppelin type of airship had brought a number of imitators. Chief amongst them was the Schütte-Lanz Company, which produced a rigid airship, having a wooden framework, wire braced.

The Schütte-Lanz airship had slightly better form than the Zeppelins, due to the fact that it had no parallel portion and conformed more nearly to what is now termed a streamline form. In all, about twenty-two ships were built by the Schütte-Lanz Company for use throughout the war. As can be seen from the photograph, (figure No. 14), the interior construction is very much like that of an early Zeppelin except that the duralumin girders are replaced by wooden girders.

In France most of the work was done on non-rigid or semi-rigid airships, but in 1912 the Zodiac Company constructed a rigid airship called the "Spiess" for the French Government, having a capacity of 575,000 cubic feet. This ship had a wooden framework divided into 14 gas cells, but its performance was unsatisfactory and it was dismantled in 1914, (figure No. 15).

In Great Britain attention was first directed to rigid airships by a contract placed with Messrs. Vickers by the Admiralty in 1908. This was the naval airship No. 1, designed for the purpose of carrying out the duties of an aerial scout for the navy. The length was fixed at approximately 500 feet with a diameter of 48 feet. The shape adopted was that recommended by Professor Zahm, which consisted of a parallel portion with a curved bow and stern, the stern having much larger radius than the bow, (figure No. 16).

Aluminum was the material selected for the construction of the airship, but the samples supplied did not reach the required strength, and in 1909 duralumin was discovered and adopted for the construction. The structure consisted of 12 longitudinal girders with transverse frames at 12½ feet centres throughout the length of the ship. Each bay in the outside framing was cross braced by wires, and the frames were supported by radial wiring similar to the spokes of a wheel. An external keel was fitted to provide communication between the two gondolas, but this keel did not add to the structural strength of the ship. The gas bags were made of rubber fabric as used by Zeppelin, goldbeater's skin having been abandoned owing to shortage of material. Valves were placed in the top of the bags contrary to the current Zeppelin practice, in which there were automatic valves at the bottom of the gas bags and hand operated valves at the top.

The ship was completed in May, 1911, and some tests on her suitability for riding at a mooring mast were made. The ship was, however, badly damaged in September when being taken from its shed, and it had to be dismantled. For sometime airship construction was discontinued, but the great success obtained by the Zeppelin Company was such that it encouraged a decision to make another attempt to build a rigid airship.

The contract for rigid airship No. 9 was signed in March, 1914. This ship was intended to be generally in conformity with Zeppelin practice. Its length was 526 feet with a maximum diameter of 53 feet. The hull shape was that recommended by Zahm, and its tranverse section was a 17-sided polygon, (figure No. 17).

The construction was practically the same as contemporary Zeppelin airships, having an external V-shaped keel through the greater part of the length. Seventeen gas bags were provided of rubber proofed fabric, lined with goldbeater's skin, and the capacity was approximately 890,000 cubic feet. The original engine equipment was four Wolseley engines of 180 h.p. each. This airship was inflated in 1916, but was not finally accepted till March, 1917. It was then used very largely for the training of officers and men, who formed the crew of later rigid airships.

The next British airships were known as the 23 class, built by Messrs. Vickers, Messrs. Beardmore and Armstrong-Whitworth. They were very similar to the 9 class, except that the length was increased to 535 feet

Figure No. 7.—Zeppelin L.71, the Last German Naval Airship.

Figure No. 8.—Zeppelin L.59 Naval Airship.

and the number of gas cells was increased to eighteen, giving a total volume of 1,000,000 cubic feet.

The system of valves was entirely different, as in these ships an automatic valve was fitted on the side of the gas cells with a top valve controlled entirely by hand. The engines consisted of four Rolls-Royce engines of 250 h.p. The later airships of this class were modified and called the 23X class, embodying a number of improvements, one of which was the abolition of the external keel, (figure No. 18). These airships were quite successful, and in spite of the radical change in the structure due to the suppression of the keel they were flown throughout their life without a mishap.

R. 31 Class

Later on the R. 31 class was built, following the type of construction employed by the Schütte-Lanz Company in Germany, incorporating a wooden structure, (figure No. 19).

These ships were 615 feet long, having a diameter of 66 feet and a capacity of 1,500,000 cubic feet. Longitudinal and transverse frames were composed of 3-ply wooden girders braced in the usual manner with wire bracing. In order to prevent excessive transverse loads due to deflation of the gas bags and the pressure of adjacent gas bags on the radial bracing, a wire was fitted along the axis of the ship and secured to the centre point of the radial wiring,—a feature not previously used on airships.

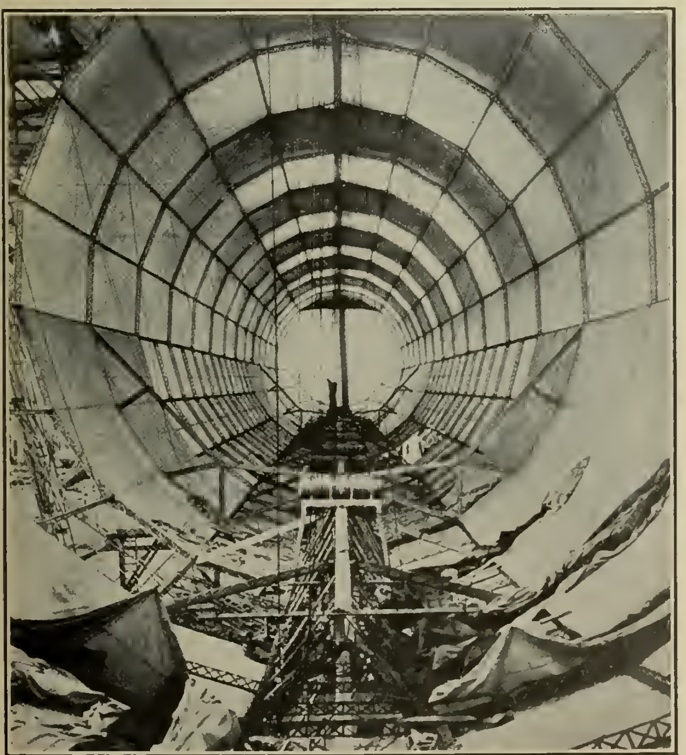

Figure No. 9.—Zeppelin L.2 Interior.

The trials were very satisfactory, but the wooden structure weathered badly, and this method of construction was given up.

R. 33 Class

In September, 1916, the German Zeppelin L. 33 was brought down in England in practically an intact condition. This airship was one of the latest German ships, having been completed only a short while before the disaster.

In January 1917, five airships were started which were to be practically the same as the L. 33. Two of these were built, the R. 33 and the R. 34, of which the R. 33 became famous, because while it was moored out to a mast it broke away from its moorings, and was brought back to its base by a small crew in a damaged condition.

The hull of these ships was of a much more nearly streamline shape, being 643 feet long with a diameter of 79 feet. The hull was fitted with an internal triangular keel containing water ballast, fuel, crew accommodation, etc. These ships were equipped with five engines of 250 h.p. each.

The R. 34, which was a sister ship, was rather more successful than the R. 33. It was employed in 1919 for the return trip across the Atlantic and with conspicuous success even although there was some anxiety when approaching the American shore on the outward journey due to adverse winds and a shortage of fuel, (figure No. 20).

Two other ships were constructed in England after the war, the R. 38 of 2,750,000 cubic feet capacity, built for the United States Government, and the R. 80 of 1,500,000 cubic feet capacity. This latter embodied many new features of design, including a considerably shorter length to diameter ratio, but was dismantled on the disbanding of the airship service in England. The R. 38 which was built for the United States Government was destroyed during its manoeuvring trials.

In the United States a rigid airship was constructed after the war called the "Shenandoah." This airship embodied all the experience collected by the allies during the war period, and was successfully used for approximately two years, but eventually came to disaster during a bad storm in 1925.

The accidents to the R. 38 and the "Shenandoah" led to a re-examination of all the conditions which related to the problem of airship construction and operation, with the result that Great Britain decided to make some radical changes in the methods of design employed for airships of this type. Similar influences may be seen in the proposed airships to be built for the United States.

Before entering into a detailed description of these more modern airships it is desirable to examine briefly the theoretical considerations which enter into the problem.

Aerostatics

The Atmosphere

When a body is floating immersed in a liquid we know by the Law of Archimedes that the weight of the body is equal to the weight of liquid displaced by the body.

An airship standing still in the air is floating immersed in a liquid, i.e. the atmosphere, and, therefore, the weight of the air displaced by the airship is equal to the weight of the airship, which in turn can be divided into the weight of the gas, the weight of the structure and other fixed loads, together with the weight of the fuel, crew, ballast and other movable loads. The difference between the weight of the air displaced, and the weight of the gas is

Figure No. 10.—Delag Passenger Zeppelin "Bodensee."

called the "gross lift." The "net lift" is obtained by deducting the weight of the structure and other fixed loads from the "gross lift."

It becomes necessary to study the properties of the air before studying the properties of the lifting gases employed in airships.

The air may be considered as a mixture of gases containing 79 per cent of nitrogen and 21 per cent of oxygen, with traces of other gases. The weight of a cubic foot of dry air at 60° F. and a pressure of 29.92 inches of mercury is 0.0764 lbs. The air acts as an almost perfect gas under the conditions to be considered here, and follows the well know law $PV=RT$, from which the effect of pressure P can be seen, and the effect of temperature is such that the density of the air is inversely proportional to absolute temperature.

Changes in barometric pressure at sea level have comparatively little effect on density, because these pressure changes are small and take place slowly, but changes in temperature have large effects on density. A change from $-20°$ F. to 100° F. decreases the density by some 27 per cent. Clouding over of the sky may cause an increase in density of some 3 per cent. Changes in humidity also have sufficient effect to warrant consideration.

The *effect of altitude* is very important, because of the large diminution in pressure which is involved and the consequent decrease in the density of the air.

Lifting Gases

Of the gases, lighter-than-air, which are available for airship use all may be neglected except hydrogen and helium.

Hydrogen is by far the most widely used gas at present. Its weight per cubic foot at a temperature of 60° F. and pressure of 29.92 in. of mercury is 0.0053 lbs. Hydrogen is seldom pure, and it is impossible to inflate an airship with 100 per cent pure gas. The purity when first put into the ship may be 98 per cent but quickly deteriorates, and a figure of 96 per cent purity is usually taken. When the hydrogen becomes mixed with too much air it has to be changed. A serious disadvantage in the use of hydrogen is its inflammability, but with care in the design of an airship allowing for ample ventilation of the hull, the risk can be minimized. The lift to be obtained from 1,000 cubic feet of 96 per cent pure hydrogen under standard conditions is equal to the difference between the weights of the air and hydrogen or $(76.4-5.3)\times0.96=68$ lbs. approximately.

Helium

This gas is slightly heavier than hydrogen, but has the great advantage of being non-inflammable. Until recently the cost was excessive, but in the United States helium is now available in sufficient quantities for their present airship programme. The weight of a cubic foot of helium under standard conditions is given as .0105 lbs. so that the lift obtained from 1,000 cubic feet of 96 per cent pure helium is $(76.4-10.5)\times0.96=63$ lbs. approximately.

Superheating

A difference of temperature usually exists between the gas in the cells of an airship and the surrounding air, due to the absorption of heat from sunshine. The outside covers of airships are usually treated with an aluminum coloured dope to reduce this effect, and ventilation of the space between the cells and the outer cover also assists.

The reverse effect may also be obtained when an airship is taken out of a comparatively cool shed into the atmosphere, which has been warmed by sunshine.

Some interesting remarks upon this subject may be found in the "log of R. 34," which airship was frequently purposely flown in clouds to obtain protection against superheating during its transatlantic flights.

Airship Aerostatics

When a balloon or airship is at rest at an altitude such that the gas cells are just full, their lower ends being open to the atmosphere, the ship is said to be at its "pressure height." If ballast is thrown out, the ship will rise and gas will flow out of the cells, until a new pressure height is reached corresponding to its changed weight.

During the greater part of a flight a rigid airship is operated with the gas cells partially empty, the lower part of each cell hanging as a wrinkled mass of fabric.

When starting on a long flight with the maximum possible load it is necessary to start with the maximum possible lift, and the gas cells will be nearly filled at starting, but in this condition the airship will have a low pressure height which will increase as the consumption of fuel reduces the load. After a certain time it will become necessary to let out gas, thus putting the gas cells again into the partially empty condition.

It is, of course, desirable to avoid letting out gas and to keep the weight as constant as possible. For this reason the recovery of water from the exhaust gases is very desirable. With a nearly constant weight it is possible to start with the gas cells partially empty to the extent that the pressure height of the ship is the maximum altitude that the ship is expected to reach during the trip.

With partially empty gas cells it is possible for a rigid airship to operate at any height between sea level and the predetermined pressure height, by means of dynamic controls without releasing either gas or ballast.

Dynamic Lift

In addition to the control of altitude by the discharge of gas or ballast, an airship may be forced up or down whilst in flight by the aerodynamic forces on the hull

Figure No. 11.—Crew's Quarters "Bodensee."

and control surfaces due to the motion through the air. A very great lifting effort may be obtained in this way.

Ballast

In a rigid airship the ballast required for manoeuvring is generally carried in the form of water distributed in waterproofed fabric containers along the keel of the ship. These containers can be discharged rapidly by controls from the control car. An antifreeze mixture is necessary under many conditions, but in addition the containers can themselves be dropped if the water should become frozen.

Fuels

In common with the automobile and aeroplane, the development of the airship commenced when a suitable internal combustion engine became available; consequently practically all airships have used gasoline as a fuel. There are many disadvantages connected with the use of this fuel for airships, not the least of which is that, for a given energy equivalent the net load to be carried by the aircraft is high compared with a gaseous fuel, and the fire risk is always present, but particularly in case of damage to the airship structure.

Heavy oils having much higher flash points than gasoline appear to offer good possibilities by removing a great deal of the fire risk, and if combined with water recovery from the exhaust gases, the loss of weight due to consumption of fuel can be considerably reduced.

When considerable weight has been lost it may become necessary to release gas to maintain equilibrium, and, therefore, it has been suggested that instead of valving out the gas it should be used as a fuel in the engines in conjunction with a liquid fuel, and in such proportions that the static equilibrium of the airship would be maintained. This system seems attractive, but has yet to be worked out practically.

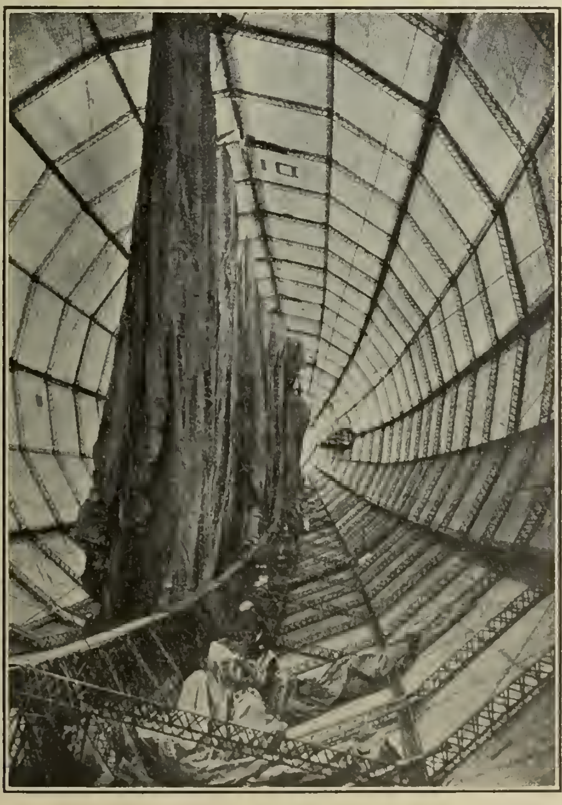

Figure No. 12.—Inside View of "Bodensee."

The "Graf Zeppelin" employs a fuel gas in addition to gasoline. The fuel gas is contained in cells extending over the central portion of the ship and up as high as the middle line, thus occupying a portion of the space usually given to the lifting gas. The "Blau" gas used has a specific gravity about equal to air, and consequently consumption of this fuel is automatically corrected by the air which displaces it without causing any loss of weight.

It is a matter of some argument as to whether a gaseous fuel of this type is more dangerous, as regards fire risk, than gasoline.

Hull Design

In the chapter on History an endeavour has been made to show how the design of rigid airships commenced on independent ideas in Germany and Great Britain, but the advance made by Germany and the needs of war caused Great Britain and the United States to follow information obtained from German ships. Then came a series of disasters, the R. 38 in Britain, the "Shenandoah" in the United States, and the "Dixmude" (ex Zeppelin) in France.

Investigation at this time showed that the theory of airship design as used in Britain omitted several important factors which influenced very considerably the strength of the ship.

New design methods were suggested, and these have since been considerably extended. It was shown that the air forces on a ship were not known, as only a few experiments for measuring air pressures on ships in flight had been made, and extrapolation from a small model to a full sized ship was hardly likely to give useful figures.

Considerable criticism has appeared in the press upon this subject, objecting that the large step in size taken in designing the present 5,000,000 cubic feet ships was made without sufficient design information being available. In order to insure sufficient strength in the airship structure it is, of course, necessary to know all the loads and forces that will be imposed upon that structure; a very exacting requirement when it is remembered that the atmosphere can at times produce storms of a very complex nature, which cannot always be avoided, and in which the wind velocities may show great variation in direction and intensity over a space of a few feet.

The *static loads* can be determined from the known buoyancy of the various compartments and the known weights of the structure and distributed loads. It is, therefore, possible to construct shearing force and bending moment diagrams for the ship under static loads. Provision must be made for the deflation of one or more gas cells and the subsequent readjustment of trim. Deflation of each gas cell in turn must be considered, and the envelope of the diagrams thus obtained must be used as the working diagram from which to design the various members.

The condition of flight fully loaded and fully inflated must be considered together with all other conditions of flight, such as at maximum height or with a light load and gas cells partially inflated. It is readily appreciated that all these combinations give plenty of work, but deal only with conditions which are known and can be allowed for.

In early ships the speeds were very low and the static loads were the only ones considered. Increase in speed, however, caused great increases in dynamic loads, which now become of the greatest importance.

The *aerodynamic loads* are very complex, and the data available incomplete. When an airship is manoeuvring in a light or heavy condition, the surplus lift or weight is balanced by aerodynamic lift obtained by driving the ship forward under power with the nose up or down as

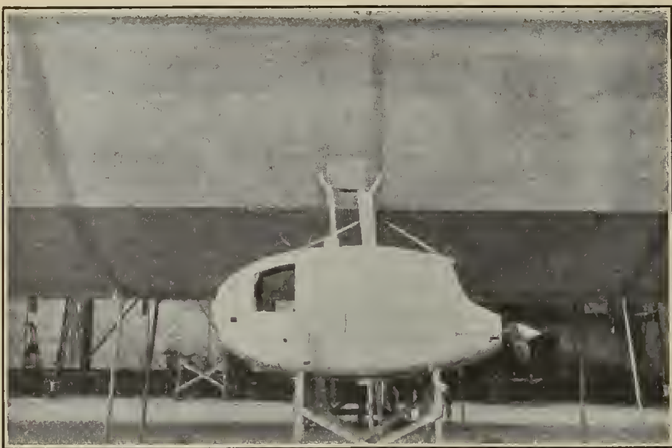

Figure No. 13.—Power Gondola "Bodensee."

may be required. Experiments have shown that the air forces on the hull in a pitched conditions are concentrated towards the ends of the ship producing large bending moments amidships. Running into a gust, or changes in the position of the control surfaces have the effect of shifting the peak of the bending moment curve. These latter effects may, of course, also occur in the lateral direction as well as in the vertical plane.

As practically all flight is not in a straight line, changes of direction occurring all the time, but particularly during maneouvres, it is necessary to consider the distribution of centrifugal forces which, of course, follow the mass distribution and are opposed by the aerodynamic forces on the hull generated by the movement of the airship.

One of the most severe conditions occurs when the airship runs into a vertical gust; this produces heavy bending moments, causing sagging of the airship structure. These gusts may reach very high velocities under certain storm conditions.

Local loads may occur due to many causes. One particular condition is that which occurs when an airship is moored to a mast. For this purpose it is necessary to reinforce the nose to carry the mooring attachment and to provide a swivelling attachment which will allow the ship to swing or roll without imposing loads in the structure.

It is possible to have the airship at the mast in such a condition that heavy loads are imposed, without any apparent change of trim of the ship. If the ship becomes heavy, and at the same time down by the nose, the nose may be supported by the mast and the ship itself still floating horizontally. The up load imposed by the mast may cause large sagging bending moments on the airship structure.

There are, of course, many other local loads due to engine cars and other concentrated loads, which need to be considered during the progress of the design. In ships constructed with radial bracing in the transverse frames, the accidental deflation of a gas cell allows adjacent cells to press against the radial bracing and thus impose large loads in the frame.

The *load factor* to be used in the design, after all possible conditions of loading have been considered, has been a subject of considerable controversy. A figure of 2 seems to have been used consistently for airships for war purposes, but for commercial ships this has now been increased considerably.

The *distribution* of loads amongst the various structural members must now be considered. Up to this point the airship hull has been considered as a whole. It is, however, only necessary to glance at one of the illustrations showing the construction of a hull for an engineer to realize that the structure is full of redundant members, and that the assumptions to be taken in the design of the members need to be very carefully reviewed.

The following extract from a paper by Mr. W. T. Sandford (Journal of the Royal Aeronautical Society, November, 1927) seems to summarize rather well the present assumptions:

"It may be of interest here to mention the methods previously employed in ships of the Zeppelin type. The gasbag loads were transmitted directly through mesh wiring as a lateral load on the longitudinals. It was assumed that the resistance to bending was supplied by the longitudinals, the shear wires taking the whole of the shear loads. Working on these assumptions, there were two methods of proceeding; incidentally these two methods gave discordant results except in special cases where the longitudinal and shear wire sizes bore a particular relationship to each other. We will call these two methods the bending and shearing methods. In the bending method the loads due to bending were calculated from the ordinary formula for beams ($M/I = f/r$) and it was assumed that the shear wires supplied the longitudinal forces required by the bending moment. In the method of shears it was considered that one frame moved down relative to the next, the tensions produced in the wires being dependent upon their elastic properties. For the longitudinals, the longitudinal components of wires were summed up at each joint right through the ship, no account being taken of the elastic properties of the girders. It is probable that the bending theory gave optimistic values and the shearing method pessimistic, since it is found by methods based on the minimum strain energy of the members that, in general, the longitudinals take a considerable part of the shear, but that bending tends to reduce the shear wire loads. It is evident that more accurate estimations are required than are supplied by these two approximate methods.

In any method of stressing it must be assumed that the principle of superposition holds, that is, the loads due to any component of the loading mentioned may be evaluated and superposed upon the loads found due to any other components. The two basic assumptions made in employing methods of redundant stressing are:—

(1) That transverse frames remain plane, i.e., they do not distort out of their own plane.

(2) All loads are applied at the joints which are assumed as pin-jointed.

Figure No. 14.—Interior View "Schütte-Lanz Airship."

Figure No. 15.—Spiess Airship.

"It is fairly obvious that these two assumptions tend towards opposite extremes and a compromise somewhere between the two must be adopted. The true assumption is that made in all redundant stressing, namely, that deflections and distortions of members are small compared with their length. One method suggested by the Stressing Panel consists in reducing the structure to the form of a composite girder to which orthodox methods may be applied. This applies if the structure may be considered as a long tube free from load along most of its length. Actually, however, an airship is continuously loaded and has not a great length compared to its diameter. In the case of an airship both ends are approximately true pyramids, hence the end frames remain plane. Also by symmetry the centre frame would be plane. It was also found that frames practically remain plane when the shape was truly polygonal. This indicates the suppression of a keel member. If the validity of this argument can be accepted it has the very great advantage that each bay may be treated separately. It was a similar line of reasoning that suggested the second method of stressing put forward by the Airship Stressing Panel. In this method each bay is treated separately, the frames being assumed as not deflecting out of their own plane.

"These methods are rather long and tedious to apply, but it is probable that any future methods will be developed from this second method and will be attempts at simplification and application to design office routine."

There is, of course, a great deal of literature on this subject, much of which is referred to in the bibliography, but which is too extensive and too detailed to be discussed here.

In designing the new British airships, care has been taken to make the joints between the main members in the form of pin-joints, thus avoiding secondary stresses of unknown amount due to rigid joints.

General Arrangement of a Rigid Airship

Before dealing with the constructional methods used in rigid airships it seems desirable to indicate the arrangement of all the components which form the airship, and for this purpose advantage has been taken of the material contained in a technical memorandum published by the United States National Advisory Committee for Aeronautics entitled the "American Airship Z.R. 3" by L. Dürr.

This airship was built by the Zeppelin factory in 1923-4 for the United States Navy, (figure No. 21).

Its principal dimensions are:—

Gas capacity...............2,472,000 cubic feet.
Length.....................656 feet.
Greatest diameter...........90.68 feet.

This airship bears the factory number LZ. 126, but was delivered to the United States as the Z.R. 3 and rechristened "Los Angeles." It was built as a commercial airship to carry twenty to thirty passengers. It has thirteen gas cells. The central and rear portions carry cars containing the engines while the forward portions carry the control car and the adjoining passenger car. The rest of the apparatus and load are inside the hull.

The ship is equipped with five motors of 400 h.p. each. It is calculated to be able to make a continuous flight of 110 hours with a pay load of 5 tons, corresponding to a distance in still air of 7,700 miles.

Hull

The hull is built on the usual Zeppelin principle. The cross section is a regular polygon with 24 sides, but with one angle on each side of the bottom straightened out. The lower part of the transverse frames is constructed so as to provide a keel frame, which extends throughout the whole length of the hull and contains all the apparatus required for the operation of the ship. The frames and longitudinal girders consist of longitudinal members and connecting strips of sheet duralumin rivetted together. The resulting lattice girders are generally triangular in section, but at a few points may be square. Longitudinal and transverse girders are fastened together by gussets and rivets.

The assembly is further stiffened by bracing wires in the plane of the transverse frame and in the panels formed by the longitudinal girders and the transverse frames. The transverse frames having bracing wires are called the main transverse frames, and those without bracing wires are called auxiliary or intermediate frames. The main transverse frames are braced by additional girders and kingposts, and divide the hull into a number of separate cells. The length of these cells is 10 metres at the rear, 15 metres in the centre and 12 metres in the front portion of the hull. The intermediate frames are generally about 5 metres apart.

The gas cells are made of goldbeater's skin attached to a light cotton fabric. Apart from gas tightness no special demands are made on the material of the gas cells since the lift stresses are transmitted to the frame of the airship by means of a special network of wires and string, and since the fabric is still further protected by safety valves against excessive loads due to expansion of the gas, (figure No. 22).

From the safety valves, which have a diameter of 50 centimetres, the escaping gas passes up through vertical shafts, and escapes into the air through hood-like openings near which are located the valves for manoeuvring purposes. The gas cells are protected from sudden changes of temperature and the action of the sun by the hull covering and the layer of air between them and this covering. The hull covering consists of strips of cotton cloth laced to the framework. The thickness of the cloth differs according to the amount of stress to be withstood. Special reinforcing strips are added in the vicinity of the propellers.

The outside surface is doped with a cellulose dope containing aluminum powder. The passenger car and the engine cars are braced outside, but when there are no special reasons for bracing any of the equipment outside the hull

Figure No. 16.—British Airship No. 1.

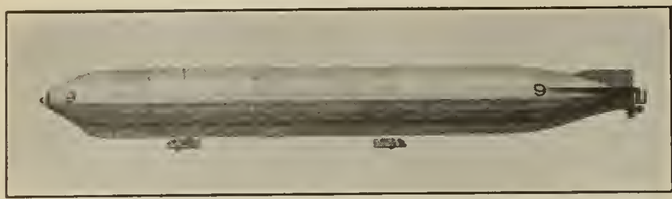

Figure No. 17.—British Rigid No. 9.

it is braced within the keel or corridor inside the hull. Heavy objects are located in the vicinity of the main transverse frames.

Power Plant

This consists of five independent power units in five separate engine cars. One of these is located under the rear portion of the hull while the other four are suspended in pairs by struts and cables on both sides of the middle portion of the hull. Access from the hull is by means of ladders and sliding doors.

The engines were made by the Maybach Engine Company and are of the twelve cylinder V water cooled type. They develop 400 h.p. at 1,400 r.p.m., thus enabling direct drive.

Propellers

Two-bladed wooden propellers are used.

Fuel Storage

The fuel is stored in the keel corridor in 70 tanks, which can be increased to 100 for specially long trips. The fuel tanks are cylindrical aluminum tanks with round ends, suspended by wires, usually in groups of three from the top girders of the keel on both sides of the walkway. In the vicinity of each engine there is a group of tanks for supplying that engine by gravity feed. These are replenished from the reserve tanks by means of wind driven pumps.

Ballast

The keel corridor also contains the ballast, store rooms, baggage, freight, etc. There are two kinds of ballast bags, one for landing ballast and the other for flight ballast. The difference is due to the fact that it must be possible to empty the former suddenly while the latter are emptied slowly. The landing ballast bags are located near the bow and stern, while the flight ballast bags are distributed throughout the keel corridor on both sides of the walkway. The former are trouser shaped with the legs downwards, and can be completely emptied in a very short time by letting the top part fall, thus inverting them. Both kinds of ballast bags are made of 3-ply rubber fabric. There are twelve landing ballast bags, each having a capacity of 66 gallons. The flight ballast bags have a capacity of 264 gallons each, and are emptied by means of valves so arranged as not to shower any of the cars.

Control Car

This contains all the apparatus for navigating the ship. A ladder leads to the keel corridor, and a door opens into the adjoining passenger car. The controls are divided between two wheels, one in the bow for the rudder and the other at the side for the elevator. For emergency use rudder controls are also installed in the lower vertical fin, to which position orders can be telegraphed from either the control car or the rear engine car.

Height regulation can be obtained by both static and dynamic forces. Since the static lift depends upon the weight of the airship and also upon the pressure, temperature and humidity of the air and of the gas, as well as on the quantity and character of the latter, it can be changed by releasing gas or ballast. Gas can be released either by purposely ascending till the safety valves open automatically or by opening the manoeuvring valves provided for landing. The cords for releasing ballast and gas terminate on ballast and gas boards above the elevator control wheel where they can be operated by handles, arranged under a diagram of the airship. The dynamic lift is varied by changing the trim of the airship either by releasing ballast or gas or operating the elevators.

Orders are transmitted to the engine cars by mechanical signals, and provision is made for communicating with the crews' quarters and with the anchoring and mooring points by telephone.

Methods of Construction

Hull Framing

The present description is confined to airships which have been evolved from the original Zeppelin methods of

Figure No. 18.—British Rigid 23X Class.

construction, and does not apply to the more recent airships now being built. From what has been given before it will be appreciated that the airship consists of a metal framework or skeleton braced together by wires, divided into compartments containing gas cells and usually having a keel or corridor built into the lower part of the structure.

The main transverse frames form a polygon usually with an uneven number of sides. These frames are built up of braced duralumin girders consisting of channels at the corners and duralumin strips forming the cross bracing between the channels. The sides of the polygon are often kingposted in the centre and braced from the top of the kingpost to the two ends of the side. Similarly at the bottom of the frame the keel member is built on to one of the sides and braced from the apex of the keel to adjacent corners of the polygon. In addition to these rigid girders the whole of the transverse frame is braced by wiring. It would be approximately true to say that every angle of the polygon is braced to every other angle.

Connecting the corners of the transverse frames and giving the outside shape to the ship there are a number of longitudinal frames. The panels formed between these longitudinal frames and the transverse frames are in themselves cross braced with wire, and intermediate between the main longitudinals there are auxiliary longitudinals spaced in the middle of the sides of the transverse

Figure No. 19.—Rigid Airship No. R.31.

Figure No. 20.—Rigid Airship R.34.

frame. Between the main transverse frames there may be one or more auxiliary transverse frames supporting the longitudinal frames, but these auxiliary transverse frames are not wire braced.

The photograph, (figure No. 23), gives a good idea of the arrangement of the transverse frames and longitudinals. It also shows some of the wire bracing.

A good view of the girder work is shown in the photograph, (figure No. 24), which shows some of the girders in the corridor of the British Airship R. 36, including the suspension of two of the gas tanks. The tail fins, rudders and elevators are framed with duralumin girders and covered with doped fabric.

The power cars and control car are all slung from the underside of the hull and are usually held in position by a combination of wire ropes and struts. In order to distribute the loads due to the lift from the gas, the gas cells are themselves supported by an elaborate system of netting, designed to distribute the lift as much as possible among members. Normally the gas cells would lift against the longitudinals in the top of the hull, but by suitable wiring it is possible to distribute these loads among the other longitudinals. It will be appreciated that in this method of construction the gas lift is carried as a side load on the longitudinal members.

Figure No. 21.—U.S. Navy Dirigible "Los Angeles."

An idea of the amount of bracing in the airship can be gathered from the photograph, (figure No. 25), which shows typical bracing as used in the British airship R. 38. A modification of the method of supporting the gas bags is sometimes used, in which a mesh wiring is used instead of the parallel wires shown in this diagram.

The outer cover is usually of cotton fabric, spread over the outside of the structure in strips, laced into position and doped. The wiring which retains the gas cells is so arranged that there is an air space left between the gas cells and the outer cover.

An interesting point in the design of airship structures arises over the use of a keel member, which forms a comparatively stiff portion of the ship running fore and aft. In the early Zeppelins this keel member consisted of a V shaped projection on the outside of the ship, which later became inverted and was put inside. When the British ships of the 23X class were designed this keel member was omitted, and terrible results were predicted, but which did not, in fact, materialize. In more recent British airships the keel was again introduced, following much the same design as contemporary Zeppelin airships.

Figure No. 26 shows the inside of the Graf Zeppelin. The keel is seen in the lower part of the picture, and also a longitudinal member in the centre, providing support for the frame bracing and access to the space between the fuel gas cells below and the hydrogen cells above.

It will be shown later that in the more recent British ships the keel has again been omitted, whereas in some projected American ships the number of keels has been increased to four.

Description of British Airship R. 101

It has already been stated that following the airship disasters previously referred to, airship construction practically came to a standstill, and in Great Britain an enquiry was held to determine the existing state of the knowledge relating to airship design and to decide under what conditions airships might reasonably be designed in the future. The result of this enquiry was to show that the existing state of knowledge was very incomplete, and undoubtedly a great deal of research work has since that time been done with a view to improving our knowledge of the subject.

There has, however, appeared so much criticism in books by Neon and by Spanner and in the press that engineers cannot help being interested in knowing exactly what there is in these criticisms. It is not proposed in this paper to make a case one way or the other, but the description given below of one of the new British airships will, it is thought, indicate that very considerable changes have been made in the design of the airship since the time of the R. 38, and that these changes have certainly been based upon some very sound scientific reasoning.

What the future holds for these airships remains to be seen, and it cannot be predicted, because with the best intention in the world it has not been possible to carry out all the full scale experiments that are necessary to obtain complete data and in addition the step taken in increasing the size to 5,000,000 cubic feet is in itself somewhat daring. Enough information, however, is available to warrant the statement that the design of these airships rests on a better scientific foundation than has ever been the case in the past.

Rigid airship R. 101, (figure No. 27), has a fineness ratio of 5.5 to 1 as compared with 8.3 to 1 for the R. 38. There has been some discussion upon a supposed difficulty of control with a short airship of this type, but extensive experiments have been carried out on the shape of the stabilizing fins, resulting in the choice of the triangular shaped fin of streamline section, which can be supported by internal bracing, and which shows a considerable improvement in efficiency over previous forms. It is estimated that the resistance of the bare hull of this airship will be but little more than 2 per cent of the resistance of a circular plate of the same diameter as the maximum diameter of the ship.

There are 15 main longitudinal girders and 15 intermediate girders whose function is merely to co-operate with the main girders in supporting the outer cover. The shape of the ship is a continuous curve without any parallel portion, and in order to more nearly approach the required shape, the longitudinal girders have been curved to an arc of a circle conforming practically to the theoretical shape of the ship.

The cross section of the hull is a polygon of 30 sides, the length of each side at the maximum diameter being approximately 13½ feet. The longitudinals are located entirely on the outside of the transverse frames, and the intermediate longitudinals are connected to the main hull in such a way that they can be forced outwards to take up slackness in the outer cover.

The airship has no keel, all the weights being stowed in the main tranverse frames. The design of the transverse frames used in this airship is very different from that previously employed, for in airships of the Zeppelin type the transverse frames were as described above, made up in the form of polygons cross braced by radial and chordal wires. With a wire braced transverse frame the deflation of one gas bag resulted in considerable side loads being put on the wiring, tending to cause distortion of the adjacent frames. In the R. 101 an attempt has been made to develop a type of transverse frame and gas bag wiring, which will overcome these difficulties. The single members of the conventional frame are replaced by stiff triangular braced structures strong enough to resist all transverse forces without any transverse bracing, (figure No. 28).

One effect of the decreased fineness ratio is that if all transverse frames were equally spaced the volume of each gas bag in the centre of the ship would represent an undue proportion of the total volume. The photograph, (figure No. 29), shows that the spacing of the transverse frames decreases towards the centre of the ship.

The R. 101 has no intermediate transverse frames. In previous airships these frames were required for the support of the longitudinal girders, but with the modified method of gas bag suspension the longitudinal girders are now relieved of side load, and these intermediate transverse frames are no longer required.

The bow of the ship has been extended beyond the theoretical shape in order to provide clearance for the mooring cone. The longitudinal members are brought out to meet at a point where a horizontal shaft is carried in bearings for the support of the mooring cone at the forward end.

Between the front face of the first gas bag and this mooring spindle there is a platform carrying winches for the mooring rope and the yaw ropes, also connections for the supply of gas, fuel, water, compressed air and electricity from the mooring mast.

A small lookout position on the top of the bow is also reached from this platform. Frame 1 is a flat radially braced frame of the Zeppelin pattern, which carries at the bottom a hinged platform, which can be let down from the ship for the entry of passengers from the mooring mast. Frame 2 is also of Zeppelin pattern. Frames 3 to 13 are all of the new ring pattern without radial bracing. Frame 4 carries two power cars. Frame 5 has access to the top of the ship by means of a stairway inside the frame.

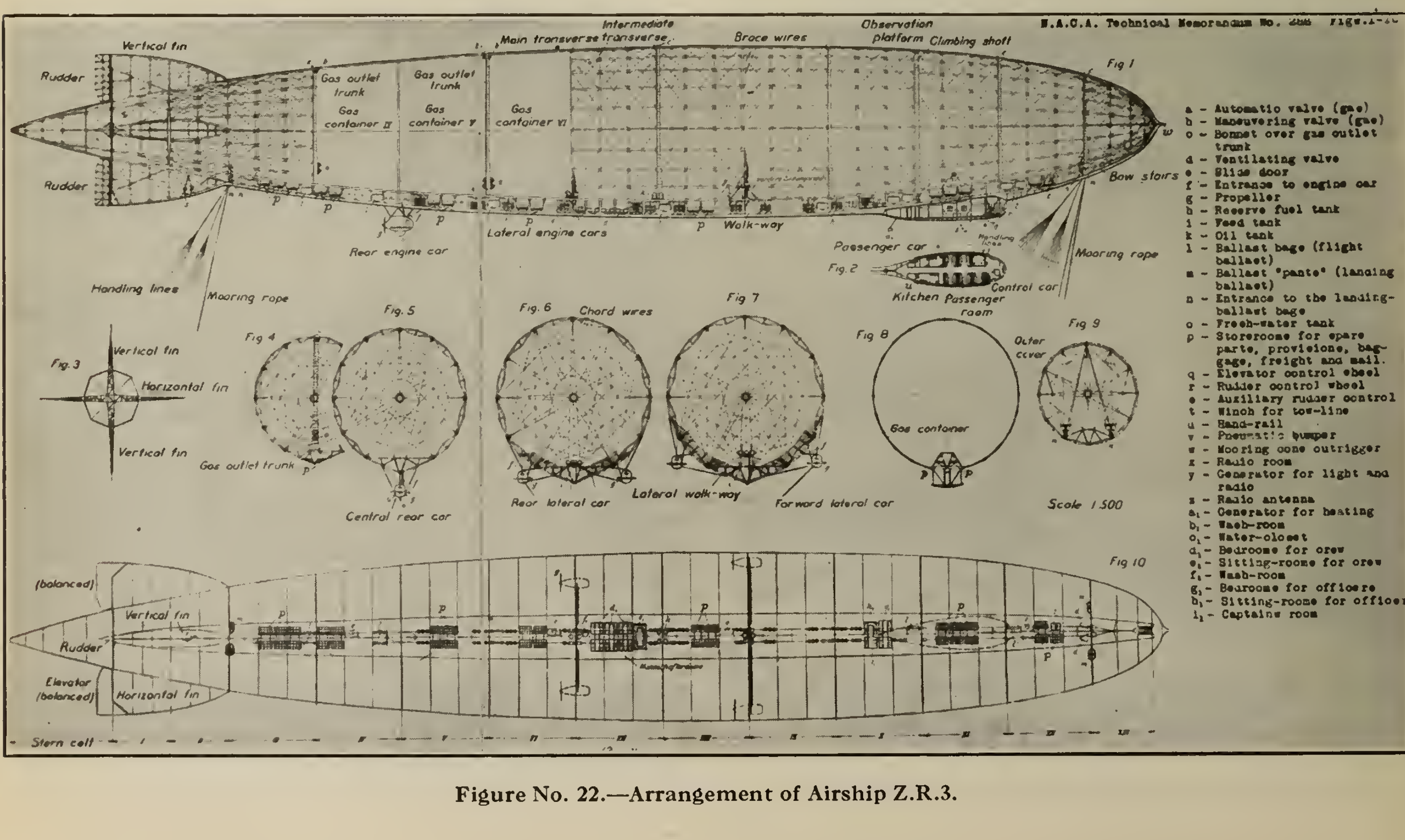

Figure No. 22.—Arrangement of Airship Z.R.3.

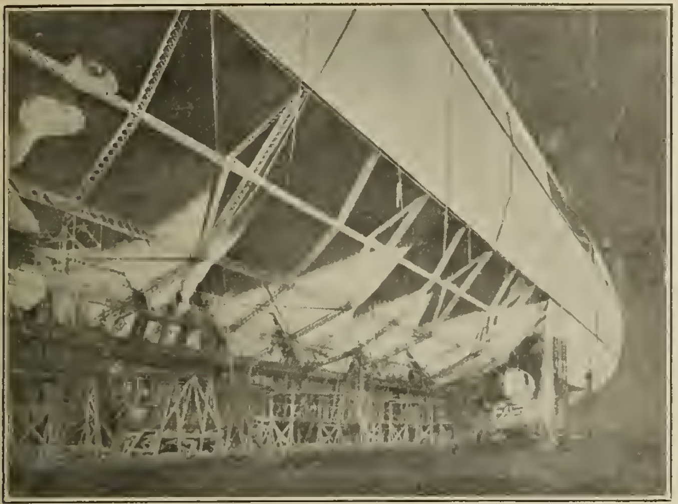

Figure No. 23.—British Rigid R.36.

Frames 6, 7 and 8 carry the passenger accommodation inside the hull. Frame 9 carries two power cars. Frame 11 carries a single power car on the centre line. Frames 14 and 15 are of special construction to carry the fins.

Details of Construction

The photograph, (figure No. 30), shows a portion in the main structure, and gives the nomenclature which will be used in the description of the various parts.

Considerable interest is attached to the construction of this airship because the manufacture of the parts of the ship was all carried out by contract. The Royal Airship Works at Cardington supplied Messrs. Boulton and Paul with a line diagram giving the geometrical properties of each part to be supplied and the loads to be carried by those parts. Messrs. Boulton and Paul designed and constructed the members in accordance with these requirements, making use of the experience gained in the design of heavier-than-air craft.

The main longitudinals are of triangular section about 45 feet in length employing three booms of stainless steel tubing to the section indicated in the photograph, (figure No. 31). These booms are spaced at 30-inch centres with struts of duralumin and diagonal bracing wires. These main longitudinals are made continuous with the frame longitudinal by means of joints with fitted bolts, and they are all curved to conform to the desired shape of the ship.

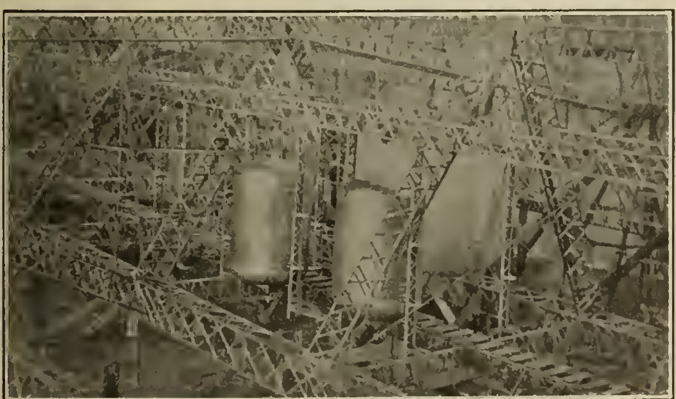

Figure No. 24.—Keel Construction, British Rigid R.36.

The *ridge girders* are constructed of stainless steel booms with webs formed from duralumin sheets. The booms in this case are all of the section shown in figure No. 32.

The *radial struts* are of similar design except that the boom tubes and the webs are each of duralumin.

The stainless steel strips used for the production of the booms and the longitudinals have the following composition:—

Carbon 0.16 to 0.22 per cent.
Silicon not exceeding 0.5 per cent.
Nickel not exceeding 1.0 per cent
Chromium 12½ to 14 per cent.

The tubes are formed on special draw benches with subsequent hardening and tempering by a continuous heat treatment process, and when completed have the following mechanical properties:—

Proof stress not less than 65 tons per square inch.

Ultimate strength between 88 and 95 tons per square inch, and to withstand a transverse close bend test around a radius of three times its own thickness without cracking. The proof stress is defined as that stress at which the stress strain diagram departs from the straight line of proportionally by 1 per cent of the gauge length.

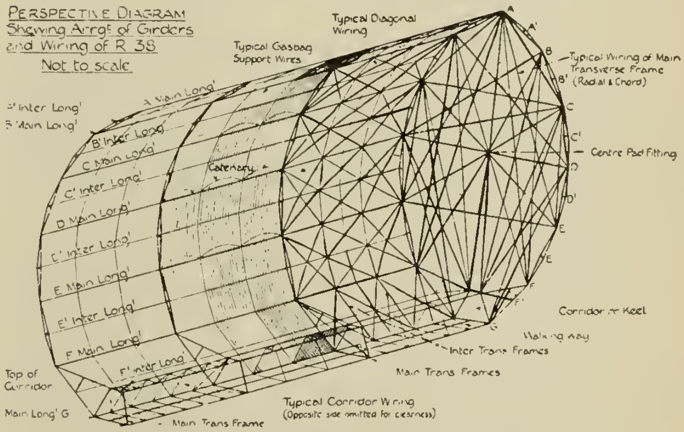

Figure No. 25.—Typical Bracing.

The stainless steel lipped tubes as used for the booms of the ridge girders are formed by rolling, with subsequent hardening and tempering; for the duralumin tubes of the same form the heat treatment is carried out prior to the drawing or rolling. Die castings of aluminum-silicon alloy and high tensile steel stampings are used for many of the connections. Typical joints are illustrated in the photographs, (figures Nos. 33, 34 and 35).

All members are erected in jigs before being shipped from the works of the contractor, and assembly has indicated that a very high degree of accuracy has been maintained throughout the whole of this work, as no fitting was required during erection.

The outer surface of the steel tubes is protected with a pigmented cellulose lacquer, and the duralumin is protected by the anodic treatment. Some criticism has been levelled at the combined use of duralumin and steel in the same structure, but it is stated that an analysis indicates that the loads imposed by changes of temperature consequent on the different coefficients of expansion of the two metals are only of a low order as compared with the failing strengths of the materials.

Very extensive tests on these new types of girders have been carried out, including a test of a complete

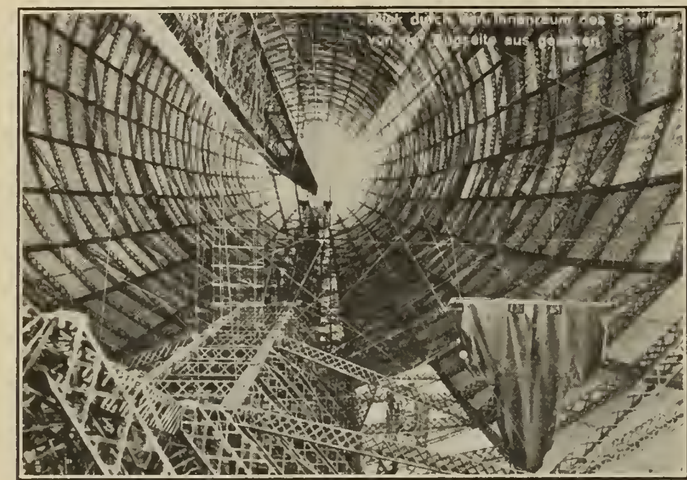

Figure No. 26.—Interior View of "Graf Zeppelin."

replica of the centre bay of the ship, consisting of two transverse frames and connecting longitudinals and shear wires. This complete bay was tested under static loads and with the gas cell inflated. The measured deflections were in very satisfactory agreement with those predetermined by calculation.

Power Plant of the R. 101

From a review of the history of previous airships the designers of the R. 101 considered that the use of gasoline had constituted the greatest fire risk in connection with their operation outside of the hazards incidental upon use during the war. For this reason it was decided that for the R. 101 a power plant using heavy fuel oil should be used instead of the usual gasoline engine.

The general arrangement of this airship has been explained before. There are five identical power units, of which the aftermost is placed on the centre line so as to give a good flow of air to the rudder. The remaining cars are in pairs some distance in front and behind the passenger accommodation.

The engines used are of the Beardmore Tornado type with a continuous rating of 585 h.p. and a maximum rating of 650 h.p. each. The oil burned is such that it has to be heated to the temperature of boiling water before it will give off any inflammable vapour at all. The engines have eight cylinders of $8\frac{1}{4}$-inch bore and 12-inch stroke arranged upright and in line. Some considerable difficulty has been experienced due to torsional resonance in the crankshaft, necessitating some changes in the dimension of the shaft, the fitting of a fly wheel at the end remote from the airscrew, and the employment of a spring coupling between the crankshaft and the propeller.

Figure No. 27.—R.101.

The engines are probably well known to some of the members of The Institute because in a somewhat heavier pattern they have been employed for some time in rail cars by the Canadian National Railway. Engine starting is by means of an auxiliary engine and a decompressor arrangement lifting the inlet valves of the main engines. When the main engine is running at about 100 r.p.m. the decompressor is shut off. The momentum of the airscrew carries the engine over full compression causing the injected charge to fire.

Variable Pitch Propellers

These propellers are designed to meet the special requirements of an airship. The blades can be turned so as to give thrust ahead or astern or into a neutral position where no thrust is being developed. If an engine is stopped the blades can be turned through about 90° so as to exert minimum drag. If the airship is going ahead the blades can be gradually turned until they form a windmill by which it may be possible to start the engines.

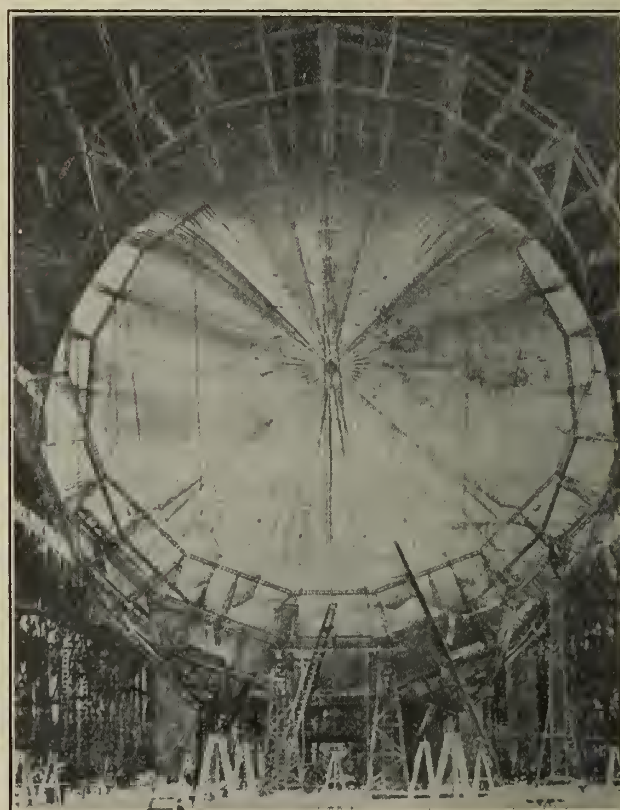

Figure No. 28.—R.101 Gas Bag Wiring.

Some trouble has been experienced with these propellers on test due to the crankshaft oscillations referred to above, and wooden airscrews of fixed pitch will be used as a temporary measure for the trial flights, and in order not to delay these until the completion of redesigned engines. One of these propellers will be designed for astern thrust, which is necessary for retarding the advance of the airship when approaching a mooring mast and under similar conditions. This decision will mean, however, that one power unit will not be available for forward propulsion.

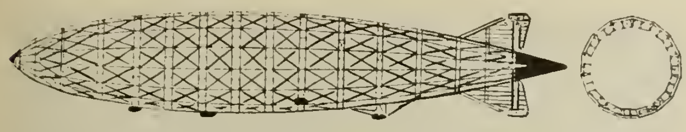

Figure No. 29.—Line Diagram, British Airship R.101.

Thrust Wires

In order to provide the proper support for the power cars when the airship is pitched and when the engines are developing full power, a bearing has been provided on the outer end of the crankshaft and a wire carried from this bearing to the structure of the airship. This thrust bearing cannot be lubricated by oil circulation, and, therefore, depends upon grease, an arrangement which for long flights certainly does not appear entirely satisfactory, (figure No. 36), but no doubt if trouble is to arise here it will become evident during the home trials and be eliminated.

Evaporative Cooling

The engine is cooled by evaporative cooling, the steam being carried away to condensers which may take the form of fabric ducts in the outer cover of the airship, but which at present are triangular shaped radiators on the side of the hull. The waste steam from the two centre engines is led to a radiator which can, if required, be drawn up into the ventilating system of the passenger quarters for heating purposes.

Auxiliary Engines

The auxiliary engines are not only used for starting the main engines, but are also required for driving electric generators and air compressors. Three of the engine cars carry generators and the remaining two cars air compressors. These auxiliary engines at present use gasoline from a tank which can be dropped in case of fire, but the use of even a small quantity of gasoline has been much criticized on account of the publicity which has been given to the use of heavy oil engines as a precaution against fire, the argument being that fire from a small quantity of gasoline is sufficient to cause destruction of the whole ship.

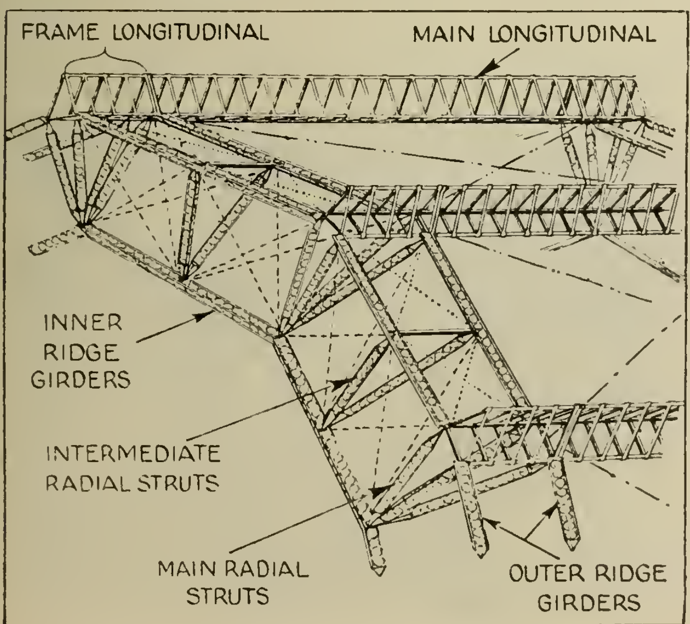

Figure No. 30.—Portion of Structure of R.101.

An arrangement of one of the power cars with the great portion of the outer casing removed is shown in the photograph, (figure No. 37).

Fabric Parts

The fitting of the outer cover is a departure from previous practice. In order to avoid the objections of doping this huge expanse of fabric when in position on the airship the material has been doped before being put into place, and is tautened on the ship by mechanical devices which allow a definite tension to be put on to each lacing point.

The control of pressure difference between the interior and the exterior of the gas cells and the outer cover is one of considerable importance. It is essential to arrange for a definite maximum rate of rise or fall for which the airship must be safe, and in the design of the R. 101 an attempt has been made to deal with vertical currents,

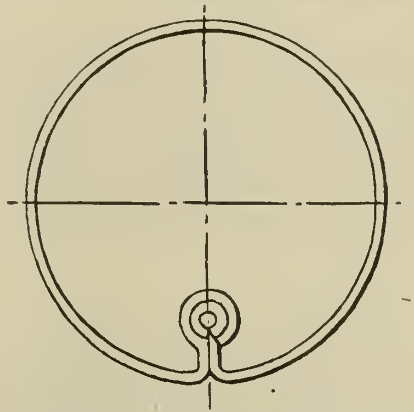

Figure No. 31.—Section Main Longitudinals R.101.

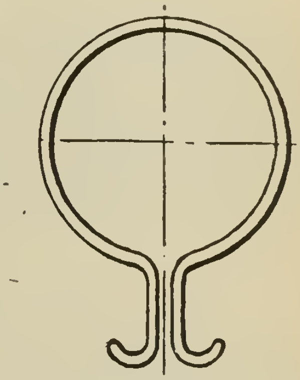

Figure No. 32.—Section Ridge Girders of R.101.

rising at the rate of 4,000 feet a minute and falling currents of approximately half this amount. If an airship is rising rapidly and the gas cells are not full, air must escape from the outer cover in order to allow the gas in the gas cells to expand. If the airship continues to rise past its pressure height a mixture of gas and air would have to pass through the outer cover.

So far as rapid ascent is concerned, therefore, the principal problem is to provide a sufficient opening to let out air at the maximum rate of rise under all conditions of flight. It is also necessary to provide for the inflow of air when the ship is descending. Simple holes in the cover are not sufficient because the pressure distribution on the outside of the ship consists of a high pressure region in the nose and tail, and a low pressure region over the remainder of the ship. The pressure distribution is in turn changed when the ship is pitched or yawed.

In the R. 101 air is admitted to the inside of the hull when the ship is descending by a series of inlet holes near the nose and tail in the regions of high pressure. These holes provide sufficient area for the general ventilation of the hull. They are not, however, sufficient to deal with the maximum rate of descent, and some additional holes with non-return valves are arranged at the bottom of the ship.

When the ship is rising air is let out of the hull by a series of slots arranged circumferentially in the cover in the neighbourhood of the centre where the hull is subjected to a reduced pressure under practically all conditions of flight. A flap is arranged so that the forward half of the

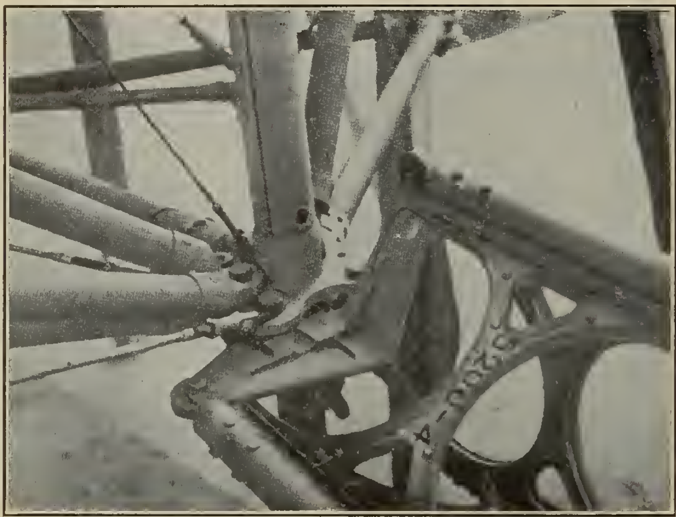

Figure No. 33.—Construction Details of R.101.

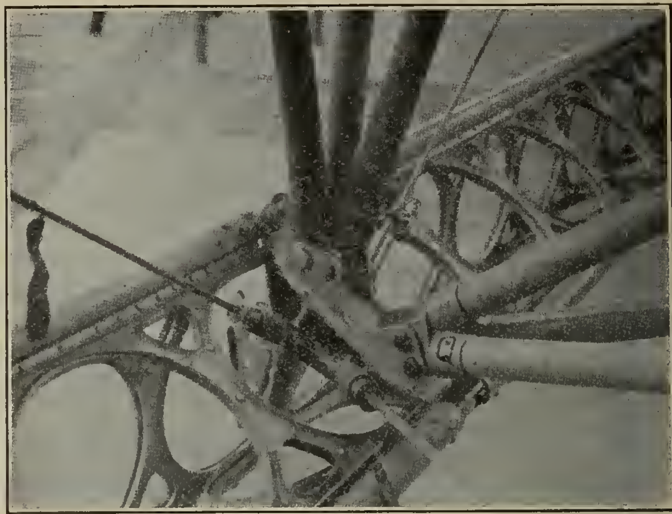

Figure No. 34.—Construction Details of R.101.

cover overlaps the back half, and the aft edge of the forward part of the cover is fitted with springs so that when there is an excess of internal pressure over external pressure the fabric can expand and provide an opening through which air can escape. These slots are, of course, completely closed when the ship is descending.

The position of these openings is indicated in the photograph, (figure No. 38).

Gas Valves

In previous airships automatic valves for limiting the internal pressure of the gas cells were provided in the bottom of the cells. When the gas cell is full these valves sit on cages connected to vertical trunks carrying away the hydrogen to the top of the ship, but as the gas cells become emptied these valves change in position.

In addition to the automatic valves mentioned above, previous airships also were provided with manoeuvring valves operated by hand, fitted in the top of the gas cells by means of which the crew could let out gas when required.

These valves are illustrated in the photographs, (figures Nos. 39 and 40).

The type of valve used in the R. 101 marks a considerable change from previous practice. It has been described by Colonel Richmond, Aeronautical Journal, 1929, as follows:—

"The valve and its method of operation are illustrated in figures Nos. 41, 42 and 43. The position chosen for the valve was on the side of the gasbag at mid-height, the valve being attached by a petticoat to the gasbag and also to the gasbag wiring. The proportion of disposable lift to gross lift in the airship is such that the pilot will never require to deflate the gasbags to such an extent that the free surface of the gas would be as high as the level of the valves. Thus the disadvantage of using valves which have to move with the free surface of the gasbag is avoided. Another advantage of this position over placing the valves at the bottom of the gasbags is that the pressure difference is greater at this height, and consequently a greater rate of discharge is obtained from a given aperture. Furthermore, when the valve is not required to open, the pressure is employed to exert a closing force, this level has the advantage of ensuring better seating of the valve.

"Two sizes of valve are employed, respectively 30 inches and 40 inches in diameter. In general, each gasbag is fitted with one valve on either side, the smaller diameter being employed in the smaller bags.

"A metal seating *A*, (figure No. 41), is fixed to a casting in the form of a wheel with four spokes. This is supported by the gasbag wiring. A fabric petticoat on the bag is bound around the rim. From the hub of the casting a tubular spindle *B* projects. Travelling on this spindle is the moving portion of the valve *C*, which is a large spun casing carrying a flexible fabric annulus which forms the seating. Fixed to the spindle is a stationary conical diaphragm *D*, within the moving casing and connected to the latter by fabric bellows *E*. Gas has direct access to the inside of the bellows and exerts a closing force on the flexible face, since the effective diameter of the bellows is greater than that of the seating. The valve is opened by the application of a small pressure to the chamber enclosed between the moving casing and the stationary diaphragm, this operating chamber being connected to the gas supply through the tubular spindle *B* and fabric cone *F*.

"The operating chamber has a direct leak to the atmosphere which enables the valve to close when there is no flow of gas into the chamber. Only a light closing spring is needed, owing to the fact that the jet of gas discharging exerts a closing force even when the valve is 10 inches away from its seat. No adjustment of this spring is required since small variations in its strength do not affect the work-

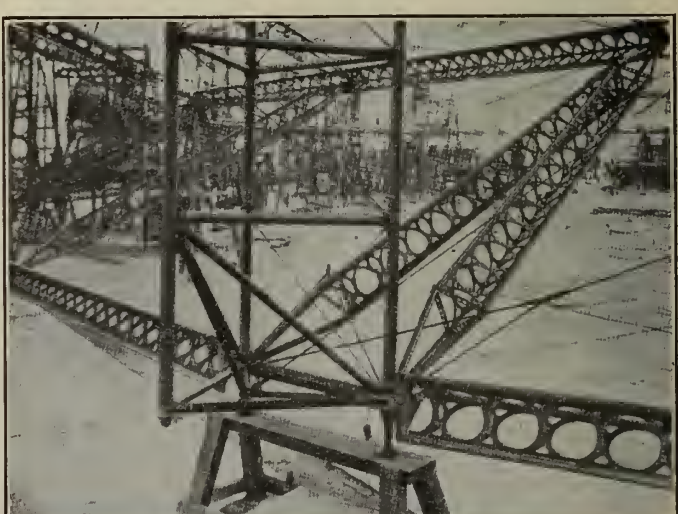

Figure No. 35.—Construction Details of R.101.

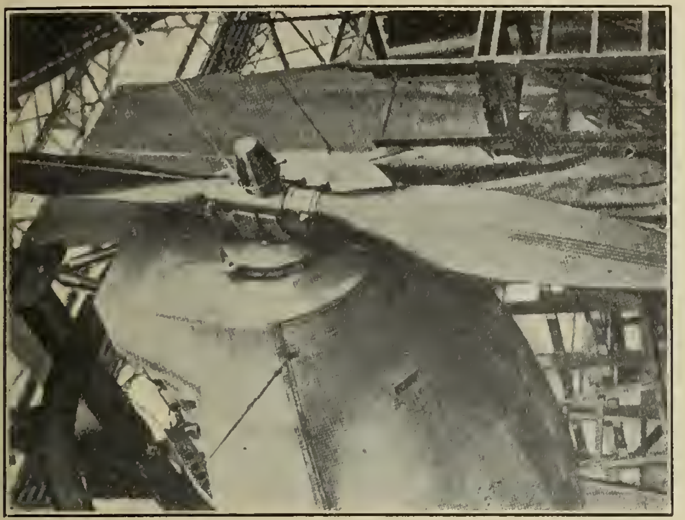

Figure No. 36.—Thrust Bearing, R.101.

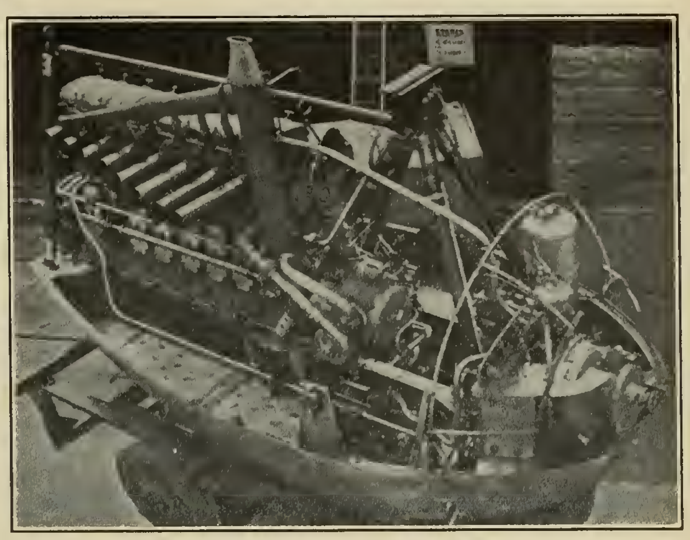

Figure No. 37.—Engine Car, R.101.

ing of the valve. The arrangement of the valve in the ship is shown in figure No. 42. One end of the U-tube or siphon pipe *G* is connected to the gasbag close to the valve, and the other end is connected to the operating chamber of the valve. The bottom of the *U*-tube is approximately level with the bottom of the gasbag, so that when the bag becomes full the gas spills round the tube and up into the operating chamber, thus opening the valve.

Owing to the permanent leak in the operating chamber a certain minimum rate of supply of gas through the U-tube is necessary to open the valve. It was found on test that by proper design of pipes the necessary velocity could be obtained with a pressure difference at the bottom of the bag of only two millimetres of water, at which the valve will open deliberately to its full extension. The rate of discharge of the 40-inch valve under these circumstances is 36,000 cubic feet per minute.

"There are two cross connections in the U-tube marked *H* and *J*. Connection *H* is a small spring loaded relay valve which can be operated from the control car. When this is open gas will enter the operating chamber of the main valve and open it, no matter what the degree of inflation of the gasbag may be, thus it serves the purpose of the so-called manoeuvring valves, which were fitted in past airships in addition to the automatic gas valves. The cross connection *J* is a fabric pipe which is normally tied off. If, however, the pilot anticipates a severe buffeting with rapid changes in height above the airship's ceiling, he can untie this connection, which means that the valves will then operate automatically when the free surface of the gas is level with this connection instead of when it reaches the bottom of the bag. Thus the generation of excessive pressures will be avoided. Since, normally, the airship will become light by the expenditure of fuel as the journey proceeds, it is anticipated that the normal procedure will be for the pilot to undo these connections after the first few hours of flight as a matter of routine."

Passenger Accommodation

For various reasons connected with the difficulties in producing an experimental airship of this size the passenger accommodation in the R. 101 has been reduced to accommodate only 50 passengers instead of 100 as originally comtemplated.

The accommodation is in two decks located between frames 6, 7 and 8.

The upper deck, having an area of 5,550 square feet exclusive of promenade, carries a lounge with promenades on each side, having glass windows in the outer cover, (figure No. 44). On this deck there is also a dining room and a number of two berth cabins. The lower deck, with an area of 1,730 square feet, accommodates the captain's control room, wireless room and kitchen.

The control car is immediately below and in communication with the captain's room. This car gives an excellent view in all directions except immediately upwards.

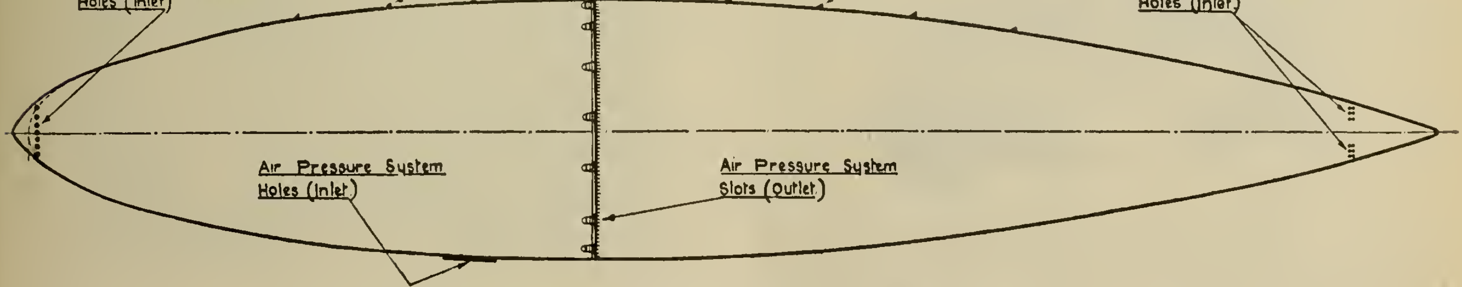

Figure No. 38.—Ventilation Outer Cover R.101.

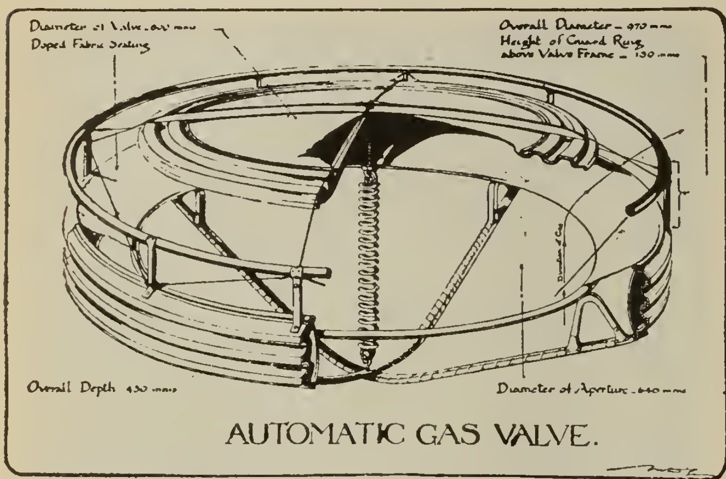

Figure No. 39.—Automatic Valve R.34 Class.

In order to determine the degree of comfort provided for the passengers, it would be necessary to take an extended trip in the airship, because the accommodation is entirely different from that provided in any other form of public transportation.

Other Airships

The R. 100

The R. 100 is a ship very similar to the R. 101; it is being constructed by the Airships Guarantee Co., a private company subsidized by the Government. In this ship the general principles mentioned in connection with the R. 101 are employed, but in this case the methods of construction are different.

In the R. 101 the booms for the frames and longitudinals were made of stainless steel, whereas in the R. 100 they are made from a special form of duralumin tube, which is the subject of a patent held by the Airship Guarantee Company.

These duralumin tubes are made up from sheet metal cut into strips and rolled in a spiral to form a round tube. The joint is connected by a spiral row of rivetting, and a special machine has been invented for carrying out the manufacture of these tubes, (figure No. 45).

The power units in the R. 100 are also different from those used in the R. 101, in that they are gasoline engines

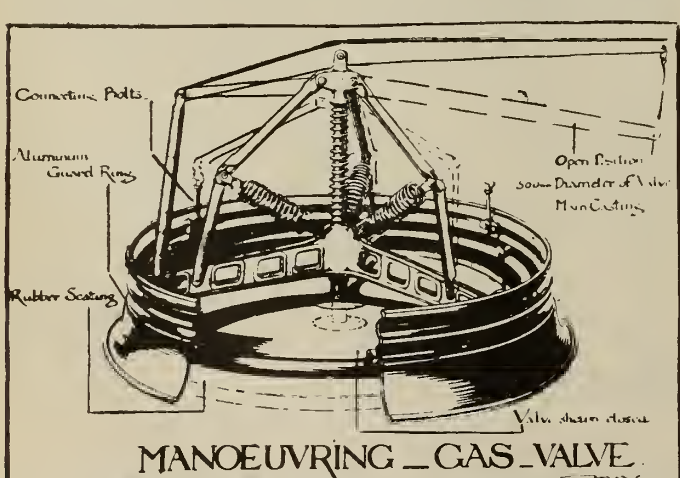

Figure No. 40.—Manoeuvring Gas Valve.

of the type which has been developed for heavier-than-air use. Very little published data are as yet available upon this airship.

Metalclad Airship

The first rigid airship to be constructed was made by Schwartz and consisted of an aluminum shell filled with lifting gas. The fact that this type of airship construction was not continued was due to a combination of circumstances, among which was the accident that occurred during the first flight, and the death of Schwartz before the completion of the ship.

The metalclad airship now being used in the United States follows the principles started by Schwartz, and consists of an "alclad" envelope, which itself serves not only as the structure of the ship, but also as the envelope for holding the lifting gas. This first ship called the Z.M.C. 2, (figure No. 46), is 149 feet 5 inches long and is 52

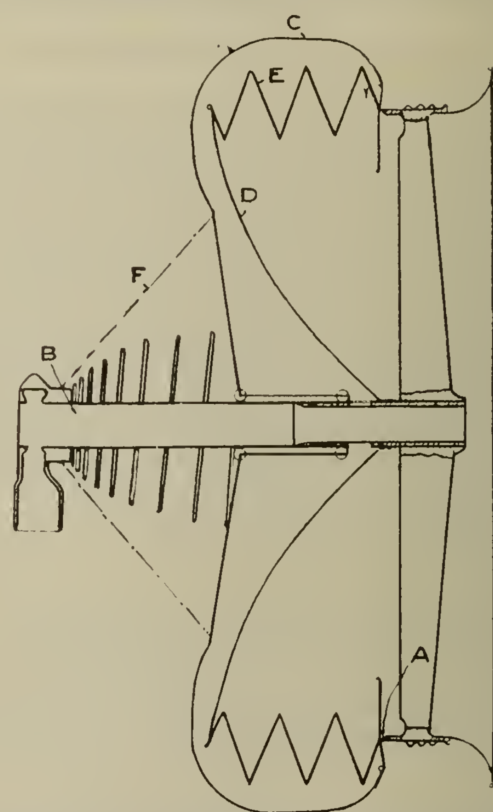

Figure No. 41.—Diagrammatic Arrangement of Gas Valve, R.101.

feet 8 inches in diameter with a fineness ratio of 2.83 to 1. It has a displacement of about 200,000 cubic feet.

The power is supplied by two Wright whirlwind, air cooled, radial engines of about 200 h.p. each. The thickness of the outer skin is 9½ thousandths of an inch.

This ship of small size is constructed more for the purpose of demonstrating the feasibility of this type of construction than for any idea of using it for commercial aviation. In order to construct a ship of this type it was necessary to invent a machine for carrying out the rivetting, which is now done by an exceedingly ingenious machine. This machine cuts off the wire into the length required for the rivets, punches the holes in the two plates, and fastens the rivets along three lines of rivetting in one operation with a minimum of labour. It is claimed that

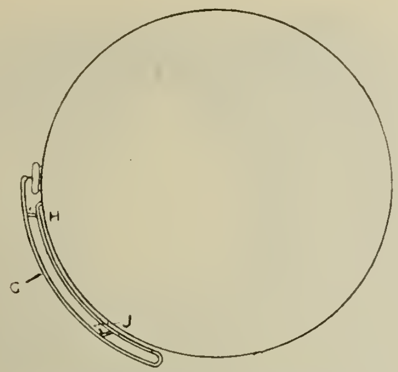

Figure No. 42.—Arrangement of Gas Valve Siphon Pipe.

this machine has successfully driven 3½ million rivets of 0.035 inch diameter with only one-third of one per cent defective rivets.

The airship is provided with internal ballonets for maintaining the gas pressure, and when filled with helium it is estimated it will have a gross lift of 12,242 lbs., of which the useful load is 3,442 lbs. The difficulties of inflating a ship of this kind were mentioned when dealing with the Schwartz airship.

It is understood that to inflate the Z.M.C. 2 the ship was first filled with carbon dioxide, which was in turn allowed to flow out from the bottom at the same time that the helium entered from the top of the ship. This airship has now been completed, and is undergoing trials, which will be watched with the keenest interest.

United States Airships

The United States Navy has placed contracts for two airships of approximately 6,000,000 cubic feet capacity,

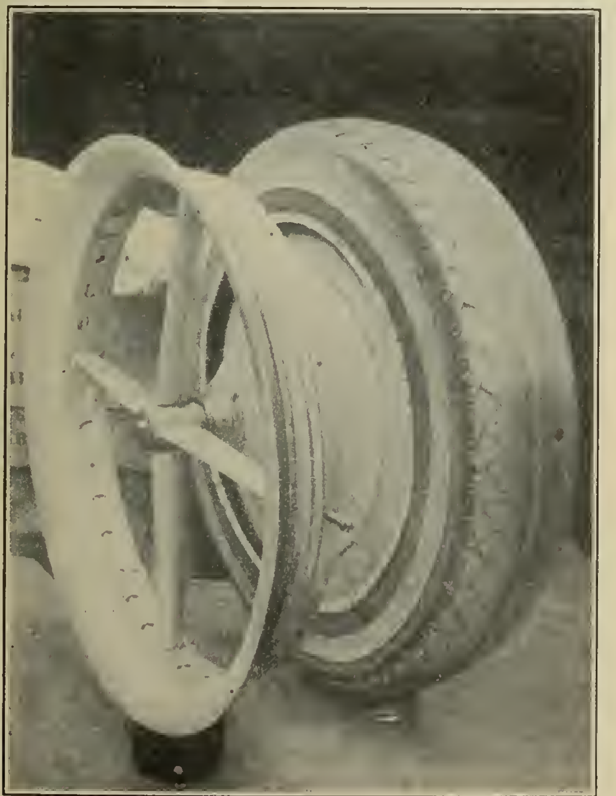

Figure No. 43.—Gas Valve R.101.

Figure No. 44.—Passenger Accommodation R.101.

but unfortunately details of these airships were not available at the time of writing this paper. An indication, however, of the trend of thought in the United States can be obtained from a recent paper by Karl Arnstein of the Goodyear Company, who was until recently connected with the Zeppelin Company.

In the transactions of the American Society of Mechanical Engineers Mr. Arnstein describes a proposed 7,000,000 cubic feet ship for commercial purposes, particularly for trans-Atlantic service. The dimensions mentioned are a length of about 800 feet with a diameter of about 132 feet, giving a fineness ratio of about 1 to 6, which is very much in keeping with the proportions of the British ships.

The type of transverse frame proposed for these large ships is the type now being used in the British ships, but in the large Goodyear ship it is interesting to note that it is proposed to use four longitudinal keels, (figure No. 47). The two side keels are intended for the accommodation of passengers and as promenade decks, and these keels are described in the paper as giving a great increase to the longitudinal strength of the ship, and forming a valuable support to the intermediate rings.

Conclusion

A consideration of the rather extensive campaign of criticism that has been raised against the airship led the author to investigate the history of steamships, and in this connection the following extracts from the Encyclopaedia Britannica are not without interest:—

"It was in 1815 that the first steamship began to ply between the British ports of Liverpool and Glasgow. In 1826 the 'United Kingdom,' a leviathan steamship, as she was considered at the time of her construction, was built for the London and Edinburgh trade."

"Isolated voyages by vessels fitted with steam engines had been made by the 'Savannah' from the United States in 1819 and by the first 'Royal William' from Canada in 1833."

Considerable competition arose over the ocean services, and there was a race between three companies to put ships into the ocean service.

"The London Company chartered the "Sirius," a 700-ton steamship, and despatched her from London on the 28th of March, 1833. She eventually left Cork on the 4th of April and reached New York on the 22nd, after a passage of seventeen days." Trouble over took all three

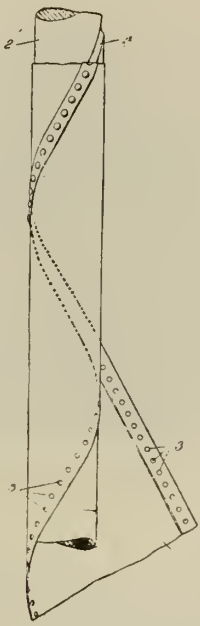

Figure No. 45.—Construction of Booms R.100.

of these early Atlantic Companies, and they soon ceased to exist. Perhaps the most serious factor against them was the success of Mr. Samuel Cunard in obtaining the Government contract for the conveyance of mails from Liverpool to Halifax and Boston.

The following extract indicates that all was not plain sailing.—

"The London Company put a second ship, the, 'President,' on their station. She was lost with all hands, no authentic information as to her end ever being obtained. Her mysterious fate settled the fortunes of her owners."

The next sentence, however, indicates that even disasters of this kind did not prevent development:—

"Steam navigation across the Atlantic was now an accomplished fact, but all the three pioneers had been borne down by the difficulties which attend the carrying out of new departures."

It is evident from the consideration of even a few quotations such as those given above that the development of steamships for ocean travel was not prevented by initial difficulties in the construction of the ship and in financing the Companies. It is interesting to consider what the future might have been if a century ago steamship construction had been stopped as a result of the difficulties that were being experienced.

Figure No. 46.—Metal Airship Z.M.C.2.

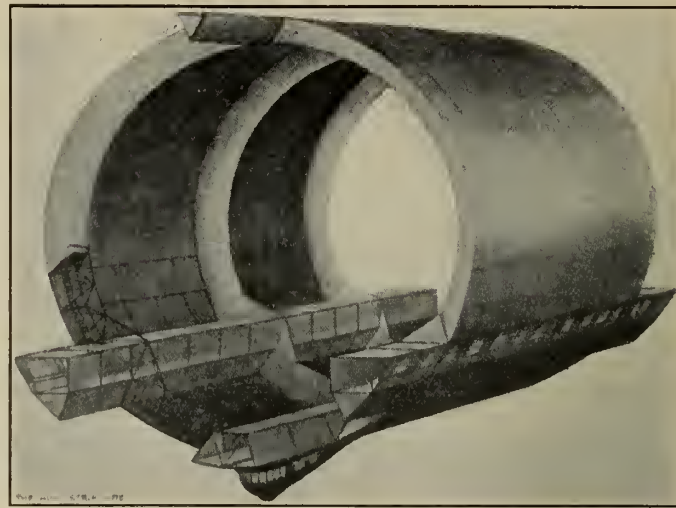

Figure No. 47.—Section of 7,000,000-Cubic Feet Airship.

If we could look forward another century, or even a much shorter time, is it not probable that we should see just as great developments in air navigation and in the airship itself as we can see by looking back on the development that has taken place in the past century in steamships?

We must always remember that rigid airship construction has all taken place within the memory of comparatively young men, and most of the members of this Institute will be able to recall the excitement caused by the initial flights of the Zeppelin airships. The enforced construction during the war period caused unnatural development of the ships in advance of the art of design; since the war more adequate time and talent have been available for research, with the result that rapid progress has been made both in the design and construction of ships of this type, and now it would appear that all that is necessary is a reasonable amount of encouragement and public interest during the period that airship builders and operators are overcoming their initial difficulties.

APPENDIX I

The author desires to acknowledge the source from which the photographs used in the text have been taken:—

Figure No.	*Title*	*Source*
1	Xerxes on his winged throne.	Hildebrant "Airships Past and Present," page 2.
2	Francisco de Lana's Airship.	History of Aeronautics, Vivian and Marsh, page 3.
3	Montgolfier's Hot Air Balloon	"Airships Past and Present," by Hildebrant, page 11.
4	Schwartz' Balloon after the Accident.	Hildebrant "Airships Past and Present," page 59.
5	Zeppelin L.Z. 1 first ascent July 2, 1900.	Plate 1, Zeppelin Catalogue.
6	Zeppelin L.Z. 3.	Plate 2, Zeppelin Catalogue.
7	Zeppelin L. 71, the last German Naval airship.	Zeppelin Catalogue, p. 13.
8	Zeppelin L. 59 Naval Airship.	Plate 11, Zeppelin Catalogue
9	Zeppelin L. 2 Interior.	Plate 7, Zeppelin Catalogue.
10	Delag Passenger Zeppelin "Bodensee."	Plate 38,Zeppelin Catalogue.
11	Crew's Quarters "Bodensee."	Plate 45, Zeppelin Catalogue.
12	Inside view of Bodensee."	Plate 47,Zeppelin Catalogue.
13	Power gondola "Bodensee."	Plate 48,Zeppelin Catalogue.
14	Interior view Schütte-Lanz Airship.	N.A.C.A. Technical Memo. 313, Fig. 1.
15	Spiess Airship.	Commercial Airships by Pratt, page 8.

Figure No.	*Title*	*Source*
16	British Airship No. 1.	British Airships by Whale, page 136.
17	British Rigid No. 9.	British Airships, page 146.
18	British Rigid 23X Class.	British Airships, page 168.
19	Rigid Airship No. 31.	British Airships, page 172.
20	Rigid Airship R. 34.	History of Aeronautics by Vivian and Marsh, page 370.
21	U.S. Navy dirigible "Los Angeles."	Aircraft Year Book 1926, page 102.
22	Arrangement of Airship Z.R. 3.	N.A.C.A. Tech. Memo. 286.
23	British Rigid R. 36.	Engineering, Apr. 15, 1921.
24	Keel construction British Rigid R. 36.	Engineering, Apr. 15, 1921.
25	Typical bracing.	Advisory Committee Report 1921-22, R. and M. 775.
26	Interior view of "Graf Zeppelin."	Zeppelin Co.
27	R. 101.	Aeroplane, Oct. 11, 1929.
28	R. 101 gas bag wiring.	Journal, Royal Aeronautical Society, August 29.
29	Line diagram British airship R. 101.	Flight, Nov. 29, 1928.
30	Portion of structure R. 101.	Flight, Nov. 29, 1928.
31	Section main longitudinals R. 101.	Engineering, Nov. 30, 1928.
32	Section ridge girders R. 101.	Engineering, Nov. 30, 1928.
33	Construction details R. 101.	Journal, Royal Aeronautical Society, August, 1929.
34	Construction details R. 101.	Journal, Royal Aeronautical Society, August, 1929.
35	Construction details R. 101.	Journal, Royal Aeronautical Society, August, 1929.
36	Thrust bearing R. 101.	Journal, Royal Aeronautical Society, March, 1929.
37	Engine car R. 101.	Journal, Royal Aeronautical Society, March, 1929.
38	Ventilation outer cover R. 101.	Journal, Royal Aeronautical Society, August, 1929.
39	Automatic valve R. 34 class.	Journal, Royal Aeronautical Society, March, 1920.
40	Manoeuvring valve.	Journal, Royal Aeronautical Society, March, 1920.
41	Diagrammatic arrangement of gas valve, R. 101.	Journal, Royal Aeronautical Society, August, 1929.
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43	Gas valve R. 101.	Journal, Royal Aeronautical Society, August, 1929.
44	Passenger accommodation R. 101.	"Aeroplane," Oct. 11, 1929.
45	Construction of booms R. 100.	"This Airship Business" by Spanner.
46	Metal Airship Z.M.C. 2.	Courtesy of Aircraft Development Corp.
47	Section of 7,000,000 cu. feet airship.	Transactions A.S.M.E., Vol. 50.

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The Forty-fourth Annual General Meeting

This year the Ottawa Branch has again undertaken the sponsorship of the Annual General and General Professional Meeting. Those who were welcomed by the Branch at the Ottawa meetings in 1919 and 1924 will need no assurance that the Forty-Fourth Meeting, to be held this month, will be well worth attending. Both as regards technical and professional papers and social events, the programme will certainly maintain the well-deserved reputation of Ottawa for successful and thoroughly organized gatherings.

While these features are attractive and important, it should be noted that the Annual General Meeting is the one occasion in the Institute's year on which its work and the proposals of Council for future developments are open to review by the membership at large.

Keen debates have often taken place at our General Meetings, but this year the discussions should be of special interest, and the greater part of the first day of the meeting will probably be devoted to them. The reports of Council and of the various Committees which will then be presented touch on many debatable points, among which may be particularly mentioned those brought up by the Committee on Policy and by the Committee on the Relations of The Institute with the Provincial Associations of Professional Engineers. Both of these deal with problems affecting the future of The Institute as well as its present status and activity.

It was at the Annual General Meeting of 1922 that the general policy and development of The Institute last received special attention, and in that year the Committee on Policy, under the chairmanship of J. B. Challies, M.E.I.C., presented a report which was promptly acted upon, and which suggested many important features of the organization of The Institute as it is to-day. For example that report recommended the representation of the four zones by vice-presidents, and the election of members of Council by Branches instead of by zones as previously; in fact it dealt very successfully with the problems of organization and policy existing at that time. During the eight years which have since elapsed, The Institute has undoubtedly grown greatly in real strength and influence, a result largely due to the sound policy of Council and the steady maintenance of our standards of qualification for admission. Meanwhile the conditions under which engineering work is done in Canada have changed considerably. A much smaller proportion of our members than heretofore are now engaged in consulting work, and a greater number are in the employ of large organizations. More are occupied in highly specialized work, or in engineering work which has definite commercial affiliations, and at the same time there has been a marked development in the organization and activities of the Provincial Associations of Professional Engineers, bodies deriving authority for licensing or registration from their respective provincial legislatures.

The extraordinary industrial growth of Canada during this period gives every prospect of continuance, and with the country, The Institute is bound to continue its development. What are the lines along which this movement can best be directed, in view of the changing conditions as regards the professional activities of our members, and the establishment of the Professional Associations? It must be remembered that these bodies were inaugurated largely as a result of the work of an Institute committee, and in the opinion of Council it is for many reasons desirable that in the future, The Institute shall draw nearer to these organizations rather than take a divergent path.

Acting on this opinion, Council at its Plenary Meeting in October 1929 received and adopted the report of the Committee under S. G. Porter, M.E.I.C., which has for three years been studying this question. This report is one of the most important of those which will be presented at the Annual Meeting. It draws attention first to the lack of uniformity in the various professional engineering acts and in the powers and procedure of the several Associations. It points out further the anomalous situation existing in Canada as regards the diversity in the regulations for admission to the various professional bodies and to The Institute. It then recommends an endeavour to remove this anomaly by making a study of the present requirements of all these bodies, with a view to obtaining agreement between the Professional Associations and The Institute for the adoption of standard uniform regulations for admission to membership.

The report observes that any scheme of this kind must recognize fully the necessity for the effective continuation of the work of the individual Provincial Associations as regards professional licensing and registration. It then remarks that when standard uniform regulations for admission have been accepted by The Institute as well as by the Provincial Associations and have become effective, the next step would be for The Institute to regard membership in a Provincial Association as sufficient evidence of qualification for admission to The Institute. In due time, if supported by the Associations, this course would result in substantial identity of membership, The Institute having accepted the Associations' members; and eventually, with the absorption of those members of The Institute who do not belong to any Provincial Association, and vice-versa, complete identity would follow. The membership of The Institute would then consist entirely of the members of the several Associations. Its Council would be elected by the members of the Associations, and as a confederation of the Associations it would become in the truest sense the representative engineering organization of the country.

Such a scheme as that outlined above cannot of course be entered upon by Council without the support of the membership of The Institute, and for this reason will form an important, if not the chief, subject of discussion at the forthcoming meeting. As already mentioned, if this course is to be followed, it will be necessary to make a comparative study of the present requirements of the Associations and of The Institute to ascertain what changes in our regulations will be necessary. In such an enquiry it will also be needful to consult fully with the various Branch executive committees, many of which are in close touch with the local Professional Associations.

Another important question affecting the development and activities of The Institute will also be submitted, namely the necessity for an increase in the revenue of The Institute. This is a matter which was discussed briefly in the editorial column in the last number of the Engineering Journal, and the enquiry mentioned above is one of the purposes for which additional funds are needed. Evidently the solution of these problems will require the sympathetic cooperation, not only of our own membership, but also of the governing bodies of the various Provincial Associations of Professional Engineers.

OBITUARIES

John Goldsworth Culshaw, A.M.E.I.C.

Members of The Institute will learn with regret of the death of John Goldsworth Culshaw, A.M.E.I.C., which occurred on August 23rd, 1929.

Mr. Culshaw was born at Windle St. Helens, Lancashire, England, on August 31st, 1886, and received his education in the Old Country. He came to Canada in 1907, when he was engaged on construction with the Grand Trunk Railway, first as a rodman and later as instrumentman, field draughtsman, topographer and transitman. From April 1910 to May 1914, Mr. Culshaw was resident engineer in charge of construction with the Grand Trunk Pacific Railway, the latter year and a half being on mountain work. From May 1914 to May 1915 he was levelman and afterwards transitman on preliminary surveys for the Alberta and Great Waterways Railway. On June 10th, 1915, Mr. Culshaw joined the 11th Service Battalion South Lancashire Regiment, and after two and a half years service in France was demobilized with the rank of Lieutenant on April 12th, 1919, returning to Canada in August of that year. Following his return he was attached to the staff of the Commissioner of Irrigation as field draughtsman on reclamation work. In 1927 he was appointed resident engineer with the Canadian National Railways, western region, and at the time of his death he was resident engineer at Neidpath, Sask.

Mr. Culshaw joined The Institute as a Student on October 9th, 1909, and was transferred to the class of Associate Member on September 21st, 1920.

Edward Arnold Thomas, A.M.E.I.C.

Members will learn with regret of the death of Edward Arnold Thomas, A.M.E.I.C., which occurred suddenly on January 4th, 1930 at Saint John, N.B.

Mr. Thomas was born at Runcorn, England on June 21st, 1885, and was educated at grammar school at Bolton, Lancashire, and Silcoats College, Wakefield, Yorkshire, attending the Manchester Technical School in 1902-1903. In 1903-1904 Mr. Thomas was with the Ordnance Survey, Great Britain, and from 1905 to 1907 he was engineering assistant to the Water and Sewerage Department of the city of Saint John, N.B. During this period part of the present Loch Lomond waterway extension was built, and Mr. Thomas was employed on this work. In 1908 he was an instrumentman with the forest survey, and in August of the same year was appointed draughtsman with the Public Works Department of Canada at Saint John. In December 1908, he was named assistant engineer, and in 1911 was appointed to take charge of Courtenay Bay development under the district engineer, Saint John Harbour. From 1915 to 1920, Mr. Thomas served overseas with the Canaadian forces, leaving Saint John as a lieutenant in B. Company, 6th Mounted Rifles. He saw service in France and later was stationed in England, where his engineering abilities were utilized. On his return to Saint John in 1920 he was again placed in charge of the Courtenay Bay work, and studies were also made for development of ocean terminals there. In 1927 Mr. Thomas resigned to accept the position of senior on the staff of the Saint John Harbour Commission.

Mr. Thomas took a keen interest in the affairs of The Institute, being on the Executive Committee of the Saint John Branch in 1926, Vice-Chairman in 1927, and Chairman at the time of his death. He joined The Institute as an Associate Member on December 18th, 1923.

Arthur Edward Eastman, A.M.E.I.C.

It is with deep regret that we record the death of Arthur Edward Eastman, A.M.E.I.C., which occurred at Cardinal, Ontario, on June 18th, 1929.

Mr. Eastman was born at Petitcodiac, N.B., on December 26th, 1880.

Following his graduation from the University of New Brunswick in 1906, with the degree of B.A.I., Mr. Eastman was for two years rodman and leveller on the Ontario-St. Lawrence Canals, for the Department of Railways and Canals, and from 1908 to 1910, he was assistant resident engineer on the same work. In 1910-1911 he was a detailer in the draughting room of the Dominion Bridge Company, being engaged on general draughting. In 1911 Mr. Eastman again became connected with the Department of Railways and Canals as assistant resident engineer in charge of improvements to the Morrisburg and other canals. He was engaged on this work until 1916, when he was for a short time instrumentman on the Toronto harbour improvement for the Canadian Stewart Company. In 1917 Mr. Eastman returned to the Dominion Bridge Company for a short period of time. From 1917 to 1921 he was on the staff of the Canadian Steel Corporation at Ojibway, Ont., as inspector, draughtsman and was also doing general field and office work on steel plant construction. In 1921-24, Mr. Eastman was located at Ogdensburg, N.Y., and in 1924 he became general assistant engineer on hydro-electric construction for the St. Lawrence Valley Power Company of Potsdam, N.Y., and remained with that firm until 1926, when he joined the staff of the Central Maine Power Company of Augusta, Maine, as general assistant engineer on hydro-electric construction and remained with that firm until the time of his untimely death.

Mr. Eastman joined The Institute as an Associate Member on March 16th, 1915.

Joseph Aimé Godefroy Goulet, M.E.I.C.

It is with deep regret that we record the death of Joseph Aimé Godefroy Goulet, M.E.I.C., which occurred suddenly on December 16th, 1929 at Peterborough, Ont.

Mr. Goulet was born at St. Eustache, Que., on October 22nd, 1868, and received his education from McGill University and the Ecole Polytechnique, Montreal, graduating from the latter institution in 1890 with the degree of M.E.

Following graduation, Mr. Goulet was in charge of the testing department of the Deane Stream Pump Company at Holyoke, Mass., until 1891. In 1891-1892 he was engaged on the sounding of the Saguenay river and relocating buoys and giving alignment for same. In 1892 and 1893, he was located in Toronto, as mechanical engineer and superintendent of the Northey Manufacturing Company. In 1893-1894 Mr. Goulet was engaged in work for the Columbian Exposition at Chicago in the agricultural machinery department. In 1894-1896, he was superintendent of dredging and mechanical engineer in charge of designing and construction at the Government shipyard, Sorel, Que., and from 1896 to 1899 he was mechanical engineer and chief designer with the Northrup Loom Company of Canada at Valleyfield, Que. From 1899 to 1900, Mr. Goulet was mechanical engineer and chief designer with the Draper Corporation of Hopedale, Mass., U.S.A., and from 1900 to 1901 he was master mechanic with Isaac Mautner and Sohn, Vienna, Austria and Buda-Pesth, Hungaria. In 1901 Mr. Goulet returned to Canada and became designing draughtsman at the Montreal plant of the Canadian General Electric Company, and has remained on the Company's mechanical staff since that time being mechanical engineer at the time of his death.

JOSEPH AIMÉ GODEFROY GOULET, M.E.I.C.

Mr. Goulet joined the Canadian Society of Civil Engineers as an Associate Member on March 16th, 1899, and transferred to the class of Member on January 26th, 1920.

Henry Holgate, M.E.I.C.

In the death of Henry Holgate, M.E.I.C., which occurred at Montreal, Que., on January 21st, 1930, a well-known figure has passed from the engineering profession. Mr. Holgate was born at Milton, Ont., in 1863 and received his education at schools in Toronto. In 1878 he was apprenticed under the late Colonel F. W. Cumberland to the Northern Railway of Canada, later absorbed by the Grand Trunk Railway. From 1878 until 1891 he was connected with railway construction and maintenance, then until 1894 with bridge and structural engineering. In 1894 he entered the service of the Royal Electric Company at Montreal, and built and operated the Montreal Park and Island Railway. In 1898 Mr. Holgate went to Jamaica as manager of the West India Electric Company, and there built and operated the hydro-electric tramway system in Kingston. Returning to Montreal in 1901 he entered into partnership with R. A. Ross, D.SC., M.E.I.C., and for ten years the firm were engineers to many enterprises, and constructed a number of hydro-electric plants including the West Kootenay Power Company and the Canada Copper Company. This partnership was dissolved in 1911. While Mr. Holgate gave much attention to hydro-electric development, he followed a general practice. He investigated for the Dominion Government in 1906, matters regarding the Trent Valley canal, and was appointed by the Government as chairman of the Royal commission of enquiry into the collapse of the Quebec bridge in 1907, his report being issued in 1908. As one of a board of consulting engineers, he reported on the future development of Montreal harbour in 1909. He was president of the Cedar Rapids Power Company in 1911, afterwards becoming its consulting engineer. The last important work undertaken by Mr. Holgate was the exhaustive study of and report upon the proposed St. Lawrence deep waterway which he carried out in association with J. A. Jamieson, M.E.I.C., of Montreal, at the request of the Montreal Board of Trade.

Mr. Holgate was a member of the American Society of Civil Engineers, and the Engineers Club of Montreal, of which he was president, and was on the board of management of the Montreal General Hospital.

Mr. Holgate joined the Canadian Society of Civil Engineers as a Member on December 1st, 1887. He was a Councillor of the Society during the years 1906 and 1908, and was a vice-president in 1911 and 1912.

John Harrison Turner, M.E.I.C.

Members will learn with deep regret of the death of John Harrison Turner, M.E.I.C., which occurred at Lethbridge on December 11th, 1929 after a prolonged illness.

Mr. Turner was born at Liverpool, England in 1863. He studied engineering at University College and City and Guilds College, London, England, and in 1879-1883, was pupil of and assistant to the late Sir W. E. Garforth, developing and fitting up coal mines in England. Following this Mr. Turner was for a time surveyor and assistant manager of the Massarelos Foundry, at Oporto, Portugal, and later was engaged on the design and erection of pumping engines for the Kimberley Water works, South Africa. He was for a time engaged on the construction of wharf and buildings and the installation of plant for ice making, grain cleaning and pumping at Bushire, Persia, and following that erected buildings and installed the plant for a large lumber mill at Peterborough, England. From 1890 to 1904 Mr. Turner was resident engineer in charge of construction of four power stations, and was assistant superintendent and superintendent of the London Hydraulic Company, England. From 1904 to 1910 Mr. Turner was owner and manager of the Wiltshire Foundry, manufacturing oil and gas engines, agricultural machinery, water and sewage plants, and from 1910 to 1915, he was contracting on bridges, and sewage and water works in Alberta and Saskatchewan. In 1914 when war broke out Mr. Turner was contracting in Lethbridge, having completed the Ninth street overhead bridge. Contracting work being at a standstill, he accepted a position with the Dominion Government Reclamation Service in Calgary. In 1917 he moved to Coalhurst Alta., where he was engaged as mine surveyor at the North American Collieries. In 1919 he passed the examination for his mine surveyor's certificate. In 1922 he moved to Lethbridge, and since that time he has been engaged in mine surveying and as mine manager, having acted in the latter capacity at the old Taylor Mine, the Majestic Mine at Taber and also the Federal Mine at Lethbridge. During the last two or three years ill health has prevented him from following his profession. Mr. Turner was a member of the Canadian Institute of Mining and Metallurgy. He was elected a Member of The Institute on May 22nd, 1922.

Bartholomew Brosnan Kelliher, M.E.I.C.

In the death of Bartholomew Brosnan Kelliher, M.E.I.C., which occurred in a nursing home in London, England, on November 7th, 1929, The Institute has lost a most distinguished member.

Mr. Kelliher was born at Castle Island, Ireland, on December 26th, 1862, and was educated at the Kilmurry and Castle Island national schools and was later apprenticed to James Dillon, M.I.C.E., of Dublin. In 1884, Mr. Kelliher came to the United States and for a time was employed as draughtsman, topographer, transitman and assistant engineer with various railways. In 1890-1896 he was resident and assistant engineer with the Northern Pacific Railway and in 1896-1897 he was assistant engineer with the Union Pacific Railway. In 1897-1898, Mr. Kelliher was mining engineer with the Annaconda copper mines at Butte, Montana, but in 1898 he returned to railway engineering. Mr. Kelliher is of course best remembered as the builder of the Grand Trunk Pacific Railway. At the time that he undertook this work it was considered impossible to build a railroad through the Rocky Mountains with only a four-tenths of one per cent grade, yet Mr. Kelliher accomplished this, and as a result the Grand Trunk Pacific has the lowest mountain grade in the world. From 1906, Mr. Kelliher was chief engineer of the Grand Trunk Pacific Railway. In 1921 he was assistant to the president of the Denver and Rio Grande Western Railway Company at Denver, Colorado and in 1925 he returned to Ireland. Mr. Kelliher was elected a Member of the Canadian Society of Civil Engineers on April 19th, 1906.

Nathan Ernest Mules, S.E.I.C.

It is with much regret that the untimely death of Nathan Ernest Mules, S.E.I.C., which occurred at Montreal on December 20th, 1929 is recorded.

Mr. Mules was born at Baltimore, Maryland, U.S.A. on May 9th, 1904. He graduated from McGill University in 1927 with the degree of Ph.D., and in the same year became a part time demonstrator at the same university, and a candidate for the degree of B.Sc. In February 1928, while he was still engaged on this work, Mr. Mules' health broke down, and after that time he was unable to engage in anything but private tutoring.

Mr. Mules joined the Institute as a Student on November 25th, 1924.

John Bennett Briggs, A.M.E.I.C.

The death of John Bennett Briggs, A.M.E.I.C., which occurred at Clacton-on-Sea, England, on October 29th, 1929, is recorded with much regret. Mr. Briggs had been in failing health for some time.

Mr. Briggs was born at Arbroath, Scotland, on June 30th, 1874. He received his education at Arbroath High School and Dundee College (St. Andrews University) graduating from the latter institution with the degree of B.Sc. in 1895.

Mr. Briggs came to Canada in 1903, and located in Toronto. He was for a time with the Gutta Percha and Rubber Company. In 1904, he was with J. A. Jamieson, M.E.I.C., Montreal as draughtsman. In 1905 he was engaged on grain elevator work with the Dodge Company, Toronto, and was later employed by the Consumers Gas Company, as draughtsman in charge of extension work, etc. In 1909 he was again on the staff of Mr. J. A. Jamieson, later becoming connected with Messrs. Alex. Pringle and Son. In 1910-1912 Mr. Briggs was with John S. Metcalfe and Company on grain elevator work. He was later employed by Westinghouse Church Kerr and Company. Mr. Briggs was subsequently in private practice as a consulting engineer in Toronto. During the war he rendered valuable service in connection with munition work first in Canada and then in the United States.

Mr. Briggs was elected an Associate Member of The Institute on June 10th, 1913.

George John Nelson, A.M.E.I.C.

Deep regret is expressed in recording the death of George John Nelson, A.M.E.I.C., which occurred at Montreal Que. on January 21st, 1928. Mr. Nelson was born at Montreal, Que. on November 18th, 1876. He graduated from McGill University in 1900.

Following graduation, Mr. Nelson joined the staff of the Lachine Rapids Hydraulic and Land Company, which company was later purchased by the Montreal Light, Heat and Power Company. In 1905, Mr. Nelson became associated with Mr. R. S. Kelsch, M.E.I.C., in connection with the Kaministiquia Power Company's development at Fort William, Ont. Mr. Nelson's connection with Mr. Kelsch continued and in 1925 he took over the latter's practice. In 1928, Mr. Nelson became electrical engineer with the Fraser-Brace Engineering Company Ltd., Montreal.

Mr. Nelson joined the Canadian Society of Civil Engineers as a Student on March 16th, 1899, and was transferred to the class of Associate Member on October 11th, 1906.

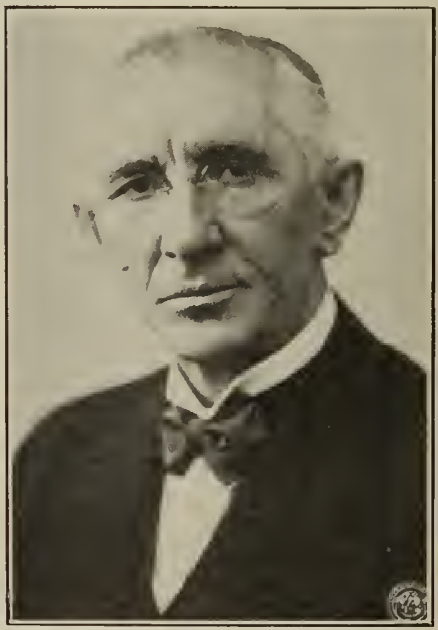
Committee *of the*
IN CHARGE OF
The Annual General

J. E. St. Laurent, M.E.I.C.
District Engineer
Department of Public Works
Vice-Chairman
of Annual Meeting Committee

J. McLeish, M.E.I.C.
Director, Mines Branch
Chairman of Ottawa Branch

Grote Stirling, M.E.I.C., M.P.
Honorary Member

R. F. Howard, M.E.I.C.
Manager of Power Sales
Gatineau Power Co.
Chairman of Trips Committee



John Murphy, M.E.I.C.
Electrical Engineer
Board of Railway Commissioners
Chairman of Reception Committee

Col. A. F. Duguid, A.M.E.I.C.
Chief, Historical Section
Department of National Defence
Chairman of Ball Committee

Ottawa Branch

ARRANGEMENTS FOR

Professional Meeting

J. L. Rannie, M.E.I.C.
Chief of Triangulation Division
Geodetic Survey of Canada

Chairman of
Annual Meeting Committee

L. L. Bolton, M.E.I.C.
Asst. Deputy Minister
Department of Mines

Chairman of Finance Committee

H. M. Barton, A.M.E.I.C.
Geodetic Survey
Department of the Interior

Honorary Secretary

W. H. Norrish, A.M.E.I.C.
Natural Resources Branch
Department of Interior

Chairman of Publicity Committee

C. A. Price, A.M.E.I.C.
Chief of Precise Water Levels Division
Canadian Hydrographic Service

Chairman of Smoker Committee

C. E. White, A.M.E.I.C.
Assistant Engineer
Canadian National Railways

Chairman of Registration Committee

PERSONALS

C. E. Hedley, S.E.I.C., has joined the staff of the Alcoa Power Company, Ltd., at Arvida, Que.

W. F. Guenther, S.E.I.C., who has, since 1924, been on the staff of the Hamilton Hydro-Electric Company, Hamilton, Ont., is now connected with the Standard Underground Cable Company of Canada, Ltd., at Hamilton. Mr. Guenther graduated from the University of Toronto in 1923 with the degree of B.A.Sc.

I. W. Boyd, S.E.I.C., who graduated from Queen's University in 1924 with the degree of B.Sc., obtaining the degree of M.Sc., in 1926, is now connected with Siscoe Gold Mines, Ltd., and is located at Amos, Que. Mr. Boyd was formerly on the staff of the Ingersoll-Rand Company at Phillipsburg, N. J. and later at Montreal, Que.

J. Jackson Crawford, A.M.E.I.C., a member of the staff of the Canadian Cellulose Company Ltd., at Cornwall, Ont., has been transferred to the Canada Paper Company at Windsor Mills, Que. Mr. Crawford is a graduate of the University of Toronto of the year 1922, and before becoming connected with the Canadian Cellulose Company he was chemist with Price Brothers and Company Ltd., at Kenogami, Que.

J. T. Rose, A.M.E.I.C., who has been with the Dominion Water Power and Reclamation Service since July 1914, has been appointed resident inspecting engineer for the Dominion Government. He is located at the City of Winnipeg power development on the Winnipeg river at Slave Falls, Man. Mr. Rose graduated from the University of Toronto with the degree of B.A.Sc. in 1915.

J. T. Thwaites, S.E.I.C., is now attached to the engineering department of the Canadian Westinghouse Company, Hamilton. In 1927 Mr. Thwaites was connected with Smart Turner Machine Company, Ltd., Hamilton, and in 1928, with the Wentworth Radio Supply Company, Ltd., Hamilton.

A. C. Knapp, S.E.I.C., who has been on the engineering staff of the Carborundum Company at Niagara Falls, N.Y., since graduating from Queen's University in 1927, has just returned to Niagara Falls after spending five months at Shawinigan Falls, Que., where he was in charge of the construction of a new furnace building for the Canadian Carborundum Company, Ltd.

W. H. Slinn, A.M.E.I.C., who was formerly engineer of special studies, Montreal division plant, Bell Telephone Company of Canada, Ltd., is now located at Hamilton where he is the company's Division Engineer. Before becoming connected with the Bell Telephone Company, Mr. Slinn, who graduated from Queen's University in 1916 with the degree of B.Sc., was assistant engineer on construction with E. G. M. Cape and Company.

J. R. Reid, A.M.E.I.C., gave up municipal engineering in April 1929 to become superintendent of construction for Foley Bros. Ltd., of Winnipeg, confining himself to highway construction on No. 1 Highway. In December 1929, Mr. Reid severed his connection with Foley Bros., Ltd. and reorganized a new company registered in Saskatchewan as the Western Engineering Company Ltd., with head office at Regina, Sask., of which Mr. Reid is president and managing director.

R. B. Winsor, Jr.E.I.C., has resigned his position on the engineering staff of the International Power and Paper Company of Newfoundland, Ltd., at Corner Brook, Nfld. and has joined the engineering staff of Canadian Industries Ltd., Montreal. Mr. Winsor graduated from McGill University with the degree of B.Sc. in May 1927, and immediately became construction engineer with W. I. Bishop Ltd., on paper mill construction for the Anglo-Canadian Pulp and Paper Mills Ltd., at Limoilou, Que.

Adhemar Laframboise, A.M.E.I.C., civic engineer of Lachine, Que., who has been in the service of that municipality since 1914 has resigned from that position. Mr. Laframboise graduated from the Ecole Polytechnique, Montreal, in 1911, and from August 1911 to March 1912 was structural engineer for the National Transcontinental Railway at Ottawa. From March 1912 to November 1913 he was employed as designer and draughtsman by the Dominion Bridge Company, at Lachine, Que.

Robert Ford, A.M.E.I.C., was appointed plant engineer of the Papineau factory of the Dominion Rubber Company, Montreal, at the beginning of the current year, having been, for several months, on the engineering staff of that company. Mr. Ford, who graduated from McGill University in 1922 with the degree of B.Sc. was resident engineer with the British Columbia Pulp and Paper Company Ltd., at Port Alice, B. C. prior to becoming connected with the Dominion Rubber Company.

Donald A. Killam, Jr.E.I.C., who was formerly connected with the International Power and Paper Company Corner Brook, Nfld., has joined the engineering staff of Canadian Industries, Ltd., at Montreal. Mr. Killam graduated from McGill University with honours in civil engineering in 1927. Shortly after graduation Mr. Killam was appointed to the staff of the Abitibi Fibre Company, Ltd., at Smooth Rocks Falls, Ont. In 1928 he was attached to the engineering department of the Canada Power and Paper Corporation at Montreal.

Kenneth Reid, Jr.E.I.C., has become assistant chief electrician of the Consolidated Mining and Smelting Company of Canada, Ltd., at Tadanac, B.C. Following graduation from McGill University in 1926 with the degree of B.Sc., Mr. Reid was for a time on the staff of the Canadian General Electric Company, Ltd., at Peterborough, Ont., and prior to accepting his present position, he was junior engineer in the electrical engineering department of the British Columbia Electric Railway Company at Vancouver, B.C.

R. S. L. Wilson, M.E.I.C., has been appointed Dean of the Faculty of Applied Science of the University of Alberta, Edmonton, Alta. Mr. Wilson graduated from McGill University in 1911 with the degree of B.Sc. and from 1912 to 1915 was in charge of purchasing, costs, subcontracts and latterly estimating with R. J. Lecky and Company, Ltd. engineers and contractors, Regina, Sask. From 1915 to 1919 Mr. Wilson was lecturer and demonstrator in mathematics and civil engineering at McGill University, and from 1919 to the present time he has been Professor of Civil and Municipal engineering at the University of Alberta.

P. M. Knowles, A.M.E.I.C., chief draughtsman, engineering department, Bell Telephone Company, Montreal, has been transferred to the Company's Toronto office. From 1916 to 1919, Mr. Knowles was on active service as a lieutenant in the Canadian Engineers, in 1917 and 1918 being officer commanding section of field company of army engineers in France on water supply, road making, bridging, construction of buildings, supervision of corps workshops. From 1919 to 1924, Mr. Knowles was draughtsman and inspector of works J. M. Miller, A.R.C.A., architect, and has held his present position since 1925.

Major R. A. Logan, A.M.E.I.C., who returned to this country during the latter part of 1929 after having been in Rhodesia, South Africa since 1927, where he was first located at N'Changa Nia N'Dola, Northern Rhodesia, as Manager, Aircraft Operating Company, African Aerial Survey, and later at Bulawayo, Southern Rhodesia, where he was manager of the African Expedition Aircraft Operating Company, Ltd., is now attached to the operations department of the Pan American Airways, Inc., and recently completed an aerial tour of the West Indies. Major Logan is a graduate of the Nova Scotia Technical College, from which he received a diploma in 1911.

Major F. R. Henshaw, A.M.E.I.C. is now at Headquarters, Military District No. 3, at Kingston, Ont. Major Henshaw graduated from the Royal Military College, Kingston in 1911, and from 1911 to 1913 attended the School of Military Engineering, at Chatham, England. In 1914 he was division officer for the Maritime Provinces, Military District No. 6, and in 1915 was chief instructor, Canadian Engineers Training Depot, in England. From 1916 to 1919, Major Henshaw served with various Canadian Engineer units in France and England. He was chief instructor at the School of Military Engineering at Halifax, N.S. and in January 1928 was attached to the Staff College at Quetta, India, returning to Canada in April 1928. Since that time Major Henshaw has been located at Ottawa with the Department of National Defence.

J. W. McCammon, A.M.E.I.C., has resigned from the Charles Walmsley Company (Canada) Ltd., Montreal, to become manager of the commercial department of the Beauharnois Power Company, Montreal. Mr. McCammon graduated from McGill University in 1912 with the degree of B.Sc., and later took an apprentice course with Canadian Westinghouse Company at Hamilton, Ont. Following this he was for one and a half years assistant to the mechanical and electrical engineer of Mackenzie Mann and Company on the Mount Royal Tunnel, Montreal, and later was for nine years manager of the pump and electrical departments of Canadian Fairbanks Morse Company, Montreal. Mr. McCammon enlisted in April 1915 with the 6th Siege Battery, was commissioned with the Royal Garrison Artillery in June 1917, transferred to Canadian Garrison Artillery with rank of lieutenant in October 1918 and demobilized in 1919.

W. S. Lee, M.E.I.C. has received the official nomination for president of the American Institute of Electrical Engineers. Mr. Lee has been a pioneer in high voltage power developments and transmission. He is a native of Lancaster, S.C., and was awarded the degree of civil engineer by the Citadel, the military college of South Carolina. Following his early engineering experience, he was appointed resident engineer at the Anderson (S.C.) Light and Power Company in 1897, resident engineer of the Columbus (Ga.) Power Company in 1898, and chief engineer of the latter in March 1902. One year later he was appointed chief engineer, and in October of that year vice-president and chief engineer of the Catawba Power Company, Charlotte, N.C. This company was a subsidiary of the Southern Power Company, and in 1905 he became chief engineer of the latter company. He later received the appointment of vice-president and chief engineer, which position he held for about fifteen years. He is at present vice-president and chief engineer of the Duke Power Company. Among Mr. Lee's other connections are the following: president of the W. S. Lee Engineering Corporation, president and chief engineer of the Piedmont and Northern Railway Company, vice-president and chief engineer and director Duke Power Company, Wateree Power Company, Western Carolina Power Company, Catawba Manufacturing and Electric Power Company, director, American Cyanamid Company, vice-chairman and trustee of the Duke Endowment. He is also engaged in practice as a consulting engineer with an office in New York City and Charlotte, N.C., and is at present engaged in that capacity in connection with the power development on the St. Lawrence river at Beauharnois, Que., of the Beauharnois Light, Heat and Power Company.

Colonel J. S. Dennis Retires from C. P. R.

Colonel John Stoughton Dennis, C.M.G., D.L.S., D.T.S., M.E.I.C., Chief Commissioner of Colonization and Development, of the Canadian Pacific Railway Company, retired on January 1st, 1930 after twenty-eight years' service with the company. But while Colonel Dennis has retired from his position as active head of the company's Colonization and Development, he will continue to act in an advisory capacity to the company's directors.

Colonel Dennis was born at Weston, Ont., in 1856. As a youth he studied surveying and soon secured the degrees of Dominion Land Surveyor and Dominion Topographical Surveyor. Going west as a very young man, he has played an important part in the development of the prairie provinces, and before the prairie provinces were formed, had risen to the position of Deputy Minister of Public Works, and chief engineer of the Northwest Territories, whose capital was then Regina. The important work he did as land commissioner for the Hudson Bay Company and in the developing of irrigation in the west, as well as the successful direction of the public works there, attracted the attention of the Canadian Pacific Railway Company, the officials of which induced him in 1903 to join the staff of the Canadian Pacific Railway Company as assistant to the second vice-president. In 1912 he was made assistant to the president which position he occupied until 1917 when he was given the appointment from which he has just retired. From 1915 to 1917 Colonel Dennis was head of the Canadian Mission in the United States and second in command of the British-Canadian Mission. In 1918 he was chairman of the Siberian Trade Commission, and was attached to the Intelligence Staff, and was in command of transportation and supplies, work enough for any ordinary three men. He was awarded the honour of

Col. J. S. Dennis, M.E.I.C.

the C.M.G. by His Majesty the King, and was also decorated by the Serbian and other governments for the part he played.

Colonel Dennis was elected a Member of the Canadian Society of Civil Engineers on November 21st, 1901; he was a member of Council in the years 1906 and 1911; he was elected a vice-president in 1907, and he became President in 1917.

Vice-President and Manager of National Bridge Company of Canada

E. S. Mattice, M.E.I.C., who for four years was manager and chief engineer of Steel Gates Company, Ltd., St. Catharines, Ont. in charge of the construction and erection of the steel gates of the new Welland Ship Canal, has been appointed vice-president and manager of the National Bridge Company of Canada, Ltd., and is located at Montreal, Que. Mr. Mattice was born at Cornwall, Ont. on December 15th, 1870 and received his education at Upper Canada College, Toronto, and McGill University, graduating from the latter institution in 1890 with the degree of B.A.Sc. Following graduation Mr. Mattice was on the staff of the Dominion Bridge Company Ltd., in 1891, with the Dominion Government on Cornwall canal from1891 to 1893, and with the Norton Iron Works Boston from 1893 to 1894. In 1894 Mr. Mattice again became connected with the Dominion Bridge Company, and from 1895 to 1910 was that Company's Montreal representative. In 1910-1911 he was assistant engineer with the Lewiston Land and Water Company at Lewiston, Idaho. In 1911 Mr. Mattice again returned to the Dominion Bridge Company, this time as contracting engineer. He organized the Structural Engineering Company in 1912, and was contracting engineer from 1918 to 1921. During this time he supervised the design of steel work for a number of large buildings in the city of Montreal including the Sun Life Assurance building, the Drummond building, the Montreal Street Railway building, the Technical school, the Bell Telephone Exchange buildings on Hospital and Ontario streets, and also Macdonald College at St. Anne de Bellevue, Que., the Technical school, Toronto, and the Yorkshire building, and Dominion Immigration building at Vancouver. Mr. Mattice was consulting engineer for Canadian Vickers Ltd., of steel work for the Montreal Harbour Commissioners' Elevator No. 3, he later was managing director of the Phoenix Bridge and Iron Works Ltd., and from 1923 to 1925 was chief engineer of Canadian Vickers Ltd., at Montreal.

E. S. Mattice, M.E.I.C.

ELECTIONS AND TRANSFERS

At the meeting of Council held on January 14th, 1930, the following elections and tranfers were effected:

Members

BILLINGS, Asa White Kenney, A.B., A.M., (Harvard Univ.), Vice-President, Brazilian Traction Light & Power Co. Ltd., Sao Paulo, Brazil.

MacLEOD, Hector John, B.Sc., (McGill Univ.), M.Sc., (Univ. of Alta.), M.A., Ph.D., (Harvard Univ.), professor of elect'l. engrg., University of Alberta, Edmonta, Alta.

PARKIN, John Hamilton, Diploma (Hon.), B.A.Sc., M.E., (Univ. of Toronto), asst. director in dept. of physics and engrg. physics, in charge of aeronautical research, National Research Council, Ottawa, Ont.

Associate Members

GLIDDON, William Gilbert Claude, B.Sc., M.Sc., (McGill Univ.), elect'l. engr., Canadian Hydro-Electric Corporation, Ottawa, Ont.

LILL, Cameron Dennis, engr. and mgr., Regina Branch, Manitoba Bridge and Iron Works, Regina, Sask.

Juniors

ARCHER, John Edward, B.A.Sc., (Univ. of Toronto), engrg. dept., Canadian General Electric Co. Ltd., Peterborough, Ont.

BANKS, Shewell Reginald, B.Eng., M.Eng., (Liverpool Univ.), design dept., Dominion Bridge Company, Ltd., Lachine, Que.

HUNT, John, B.Sc., (St. Andrews, Scot.), asst. designer, Canadian Vickers, Ltd., Montreal, Que.

LAIDLAW, Douglas Staunton, B.A.Sc., (Univ. of Toronto), dftsman., B.G. de Hueck & Co. Ltd., Montreal, Que.

PAULSEN, Rudolph Odin, B.Sc., (Univ. of Man), detailer, Winnipeg Hydro-Electric System, Winnipeg, Man.

Affiliate

GALILEE, John Anthoney Masey, in charge of technical advertising, Canadian Westinghouse Company, Hamilton, Ont.

Transferred from the class of Junior to that of Associate Member

ANDERSON, Dan, B.Sc., (McGill Univ.), elec'l. engr., Power Corporation of Canada, Montreal, Que.

JOHNSTON, Harry Lloyd, B.Sc., (McGill Univ.), plant engr., Canada Paper Company, Windsor Mills, Que.

LESLIE, Roy Campbell, B.A.Sc., M.A.Sc., (Univ. of Toronto), design office, Canadian Bridge Co. Ltd., Walkerville, Ont.

MUIRHEAD, Stuart Robert, B.A.Sc., (Univ. of Toronto), engr., Sask. Govt. Telephones, Regina, Sask.

Transferred from the class of Student to that of Associate Member

HOWES, Frederick Stanley, B.Sc., M.Sc., (McGill Univ.), Ph.D., (Univ. of London), lecturer and lab. demonstrator, dept. of elect'l. engrg., McGill University, Montreal, Que.

Transferred from the class of Student to that of Junior

BINNS, George Frederick, B.Sc., (McGill Univ.), asst. factory engr., Imperial Tobacco Co. of Canada, Ltd., Montreal, Que.

BRUMELL, John Hunter, production engr., Canadian Ingersoll-Rand shops, Sherbrooke, Que.

GRANT, Alexander George, B.A.Sc., (Univ. of Toronto), engr. on constrn. of Hamilton Terminal, Canada Steamship Lines, Russell Construction Co. Ltd., Toronto, Ont.

KEEFLER, Ralph Holley, B.A.Sc., (Univ. of Toronto), general commercial engr., Bell Telephone Company of Canada, Montreal, Que.

Students Admitted

DICKSON, William Leslie, B.Sc., (N.S.T.C.), 231 Bonnaccord Street, Moncton, N.B.

DUTTON, William Lawrason, (Undergrad., Univ. of Toronto), East House, University of Toronto, Toronto, Ont.

HALL, William, (Undergrad., Univ. of B.C.), 1256 Denman Street, Victoria, B.C.

MILLER, William Frederick, (Undergrad., Queen's Univ.), 31 Commercial Street, North Bay, Ont.

PETERS, Henry F., (Undergrad., Univ. of Man.), 132 Colony Street, Winnipeg, Man.

PHILLIPS, Ernest Albert, (Undergrad., Univ. of Toronto), South House, University of Toronto, Toronto, Ont.

SOUTHAM, William Watson, (Undergrad., McGill Univ.), 3434 McTavish Street, Montreal, Que.

BOOK REVIEWS

Select Methods of Metallurgical Analysis

By W. A. Naish and J. E. Clennel. Chapman & Hall, Ltd., London, 1929. Buckram, 6 x 9¾ in., 495 pp., front., illus., figs., tables, $9.00.

This book, dealing as it does with analytical methods, must necessarily discuss matters about which a good deal has been written already. The methods described are those calculated to give accurate results with the expenditure of a reasonable amount of time. The chapters on the metals themselves make this book more complete than the ordinary work of its class, and enable the reader to make an intelligent application of the methods of analysis of complicated products. The presentation of alternate methods of analysis is another good feature of the book, as also is the extensive and complete bibliography attached to each division. The methods outlined give every evidence of including the well tried methods of the past, and also keep the chemist up to date with the latest proved methods for accurate analysis. The amount of detail given in many of the methods is much greater than that commonly employed, and most of us will realize the value of such detail.

To sum up the matter, this book is essentially of a practical nature, and can be recommended as a real contribution to the analytical chemist's library.

HAROLD J. ROAST,
President and General Manager,
National Bronze Company,
Montreal.

The Radio Manual

By George E. Sterling, edited by Robert S. Kruse. D. Van Nostrand Company, New York, 1928, leatherette, 5½ x 8 in., 666 pp., illus., figs., tables, $6.00.

The first paragraph of the preface of this book states that "this work has been prepared to serve as a guide and text book to those who expect to enter the radio profession as an engineer, inspector, commercial or amateur operator." This is a fairly accurate indication of its scope.

The author has not discussed theory except in elementary terms, and only the simplest of mathematical expressions are used. In dealing with the fundamentals, the author has endeavoured to present the subject in simple form in the hope that any one previously unacquainted with the subject might be able to obtain a working knowledge. Apart from the portions covering first principles, the book might be accurately described as a treatise covering current American radio practice. It contains detailed descriptions of typical installations in all fields of radio, and in this respect it should prove very useful, both to the student and the operative engineer. It should also be useful to the specialist for the general information contained therein regarding the branches of the radio field other than his own specialty.

It contains little of the historical background of radio, except in the chapter on amateur short wave apparatus, in which there is a brief outline of the history of the development in the United States. Not much is said as to the progress and development made in other countries.

The author, nevertheless, covers the whole of the radio field exceedingly well in a descriptive manner and gives a comprehensive view of the present state of radio.

J. H. THOMPSON, A.M.E.I.C.,
Canadian Marconi Company,
Montreal.

Basic Principles of Concrete Making

By Franklin R. McMillan, with an introduction by F. E. Schmitt. McGraw-Hill Book Company, New York, 1929, buckram, 6 x 9 in., 99 pages, illus., figs., tables, $2.00.

This book fills a want that has long been felt amongst the students of concrete. It is often said, and truly so, that necessity is the mother of invention. This book was born out of the necessity for putting the whole subject of concrete-making in such simple and lucid form that much of the mist surrounding this subject at the present would be dispelled. The author has succeeded in doing this. Mr. McMillan's little book of one hundred pages, divided into nine chapters, sets forth the fundamental principles underlying the best methods for the production of uniform and durable concrete for whatever service it may be put to. The purpose of the book is not to lay down methods, rules or specifications: it is an exposition of the laws governing the fundamentals on which all methods, rules and specifications should be based in order to obtain uniformity in structures and the anticipated results. As the author says in the preface, "the text is not written for the man at the mixer or the concrete finisher." It is written for the man in responsible charge of the work, in order to give him a thorough understanding of the basic principles involved so that he may set down the necessary instructions or specifications for the work at hand through the personnel of his own organization.

Chapter 1 treats of the philosophy of concrete mixtures. For too long the subject of mixtures has been approached from the wrong end, through fixed proportions, such as 1-2-4 or 1-2½-5 mixtures. The author in a very graphic and original way explains concrete mixtures on the basis of the water-cement paste, the active element of concrete. Now that the water-cement ratio law of Abrams has been thoroughly established it seems to be the next logical step to base the mixture on the water-cement paste, for the concrete cannot be better than the water-cement paste that holds the particles of sand and stone together.

Chapter 1, in the words of the author "is in effect a summary of the entire text stripped of explanation, proof or illustration." Chapter 2 treats of the combined and uncombined water. The combined water is that which through the curing of concrete has become water of constitution or which has chemically reacted with the cement to form new compounds. The uncombined water is the excess that has had to be used to give the concrete the necessary plasticity to render the concrete placeable. Figure 1 in this chapter illustrates very clearly the effects of combined and uncombined water. Chapters 3 to 9 respectively treat of the compressive strength, water-tightness and other properties, combining aggregates with cement paste, design of concrete mixtures, selection of curing period and water-cement ratio, selection of aggregates, importance of proper construction methods. All through these chapters much stress is laid on the quality of the water-cement paste and other salient points in the art of making uniform and durable concrete, such as water-cement ratio, size and grading and type of aggregates, effect of curing and age, necessity of using plastic consistency, cause of segregation and its effects, methods of placing and treatment, effect of temperature, time of mixing, transporting concrete and importance of proper placing, etc.

Many of the principles mentioned in this volume have been enunciated before here and there in concrete literature, but this is the first book to put them all in such clear and concise manner and with such effectiveness. It is a text which can be recommended and should be thoroughly mastered by all those in responsible charge of concrete construction. If the principles contained therein were to be practised, the dawn of a new concrete age would soon arrive.

B. VIENS, M.E.I.C.,
Director, Testing Laboratories,
Dept. of Public Works, Ottawa.

Transmission Networks and Wave Filters

By T. E. Shea. D. Van Nostrand Company, New York, 1929, buckram, 6 x 9 in., 470 pp., figs., tables, $6.50.

This book is an extremely important contribution to the subject of wave filters, the subject of transmission networks being apparently inserted merely as an introduction to the mathematical theory of filters.

The simplest use of such a filter is to convert a distorted alternating current into a pure sine wave by filtering out the harmonics. The theory of filters was first developed by Mr. G. A. Campbell, one of the Bell Laboratories engineers, who in 1915 showed how to make high pass, low pass and band pass filters, Mr. Campbell's work being based on that of Oliver Heaviside, who must be recognized as the founder of transmission engineering. Mr. Campbell's work on filters was developed further by O. J. Zobel and K. S. Johnson at the Bell Laboratories in New York and by K. W. Wagner in Europe. Filters are of great importance in connection with telephone repeaters, radio, carrier current transmission over wire lines, picture transmission over telephone lines, talking moving pictures, and, in fact, all modern developments in the communication art owe much to their use.

This book covers somewhat similar ground to K. S. Johnson's "Transmission Circuits for Telephone Communication," but is more comprehensive, and devotes more space to the subject of filters and less to the theory of networks. There is also a chapter on the resolution of steady state and transient waves into their sine wave components, by means of Fourier analysis.

The book was evidently written for those with some previous knowledge of telephone transmission, in fact, we are told in the preface that it was written for the "out-of-hour courses" at the Bell Laboratories. For those who are unacquainted with transmission theory, we would recommend that before taking up Mr. Shea's work they should read some such book as "The Propagation of Electric Currents in Telephone and Telegraph Conductors," by A. J. Fleming, although much may be learned about filter design from this book without going thoroughly into telephone transmission.

The book will, no doubt, be heartily welcomed by all those who desire a knowledge of electric wave filters as they will find in this volume a great deal of information previously unavailable.

W. B. CARTMEL, M.E.I.C.,
Engineering Department,
Northern Electric Co. Ltd.,
Montreal.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
North-East Coast Institution of Engineers and Shipbuilders: Transactions, 1928-1929, Vol. 45.
The New Zealand Society of Civil Engineers: Proceedings, 1928-1929, Vol. 15.
The Institution of Civil Engineers: Minutes of Proceedings, Nov. 1928-Feb. 1929, Vol. 227, Pt. 1.
The Royal Society of Canada: Transactions, May, 1929.

Reports, etc.

Department of Trade and Commerce, Canada:
Central Electric Stations in Canada, Census of Industry, 1927.

Department of Mines, Canada:
Second Progress Report of the Dominion Fuel Board, 1923-1928.

Department of Labour, Canada:
Labour Legislation in Canada, as existing December 31, 1928.

Department of the Interior, Natural Resources and Intelligence Service, Canada:
Humidity in House Heating.

Department of the Interior, Dominion Water Power and Reclamation Service, Canada:
Hydro-Electric Progress in Canada in 1929.

Coast and Geodetic Survey, United States:
Special Pub'n No. 140: Manual of First-Order Levelling.

Bureau of Standards, United States:
Misc. Pub'n No. 97: Thermal Properties of Petroleum Products.
Misc. Pub'n No. 98: American National Screw Thread Tables for Shop Use
(1) Standard Threads.
Misc. Pub'n No. 99: (2) Special Threads.
Misc. Pub'n No. 102: Annual Report of Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1929.

Bureau of Mines, United States:
Chromite in 1928.
Salt, Bromine and Calcium Chloride in 1928.
Magnesium and its Compounds in 1928.
Iron Ore, Pig Iron and Steel in 1928.
Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1928.
Potash in 1928.
Bulletin No. 312: Bauxite, Floatand sink Fractionations and Flotation Experiments.
Bulletin No. 313: Permissible Storage-Battery Locomotives and Power Trucks.

Central Publication Branch, India:
The Common Commercial Timbers of India and their Uses.

Montreal Board of Trade:
Report on the St. Lawrence Waterway Project.

Quebec Streams Commission:
Seventeenth Report, 1928.

Ohio State University:
Engineering Experiment Station Bulletin No. 48: Design of Tall Building Frames to Resist Wind.
Engineering Circular No. 18: Simulative Service Tests for Glazed Brick.
Engineering Circular No. 19: Mining and Cleaning Domestic Coal in Ohio.
Engineering Bulletin No. 47: A Method of Predicting Illumination from Light Courts.

University of Michigan:
Engineering Research Bulletin No. 13: A Practical Method for the Selection of Foundations based on Fundamental Research in Soil Mechanics.

University of Nevada:
Bulletin, Oct. 1929: Tables of Elastic Properties of Alloys.

Rensselaer Polytechnic Institute:
The Engineer and the Intellectual Life.
Suspension Bridge Analysis by the Exact Method Simplified by Knowledge of its Relations to the Approximate Method.

National Electric Light Association:
Report of the Underground Systems Committee, Engineering National Section: Conduit and Manhole Temperatures.
Report of the Customers' Records Committee, Accounting National Section: How Customer Departments Promote Good Will.
Report of the Prime Movers Committee: Pulverized Coal.

Corporation of the County of Wentworth:
Seventh Annual Report of the County Engineer and Road Superintendent, 1929.

Technical Books, etc.

Presented by E. & F. Spon, Ltd.
Hot Water Supply, 8th ed.

Presented by Canadian Engineering Standards Association:
Standard Specifications for Commercial Bar Steels: G26-1929: Commercial-Quality Hot-Rolled Bar Steels; G27-1929: Commercial Cold-Finished Bar Steels and Cold-Finished Shafting.
Standard Specification for Sampling for Check Analysis of Steel Billets, Bars and Shapes.
Standard Specification for Carbon Steel Billets and Bars of Forging Quality.

Purchased by E. I. C. Library:
Pitman's Technical Dictional of Engineering and Industrial Science, in Seven Languages—English, French, Spanish, Italian, Portuguese, Russian, and German.—4 vols.

Work of the Ontario Metal Industries Research Association

Industrialists in all parts of the Dominion of Canada will watch with great interest the development of a significant new undertaking sponsored jointly by the metal industries of the province of Ontario and the Ontario Research Foundation.

This is a co-operative movement for the carrying on of a comprehensive plan of research through the organization of the Ontario Metal Industries Research Association which is to act as the link between the Foundaton and the manufacturers.

Active direction of the new organization is completely in the hands of the industries themselves, with an executive composed of forty-six representative individuals from as many different firms acting as the general board which will supervise the work. R. W. Gifford of the Massey-Harris Company, Ltd., Toronto, has been selected as chairman; J. J. Ashworth of the Canadian General Electric Company, Ltd., as honorary treasurer and R. Skelton of the Ontario Research Foundation is secretary. Offices of the association are at 47 Queen's Park, Toronto.

Briefly, the plan of operation is that the Foundation under the chairmanship of Sir Joseph Flavelle and with Dr. H. B. Speakman as director, will provide laboratories, staff and facilities. Overhead and general expenditures of the experimental work are to be borne by the metal industries, through the new organization.

The metal industries of Ontario, therefore, have complete research facilities placed at their disposal without the necessity of shouldering capital costs and their share of the undertaking, basically, consists simply of running expenses.

A thoroughly modern Chemical and Metallurgical Research Building is now nearing completion which is to house the special laboratories for this research and O. W. Ellis, M.Sc., well-known metallurgical engineer, will direct the work of the metallurgical division. After studying at Birmingham University, he was chief metallurgist at the Royal Ordnance Factories, Woolwich, England, later coming to Canada as assistant professor of metallurgical engineering at the University of Toronto. Since that date, he has been associated with the Mellon Institute of Industrial Research in Pittsburgh and the Research Department of the Westinghouse Electric and Manufacturing Company in the same city. As a consultant, he has had wide experience in dealing with the special problems confronting the metal industries in Canada.

Special stress has been laid, in the organization of the O.M.I.R.A. on the practical application of this metallurgical research to plant practice.

"This whole project," says an official announcement just issued, "is based on the view that each company, large or small, is concerned with the business of establishing plant practice on the best possible basis because nothing less permits a legitimate profit on operations or can insure a continuance of business success. Funds raised constitute an investment and a guarantee that whatever the group may accomplish will be available to the individual. As results are obtained, the Foundation will stand ready to assist in their application to your particular business. This latter is a most important consideration."

Already an extensive program of investigation has been mapped out and preliminary work actively commenced. The research will be carried out along the following particular lines:

(1) Macroscopic and microscopic examination and photography of metals, alloys and, if necessary, other solid materials.
(2) Determination of melting points and critical points in steels and other alloys and, under certain conditions, the checking of thermocouples.
(3) Chemical analysis of metallurgical materials.

(4) Mechanical testing of materials in tension, compression, etc., and also the conduct of hardness tests and the calibration of hardness-testing machines.

(5) General investigation of metallurgical processes, such as founding, forging and rolling, with a view to possible improvement.

(6) Investigation of causes of failures in metal parts in service.

(7) Checking of methods of heat treatment of metals and alloys.

(8) Search for information already published in regard to metallurgical processes and the creation of a very complete metallurgical library for the use of members, — for the elimination of unnecessary work and to provide accurate information.

Even a casual glance at the proposed studies, obviously, is sufficient to demonstrate that the new co-operative movement can be of direct and practical assistance to every metal industry in the territory which it is now preparing to serve.

Actual membership covers wide range of manufacturing activity and firms connected with practically every phase of the metal industries in Ontario are all represented. The gist of the scheme lies in the fact that, with research an admitted necessity for present-day industrial progress of every sort, many firms are handicapped for financial reasons due to the heavy burdens it would be necessary for them to shoulder in order to carry on the required work individually. By this means, they can take advantage of complete facilities at an expenditure which is only nominal.

In addition to the officers mentioned above, the newly-elected Council of the Ontario Metal Industries Research Association includes:

J. L. Agnew—The International Nickel Co., of Canada, Ltd.
H. J. Bassett—Galt Malleable Iron Co. Ltd.
Thos. F. Bingham—Otis Fensom Elevator Co. Ltd.
W. J. Blair—Canada Cycle and Motor Co. Ltd.
H. B. Bowen—Canadian Pacific Railway Co.
J. B. Carswell—Burlington Steel Co. Ltd.
H. Champ—Hi-Speed Tools, Limited.
C. V. Corless—Consulting Metallurgist.
A. G. Davis—International Harvester of Canada, Ltd.
L. F. Fitzpatrick—Flexible Shaft Co. Ltd.
T. R. C. Flint—Toronto Hydro Electric System.
W. C. Franz—Algoma Steel Corporation Ltd.
J. G. Fraser—Northern Bolt, Screw and Wire Co. Ltd.
A. R. Goldie—Babcock-Wilcox and Goldie-McCulloch, Ltd.
E. H. Gurney—Gurney Foundry Co., Ltd.
C. B. Hamilton, Jr.—The Hamilton Gear and Machine Co. Ltd.
R. M. Hamilton—Canada Machinery Corpn. Ltd.
H. U. Hart—Canadian Westinghouse Co. Ltd.
R. T. Herdegen—Dominion Forge and Stamping Co. Ltd.
C. J. Ingles—Toronto Hardware Manufacturing Co. Ltd.
C. S. Mackenzie—Ontario Steel Products Co. Ltd.
G. S. Mallett—Anaconda American Brass, Ltd.
H. Malley—Sawyer-Massey, Ltd.
P. F. Mellinger—Canadian Acme Screw & Gear, Ltd.
W. H. Moyse—General Motors of Canada, Ltd.
R. J. Needham—Canadian National Railway.
J. G. Notman—The Welland Vale Mfg., Co. Ltd.
W. O. Oliver—The Steel Co., of Canada, Ltd.
A. P. Page—Frost Steel and Wire Co., Ltd.
N. F. Peterson—Canadian Acme Screw and Gear Ltd.
A. Ross Robertson—Dominion Bridge Co. Ltd.
D. Roden—Roden Brothers, Ltd.
C. W. Sherman—Dominion Foundries and Steel, Ltd.
A. H. Tallman—Tallman Brass and Metal Co. Ltd.
F. Tissington—Tools and Hardware, Ltd.
W. G. Turnbull—The Turnbull Elevator Co., Ltd.
M. F. Verity—Massey-Harris Co. Ltd.
G. N. Wedlake—Cockshutt Plow Co. Ltd.

Widespread general interest in the effort is due to the practicability of applying the same principle to almost any other type of industry in Ontario and the fact that the Ontario Research Foundation is prepared to cooperate, in a similar way, with other manufacturing groups.

International Illumination Congress

(To be held in Great Britain in September 1931).

During recent years there has grown up a general recognition of the value of international conferences, which serve many good purposes, in facilitating unity of action on matters of common interest, in assisting standardization, and especially in promoting exchange of experience, personal intercourse and friendly relations between experts in different countries.

This tendency has been especially evident in connection with illumination. Illuminating Engineering Societies exist in Great Britain and the United States, Germany, Austria, Holland and Japan; and everywhere there are developing organizations which aim at bringing about better lighting.

Experts on such a rapidly developing subject as lighting naturally desire to exchange views and learn of activities elsewhere and this wish has led to continuous growth in the extension of the movement towards international treatment of the subject, which had its origin in the International Photometric Commission, founded in 1901. The expediency of broadening the scope of this body so that all illuminants and all aspects of lighting might be represented was soon recognised. In 1913 effect was given to this desire by the reconstitution of the Commission on a wider basis as the International Commission on Illumination, to which are linked National Committees in all the chief countries of the world. The outbreak of war naturally imposed a check on its development, but subsequently meetings in Paris (1921), Geneva (1924), Bellagio (1927) and New York (1928) revealed continuous progress. The International Illumination Congress and the Session of the Commission held in the United States last year probably formed the most important conference on lighting matters ever held. It was marked by great enthusiasm, being attended by 500 delegates from the following countries:—Austria, Belgium, France, Germany, Great Britain, Holland, Italy, Japan, Sweden, Switzerland and the United States.

It has been decided that the next International Illumination Congress is to be held in Great Britain in 1931. All interested in the cause of better lighting are uniting to render this Congress an outstanding success. In this country the machinery for the study of illumination is perhaps more perfectly organised than in many other places, and the aid of all the leading scientific and technical bodies interested and of organizations concerned with gas and electric lighting is being secured. The National Illumination Committee of Great Britain, in cooperation with the Illuminating Engineering Society, will be responsible for this important event. Several Committees are already at work on the arrangements, fuller particulars of which will be announced in due course.

The International Illumination Congress, which will take place during the period September 3rd to 13th, 1931, will be combined with a Voyage d'Etude of places of interest in England and Scotland so that other cities beside London will share in the work of the Congress. Papers dealing with the most varied aspects of lighting will be presented and these will be grouped so as to ensure that topics of special local interest will be dealt with at each centre. The Congress will be followed by the technical meetings of the International Commission on Illumination, which will be held in Cambridge during September 13th-19th.

The Honorary General Secretary of the Congress is Colonel C. H. Silvester Evans (C/o The Illuminating Engineering Society, 32, Victoria Street, London, S.W. 1) to whom all communications should be addressed.

The Guide Book "Along Quebec Highways"

The most complete tourist guide-book of the Province of Quebec that has ever been published, has just been issued by the Department of Highways.

The publication of this guide-book had been looked forward to with considerable interest for the last few months. It consists of a volume of nearly 900 pages, in which are described all the cities and towns, villages and parishes situated along the provincial highways. It contains most valuable historical, municipal, industrial, commercial and descriptive data.

The opening chapters are devoted to a general description of the province of Quebec. They deal with the geographical position of the province, its history, climatic conditions, physical aspect, mineral wealth, forests and fisheries, agriculture, manufacturing industries, economic situation, good roads system and population.

Then follows a complete and detailed description of each of the fifty main highways of the province, to which has been added the famous tour of the Isle of Orléans.

Each of the chapters devoted to a particular highway, first gives a general description of the road itself, of the country it traverses, a complete list of the cities, towns, villages and parishes on that road, with their respective populations, the nature of the pavement of the road, the distance from both its terminal points, as well as the distance between each municipality. In each case a map accompanies that description.

The guide-book then gives a detailed description of each of the cities, towns, parishes and villages.

It contains 325 illustrations representing the most interesting places in the province. Besides, it has 76 full-page road maps, 32 plans showing the points of entry and egress of the principal towns, and a general map of the highways of the province. The book contains altogether 435 drawings and photographic reproductions, forming 293 pages of illustrations.

To complete the work there is an alphabetical list of all the localities mentioned in the guide-book, with their population, the county, the number of the highway along which each locality is situated; general information regarding traffic regulations, road signs and symbols, Canadian and United States Customs laws; a summary of the fish and game laws; a list of distances between the principal points in the province and the leading cities and towns in the United States.

The book has been most carefully printed, and the illustrations are clear and distinct. It is elegantly bound in a fine solid rigid cover.

The French edition only has so far been issued. The English edition is now under way and should be completed within the next couple of months or so.

On account of the high cost of production, the Department of Highways cannot undertake to make a general free distribution of this guide-book. It has, therefore, set a nominal price of $2.00 a copy for the book, postage free. This amount does not nearly represent the cost of preparation and printing. Motorists cannot dispense with the information contained in the guide-book, and all those who wish to be well posted on Quebec matters will find it a most valuable book.

Ice, Snow and Frazil*

Thanks are due to the officers of the World Power Conference who, at very short notice, have made it possible to exhibit a number of moving pictures made by Canada's Trade and Commerce Department.

The pictures have a bearing on work which was accomplished 25 years ago and which, at that time, was discussed before the Canadian Electrical Association. They also relate to demonstrations made for The Engineering Institute of Canada ten years ago.

Neither of the above organizations, however, discussed the special phase of the ice question with which the pictures deal nor was there mention of the vital part which *agitation* plays in the creation or formation of frazil ice at hydraulic works.

For many years it was very generally believed that if a stream were free from waterfalls and turbulent rapids no frazil would be formed in it and, consequently, no ice difficulties would be encountered at hydraulic works located upon such streams, The wind, however, often disturbs the surface of an otherwise smooth body of water and prevents a sheet of surface ice from forming upon it; under such conditions myriads of ice spicules float along, multiply by acting as nuclei, agglomerate into mushy masses and stick to every cold thing that they touch. Strange though it may seem the writer has seen waterwheels 72 inches in diameter affected by frazil although those wheels were supplied with water from a forebay through which the water moved so slowly that its surface was as smooth as a mirror. The gates of those wheels were often frozen to the penstocks or wheel-cases while the gates were in the ¼ open position, that is while the water passing through them was much disturbed or agitated.

Still water—quiet water—may have its temperature lowered below the freezing point without turning into ice. The scientists tell us that water at 32° F. has a "tendency to crystallize but finds difficulty in making a beginning; *agitate* it," they say, "or introduce any colder thing than itself into it, and ice-formation immediately begins." Intakes, racks or screens, sharp bends in pipes or penstocks, valves, sluices and the gates and water-distributors in hydraulic power plants all tend to *agitate* water as the latter passes along and, if those metallic parts of the plants are *cold*, if their temperature is ever so little below 32° F., when the temperature of water is at its critical point, crystallization immediately takes place.

The ice that is formed under the above conditions is called *frazil* in Canada and it is often misnamed "anchor ice" because of its resemblance to the latter. Frazil is soft or mushy so long as it is immersed in water and is not subjected to the cooling action of the air, or, of anything else with a temperature below 32° F. Frazil resembles "lolly"—the mushy ice encountered in salt water harbours in cold climates.

The pictures illustrate in a novel and striking manner the speedy way in which particles of frazil are created by *agitation*, the way they multiply, the way they stick to everything colder than themselves, and, finally, and best of all, how easy it is to prevent them from sticking to anything by the employment of an exceedingly small amount of heat.

Twenty-five years ago, after successfully using the steam from a thirty horse power boiler to prevent a 3,000 horse power hydro-electric plant, which used 1,667 cubic feet of water per second, from being shut down by frazil, it was very hard to find anyone who would believe what had been done. Hydraulic engineers showed that it would require the heat-equivalent of nearly fifty 3,000 h.p. stations to raise the temperature of the water at one such station 1° F.—without melting any ice at all. These men of course missed the point entirely. The writer's experience was that ice would not cling to anything if the temperature of that thing were maintained above 32° F.—the freezing point of water.

Dr. H. T. Barnes, M.E.I.C., of McGill University, Montreal, in 1904 with a differential electrical thermometer, showed that the temperature of the water, in the St. Lawrence river, only varied a few thousandths of a degree at the times when the air's temperature changed from 40° F. above zero to 30° F., below zero. Maintaining the temperature of the immersed metal parts of a hydraulic plant at a temperature of a thousandth of a degree above the freezing point of water, and thus preventing ice from adhering to them, proved to be an easy task. Even though it were necessary to heat water or to melt ice in order to prevent ice from interfering with a power plant's operation it is interesting to note that the whole stream need not be heated. One hundred and forty four million (144,000,000) times as much water passed down a Canadian stream last winter as was turned into ice at a given point on it. However, as is said above, neither need water be heated nor ice melted at a power plant. A little heat in the hydraulic apparatus acts like a lubricator and the freezing water flows on past the plant as water glides off the back of a duck.

Some plant in Scandinavia employ electric rack or screen heating and they were described in papers at the World Power Conference in 1924. Last year at The Engineering Institute of Canada's annual convention, complete details of the Shawinigan Water and Power Company's electric rack heating were presented. Methods of construction and power consumption were fully described. None of the designers of any of those installations knew that patents for electrically heated racks were granted to the writer in the year 1906! "How old the new."

Particles of snow falling into water when the latter is ready to turn into ice act as nuclei and start ice-formation which proceeds cumulatively at a great rate of speed.

Winter operation of hydraulic plants, now that ice handling is better understood, is not the very difficult and hazardous thing it was 25 years ago.

Electric heating, frequently a most uneconomical proceeding, may, at times, be warranted for heating racks in order to combat ice troubles on account of the fact that its need and employment is only an occasional, and not a continuous one.

*This is a report of an extemporaneous address given by John Murphy, F.A.I.E.E., M.I.E.S., M.E.I.C., of Ottawa, at the World Power Conference in Tokyo, Japan, in November last. Mr. Murphy was a delegate at this conference representing; The Engineering Institute of Canada, Canadian Engineering Standards Association, and Member Canadian National Committee W.P.C., representing the Department of Railways and Canals and the Board of Railway Commissioners for Canada.

BRANCH NEWS

Border Cities Branch

R. C. Leslie, Jr.E.I.C., Secretary-Treasurer.
Harold J. A. Chambers, S.E.I.C., Branch News Editor.

The regular meeting of the Border Cities Branch was held on January 10th. The speakers of the evening were S. I. Krieger, German mathematician and J. H. Walker, superintendent of central heating for the Detroit Edison Company.

Prof. Krieger's address consisted of outlining methods for making or checking very rapidly, several arithmetical computations and then illustrating these methods. Included in these arithmetical gymnastics were the "magic square," the rules of 3, 7, 9, 11 and 101,—the rule of 101 being discovered by Prof. Krieger, the multiplying of two numbers of 20 figures mentally, the time taken being only that necessary for writing down the answer, and the obtaining of the day of the week for any date from the year 900 to the year 2000.

Mr. Krieger also illustrated a method of computing logarithms using the formula $M = L + X\ (434 - 2X)$ where L is the logarithm of the first figure of any number, X is the quotient obtained by dividing this first figure into the remaining figures of the number and where M is the mantissa of the desired logarithm.

i.e. to find the logarithm of 512,—

$$L = \log. 5 = 0.69897$$
$$X = \frac{12}{5} = 2.4$$
$$M = 0.69897 = 2.4\ (434 - 4.8) = 0.69897 + 0.01030 = 0.70927.$$

Therefore, since the characteristic of 500 is 2, the log. 512 = 2.70927.

Defining that by central heating he meant not the European idea of replacing fire-places, etc. by a central heating unit in the basement of a building, but the heating of a large number of buildings from one central plant, Mr. Walker in his address outlined the development of central heating since its introduction by Holly in 1870, and then by the use of lantern slides illustrated the progress made in central heating by the Detroit Edison Company in the business section of Detroit.

The speaker stated, that after several unsuccessful attempts at central heating by the use of hot water, in 1900, steam satisfactorily replaced hot water as a medium for the distribution of heat.

He also stated that central heating has several advantages over separate heating units. Firstly, the space usually taken up by boilers and coal storage in the large modern buildings is now utilized for other purposes, since this space, as in the case of basements of departmental stores, is also often valuable. Secondly, the nuisance of handling fuel and ashes in the building is obviated, and thirdly, intangible assets such as the elimination of smoke and soot from around the building as well as doing away with the hauling of coal, are obtained.

With reference to efficiency, the speaker stated that the Detroit Edison plants had roughly, an efficiency of production of 80 per cent, an efficiency of distribution of 85 per cent and an efficiency of use of around 90 per cent, giving an approximate total efficiency of 60 per cent against an efficiency of 50 per cent for individual heating units.

The fields for central heating as outlined by Mr. Walker were business, residential and industrial buildings. To date, he stated, that office buildings were the chief market for central heating companies being more economically heated than residences. Residences entail a greater ratio of pipe to heat used, and this field is consequently open to the use of gas and oil. The industrial building field is only beginning to develop.

There are in North America, the speaker stated, 161 plants with a total capitalization of $237,000,000.00 and earnings around $56,000,-000.00.

Regarding fuel, Mr. Walker stated that pulverized coal was now used in many plants, but that in Detroit lump coal was used. This was because, firstly, some of their plants were constructed prior to the development of the Cottrell treaters; secondly, because of the need to be able to burn any grade of fuel; thirdly, in the city the undesirability of shooting ash dust into the air, and fourthly, the possibility of selling the ashes.

The Detroit Edison, Mr. Walker stated, were pioneers in the use of the *W* type of boiler and depended more upon the over-all efficiency of heat distribution than upon the efficiency of the boilers alone.

He also dwelt briefly on the chemistry of the water used. The Detroit Edison Company use the Zeolite method of treatment.

The method of charging for the heat supplied in Detroit, he stated, is either by a flat rate or on a basis of condensation.

At the conclusion of the addresses a hearty vote of thanks was conveyed to both speakers, on behalf of the members, by O. Rolfson, A.M.E.I.C., chairman of the Branch.

Calgary Branch

W. H. Broughton, A.M.E.I.C., Secretary-Treasurer.
H. R. Carscallen, A.M.E.I.C., Branch News Editor.

The Calgary Branch held its third annual ball on November 22nd at the Palliser hotel and it was a wonderful success. This is now a fixed annual function in the affairs of the Branch and has progressed to such an extent that it has become one of the outstanding social events of the city. This has not come about without a great amount of hard work and the committee in charge has certainly earned the thanks of the entire Branch in this respect. It is believed that the annual ball has done much towards bringing The Institute to the attention of the general public and in that way is performing a real service in the affairs of the Calgary Branch.

In the decorations The Institute was prominently featured by a large reproduction of its emblem in the form of a shield suitably illuminated with coloured lights and mounted on one wall, while a large sign with E.I.C. in Neon lighting was displayed in another part of the ballroom. Purple and gold streamers from these principal pieces added to their effectiveness. Swaying balloons and vari-coloured streamers completed the decorations while two large spotlights supplemented the normal lighting of the ballroom. The sub-committee in charge of decorations, Messrs. W. St. J. Miller, A.M.E.I.C., F. G. Cross, A.M.E.I.C., G. H. Morton, A.M.E.I.C., and R. Mackay, A.M.E.I.C., deserve great credit for the results obtained.

The patrons and patronesses were as follows:—

Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., President of The Institute. His Honour Lt.-Gov. W. G. Egbert and Mrs. Egbert. His Worship, Mayor F. E. Osborne and Mrs. Osborne. Mrs. F. J. Robertson and Mrs. W. St.J. Miller, wives of the chairman and vice-chairman respectively, performed the duties of hostesses in a very acceptable manner.

The Petroleum Industry of Alberta

B. L. Thorne, M.E.I.C., engineer, Coal Mines Branch of the Department of Natural Resources, C.P.R., spoke to the Calgary Branch on the petroleum industry of Alberta at a meeting held in the Board of Trade rooms on December 5th.

Mr. Thorne had obtained the loan of a moving picture film on this subject from the Canadian Pacific Railway Company. The film, he explained, was prepared by the Associated Screen News for the Department of Colonization and Development, C.P.R. The speaker described the film in a short talk, after which it was shown on the screen.

The picture started with a map of the various oil fields on the continent, extending from the Gulf of Mexico to Alberta. Then followed a short historical account of oil development work in Alberta, featuring the "Grand Old Man" of the Alberta field, Mr. A. W. Dingman who had charge of the old "Discovery" well, the first producer in the Turner Valley oil field.

It was brought out by the speaker that a great deal of geological prospecting has been carried out in the foothills area during the last few years, particularly in the last two years. Studies of the geological structures by means of shallow drilling had been carried out not only in the Turner valley but also on the prairies, in the Ghost river, Highwood and Pincher areas, also in structures west of Turner valley.

The film included a number of scenes in and around Turner valley illustrating the tools used, also general characteristics and different methods in use in the oil development work. The different types of rigs used, viz., standard, rotary and diamond drill were illustrated.

A portion of the film pictured the method of recovery of samples from the wells and their examination with the microscope, this latter work being carried on in a very thorough manner by the supervisory engineer of the Dominion Government and his staff located in Calgary.

Pictures were shown of the "Wonder Well" of the valley, Royalite No. 4, the extent of freezing on pipes conveying gas from the producing wells as depicted by the coating of ice on conveyors, the gas scrubbing plant of the Royalite Oil Company in Turner valley, etc. The film also showed sections of geological horizons encountered, diamond drills and their samples and a diagrammatic representation of the drilling of a well and its production from a gas horizon.

The picture showed the disposal of the gas residue from wells after extraction of its gasoline content, part of it being transported to and used in towns and cities in Alberta, while the portion which cannot be used in this way is burned. A night film was shown of various flames of waste gas burning in the Turner valley.

A map of the province followed, on which was shown all of the prospective fields according to present information.

Refining operations at local refineries were then depicted, also the laboratory methods used to ensure that none but sweet, clean gas shall reach the public.

The film ended with a few views showing the dispersion of the gasoline by train and truck to the distributing stations and to the consumer.

Mr. Thorne in his introductory remarks brought out some very interesting information regarding the development in the Turner valley oil field. This went to show that recent activity has centered in the south end of the valley, south of Sheep creek. The production from the Turner valley field for January 1929 was 38,506 barrels, of which only 3,279 barrels came from wells south of Sheep creek. In November, 1929, the total production was 99,379 barrels, of which 52,892 barrels were produced south of Sheep creek. At the beginning of 1929 there were only twelve active wells south of the creek, which number has now increased to fifty. A few of these are producing and the remainder are either drilling or rigging in preparation to start drilling operations.

An animated discussion followed the showing of the moving picture film, after which Mr. Thorne was tendered a very hearty vote of thanks for his interesting lecture.

A general meeting was held in the Board of Trade rooms, Calgary, on December 19th, 1929.

Certain proposed amendments to the Branch by-laws were discussed after which S. G. Porter, M.E.I.C., gave a report on the proceedings at the Plenary Meeting of Council held in Montreal in October.

Mr. Porter explained that he was present at the Plenary Meeting not as a member of Council but as chairman of the Committee on Relations with the Provincial Association of Professional Engineers which was meeting in Montreal at the same time.

Mr. Porter outlined briefly the history of the movement for affiliation and the progress made to date as embodied in the report of his committee to Council. He now thought substantial progress had been made and it was likely that affiliation will come into effect very much more quickly than appeared to be possible during the earlier years of the movement. The speaker stated that he had retired from the chairmanship of the committee after five years of rather strenuous work, to leave its consummation in other hands.

There was considerable discussion, taken part in by various members present, during which Mr. Porter answered a number of questions.

J. H. Ross, A.M.E.I.C., member of Council for the Branch, gave a short report on other phases of the business transacted at the Plenary Meeting and told of the hearty appreciation of the work done by Mr. Porter as expressed by Council and recorded in its minutes.

The chairman then introduced Mr. F. N. Rhodes, head of the electrical department at the Provincial Institute of Technology and Art, to address the members present on "Static Electricity."

Static Electricity

The speaker stated that he had of necessity to considerably curtail his address because of time taken by the large amount of business transacted earlier in the evening.

Mr. Rhodes explained that although the name given to his paper on the notice of meeting was "Static Electricity" this was really a misnomer, as the subject was concerned with the *flow* of atmospheric currents which were not necessarily of static origin.

He drew attention to the importance of the subject to all engineers concerned with the maintenance of aerial lines for power or communication, also its bearing on wind and storms to aviation and to those interested in rainfall.

The excellent work in investigating and establishing data by Scott, L. A. Bauer, Swam and others was commended, it being explained that this was one of the scientific objects of the Polar expeditions.

Figures were given showing the large amount of electric power continuously flowing from air to earth and in the reverse direction, other than lightning, and the various theories explaining these were reviewed.

The action of clouds as electric generators was then discussed, and their final discharge in the form of lightning.

The reasons for static surges on transmission lines were fourfold, the speaker claimed, first direct to the line; second electro-magnetic induction fron adjacent discharge; third, the shifting of a cloud binding an electro-static charge, and fourth the collecting of convective current from dust and moisture.

The discussion following the reading of the paper was evidence of the appreciation of those present.

General Meeting

A general meeting of the Branch was held in the Board of Trade rooms, Calgary, on January 9th, 1930, to discuss the question of a general increase in dues to members as proposed by Council. Unfortunately only seventeen members were present.

The secretary read the report of the Finance Committee of The Institute in which was set out the necessity for the increase in dues, after which the chairman called on J. H. Ross, A.M.E.I.C., councillor for the Branch, to open the discussion.

Mr. Ross summarized the old scale and compared it with the new scale as proposed by Council, which is to be considered at the Annual General Meeting to be held on Ottawa in February, 1930, and discussed in detail the reasons why a larger income is desirable by Headquarters. He thought the figures submitted showed that Headquarters expended their funds to good advantage and that some of the smaller Branches were justified in asking for a larger return in rebates, but that possibly some of the larger Branches, including Calgary, might do with less than they are now getting.

The Hamilton Branch scheme was also reviewed by Mr. Ross, who thought that we should vote for whatever scheme is put forward by the members assembled at the Annual General Meeting.

A discussion being called for by the chairman, Mr. F. K. Beach gave a masterly exposition of the reasons why he thought no increase in dues necessary at the present time. Mr. Beach explained that he had prepared the case against general increases well knowing that the case in favour would be prepared and presented by the councillor for the Branch, as he felt that members should have both sides before them in reaching a decision.

Mr. R. S. Trowsdale offered the suggestion that Associate Members should automatically become Members at some specified age, (say 40) and so provide additional revenue. The secretary pointed out that under the present scale Calgary would suffer a loss of about $30 if it increased its corporate membership from 97 to 100, and he would favour some scheme which would remove this anomaly.

Before the meeting closed it was announced that a dinner meeting was to be put on jointly by the Professional Engineers Association of Alberta and the Calgary Branch of The Engineering Institute of Canada in the Elizabethan room, Hudson's Bay building, Calgary, on January 18th. The chairman thought this a good opportunity for promoting closer relations between the two bodies and urged that as many members as possible make it a point to attend this dinner.

Victoria Branch News

K. M. Chadwick, M.E.I.C., Secretary-Treasurer.

The annual meeting of the Victoria Branch was held on December 5th, 1929, at which the following officers were elected for the coming year:

Chairman	H. F. Bourne, A.M.E.I.C.
Vice-Chairman	A. L. Carruthers, M.E.I.C.
Executive Committee	F. C. Green, M.E.I.C.
	O. W. Smith, M.E.I.C.
	J. P. Forde, M.E.I.C.
	I. C. Barltrop, A.M.E.I.C.
Secretary-Treasurer	K. M. Chadwick, M.E.I.C.

Following the election of officers, Mr. Bourne the new chairman took the chair, and R. F. Davy, A.M.E.I.C., addressed the meeting, his subject being "Engineering Achievement in Canada during the past Century."

The annual report and financial statement of this Branch will appear among the Branch Annual Reports to be presented at the Annual Meeting of The Institute and published in a subsequent issue of The Journal.

Halifax Branch News

R. R. Murray, A.M.E.I.C., Secretary-Treasurer.
W. J. DeWolfe, A.M.E.I.C., Branch News Editor.

The annual meeting of the Halifax Branch was held at the Halifax hotel on the evening of December 19th, at 6.30 p.m. The meeting was of the supper meeting nature, and the chairman, H. F. Bennett, A.M.E.I.C., presided. Seated on his right was Professor F. H. Sexton, Principal of the Nova Scotia Technical College, who was the principal guest. It had been expected that the general secretary, R. J. Durley, M.E.I.C., would be present but he was not able to do so.

Chairman Bennett called the meeting to order immediately after supper and extended a cordial welcome to out of town members who were present and also to J. B. Hayes, A.M.E.I.C., B.Sc., Nova Scotia Technical College, who has recently taken over the managership of the Nova Scotia Light and Power Company, in the stead of the care of Mr. J. F. Lumsden, lately deceased.

The attendance was about forty.

The minutes of the November meeting were read and approved.

The regular business of the meeting was suspended whilst Professor Sexton read the report of the local joint committee on the co-ordination of The Institute with the various Professional Associations in Canada.

The report in general strongly favoured the formation of one large body to carry on the social, ethical and legal activities of engineers throughout Canada, and in detail enumerated many reasons why such a body is desirable. A resolution approving of the report was moved by F. A. Bowman, M.E.I.C., and seconded by C. H. Wright, M.E.I.C. Mr. Bowman felt that the time is ripe for our Branch to give a formal lead to other branches in Canada, whilst Mr. Wright said that the idea back of the resolution is to approve of one general organization and also that as this province had always been in the van in matters of a progressive nature we should put our shoulder to the wheel in our own best interests.

Mr. Wright took occasion to compliment Colonel F. W. W. Doane, M.E.I.C., as being the prime worker in the matter in hand, also Professor F. R. Faulkner, M.E.I.C., and the committee for their earnest and painstaking work. Major H. W. L. Doane, M.E.I.C., added a few remarks to those already made, he having made more extended remarks as already recorded at the November meeting. The report of the committee was adopted unanimously and it was decided to send a copy of it and the resolution to all the Professional Associations and Institute Branches, and all the members of the Council of The Engineering Institute.

The Branch committee appointed to consider the advisability of combining with the Provincial Professional Association to hold a joint banquet, reported that a banquet had been arranged to be held on the evening of January 16th next, at the Halifax hotel. The programme will consist of an orchestra, a quartette, one principal speaker, and a toast to each of the local engineering societies. The cover charge to each member is a nominal one and the balance of cost will be absorbed by the two societies. The report was adopted.

The report of the Branch Executive was ready by R. R. Murray, A.M.E.I.C., secretary-treasurer, and gave a detailed account of the activities of the Branch during the year, commenting very favourably on the general good attendance at meetings; on the increasing interest of members and the general good quality of the addresses delivered, amongst which were that by Col. C. H. L. Jones, M.E.I.C., on the Mersey Newsprint development at Liverpool, N.S. and that by Mr. Otto Schierbeck, on Re-forestation in Nova Scotia, also to the success of the Students' meeting in October.

The report of the secretary-treasurer, giving a detailed statement of receipts and expenditures for the year, showed the Branch to be in a healthy condition financially. Some few members have allowed themselves to fall behind in dues but it is hoped to have a clean sheet shortly.

The report of the Membership Committee was ready by Prof. W. P. Copp, M.E.I.C. The report evidenced an earnest effort to enroll new members and to interest all members in the work of the Branch.

The Paper's Committee's report was read by Col. F. W. W. Doane, M.E.I.C., and referred particularly to the papers read at each meeting. It also contained suggestions for addresses on a long, varied and most interesting list of subjects including:—The Refining of Sugar, Cold Storage, Harbour Commission and others of a like interesting nature.

The Publicity Committee's report outlined the efforts made during the year to bring to the eye of the public the activities of the Branch and offered the suggestion that engineers are all too modest in not claiming for their profession that need of recognition which is their due and that such should not be the case; that in too many enterprises the engineer, who was the central figure, was entirely left out of the picture whilst the glory of accomplishment too often accrued to those less conspicuously engaged in the undertakings. It was good to note that at the hydro plant, which will serve the Mersey mill, there has been erected a tablet on which are inscribed all the names of the engineering staff who made the power development possible.

Prof. W. F. McKnight, A.M.E.I.C., councillor, gave the meeting a survey of the Council's work and stated that a more detailed report will come to each member in the columns of the "Journal" at a later date.

The scrutineers appointed to consider the election ballots reported the following as having been chosen as the Executive for 1930:—

Chairman........................W. P. Copp, M.E.I.C.
Executive........................H. C. Burchell, M.E.I.C.
C. B. McDougald, A.M.E.I.C.
J. L. Allan, M.E.I.C.
C. St.J. Wilson, A.M.E.I.C.
H. F. Bennett, A.M.E.I.C.
W. H. Noonan, A.M.E.I.C.
L. M. Allison, A.M.E.I.C.
J. J. Sears, A.M.E.I.C.
L. M. Matheson
G. S. Stairs, M.E.I.C.
J. D. Fraser, Jr.E.I.C.

Chairman Bennett now delivered a very interesting and informative address on his retirement from the chair. He had received the greatest possible co-operation of the executive during the year; been aided in his work by the various committees who laboured faithfully; been assisted very materially by members generally by their increasing interest and attendance at meetings. He referred in very sincere and feeling terms to the loss sustained by the Branch through the deaths of two of our outstanding members, viz., Prof. D. W. Munn, of the Technical College staff, and Mr. J. F. Lumsden, manager of the Nova Scotia Light and Power Company.

He made a reference to the growing recognition by the public of the value and necessity of the engineer in the management and upbuilding of industry; to the efforts being made at headquarters to render greater service to the membership and finally quoted President Beatty, of the Canadian Pacific Railway, to the effect that the engineer is absolutely essential to the proper government of a country.

Chairman H. F. Bennett, A.M.E.I.C., expressed the hope that his successor in office, Prof. Copp, may have the same happy co-operation during the coming year.

Prof. W. P. Copp, M.E.I.C., on assuming office, thanked the members for the honour done him and in a short, well delivered address assured all of his intention to work hard for the Branch welfare during 1930 and to do all in his power for the advancement of the profession.

Professors F. R. Faulkner, M.E.I.C., and H. C. Burchell, M.E.I.C., were re-appointed as auditors. W. A. Winfield, M.E.I.C., was appointed Branch representative on the General Nominating Committee of The Institute.

The thanks of the Branch were voted to Moirs', Limited, for boxes of chocolates presented to each member and to the Northern Electric Company for serviceable desk diaries for 1930.

It was stated that there is strong likelihood of a Maritime Professional Meeting being held in Saint John, N.B., next summer and the Branch will co-operate to make it a success.

It was announced that J. A. Wilson, A.M.E.I.C., controller of Civil Aviation Department of National Defence, will address the January meeting on the subject:—Aviation.

J. B. Hayes, A.M.E.I.C., newly appointed manager of the Nova Scotia Light and Power Company, voiced his pleasure at being once more on his native heath and amongst his friends of the engineering profession and complimented the Branch on its increased activity and usefulness during his absence. And thus was concluded another successful annual meeting, all present joining in the singing of "Oh, Canada," and "God Save the King."

Joint Dinner

The annual meeting of the Association of Professional Engineers of Nova Scotia was held on the afternoon of January 16th, at the Technical College, in Halifax.

President Thos. J. Locke, district engineer, Department of Public Works of Canada, was in the chair and called the meeting to order at 2.30 p.m. After a word of welcome to the out of town members the report of council for 1929 was read and adopted. The report was a very concise resumé of the work done during the year.

The report of the Joint Co-operation Committee—a copy of which has already reached each association in Canada— was read and a resolution adopted, unanimously, that we endorse the movement towards closer union of the principal engineering societies in Canada.

The financial report was read and showed the association to be in a safe condition, financially.

The registrar's report was also approved by the meeting.

Following these, and some committee reports, the meeting was given over to a series of five-minute talks on a number of questions of import to members.

(1) Proper zoning of the province for the better enforcement and administration of the Engineering Profession Act.
(2) Has registration of engineers in Nova Scotia been successful?
(3) Do infringements of our act occur without the knowledge of the council?
(4) The closer co-operation of The Engineering Institute of Canada and the Associations of Professional Engineers.
(5) 1930—The beginning of the graduate engineers requirements for admission.
(6) Prompt payment of fees.
(7) Should there be a summer meeting as well as the annual meeting?

There was a good discussion on all these points and some valuable information gleaned.

The report of the scrutineers showed the following officers as having been elected for the year 1930.

President—R. J. Bethune, A.M.E.I.C., divisional engineer, Guysboro Railway.

Vice-President—R. W. McColough, chief engineer, Department of Highways, Nova Scotia.

Past-President—Thomas J. Locke, district engineer, Public Works of Canada.

Councillors.

H. F. Bennett, A.M.E.I.C...........term expires January 1931.
W. F. McKnight, M.E.I.C.......... " " " "
Two to be appointed to fill vacancies caused by the death of J. F. Lumsden, M.E.I.C., and the selection of R. J. Bethune as president.
H. W. Johnston..................Term expires January 1932.
K. G. Chisholm.................. " " " "
Ira P. MacNab, M.E.I.C........... " " " "
W. P. Copp, M.E.I.C.............. " " " "
Seven members to be appointed by the Lt.-Governor-in-Council.

Auditors

W. J. DeWolfe, A.M.E.I.C. and H. F. Laurence, M.E.I.C.

The meeting was concluded by the installation of officers and a short address by the new president.

At 7.00 p.m. the engineers and their guests, to the number of about 90, sat down to a banquet which was held in the St. Julien room of the Halifax hotel.

This was a joint banquet conducted by The Engineering Institute of Canada and Association of Professional Engineers of Nova Scotia. The first half of banquet was presided over by Prof. W. P. Copp, M.E.I.C., chairman of the Halifax Branch, and the second half by R. J. Bethune, A.M.E.I.C., president of the Association.

During the dinner several choruses were rendered by members whilst the Joe Mills Orchestra dispersed enjoyable music.

A comic sketch, introducing sleight of hand magic, was engineered by Mr. Phil Moore, Mr. A. R. Cobb and Mr. Patterson, and was very much appreciated.

At the conclusion of dinner a number of toasts were honoured.

Prof. F. R. Faulkner, M.E.I.C., in happy vein stated that the Association is really the offspring of The Institute, and gave an interesting description of its development since 1920, when it was organized.

Mr. T. J. Locke was earnest in his thanks for the kind words said of the Association and delivered a good address on the present position of engineers and the very bright outlook for the future.

The Northern Electric Company's quartette, consisting of four of the city's leading male singers, rendered a number of solos and quartettes which were of a high artistic order and which were heartily applauded.

Prof. H. W. McKiel, M.E.I.C., president of the New Brunswick Association of Professional Engineers, delivered a short address bringing the greetings of that body. The theme of the address was the closer co-operation of the two engineering bodies in Canada and he stressed the point that such action is much needed and must come soon.

President Bethune then took charge of the gathering and introduced Dr. H. F. Munro, Superintendent of Education for Nova Scotia, who delivered a forceful address on "The Coming Naval Disarmament Conference." Dr. Munro, who claimed to be an engineer inasmuch as he is doing constructive work in building up a high grade system of education in Nova Scotia, said at the beginning that there are four principal angles to the question of disarmament:—disarmament itself, diplomacy, statesmanship and economics.

He emphasized the point that, if Great Britain and the United States would unite to say yes on the matter, the question of diplomacy and economics would be settled at once.

He said that each world nation has its own diplomatic policy, due to geography and other conditions which exist.

Great Britain's policy rests on maritime freedom and neutralization of the smaller states in Europe.

The U.S. policy is founded on splendid isolation as indicated by the terms of the Monroe Doctrine.

Dr. Munro gave some interesting figures to show the cost of armament to nations to-day and stated that Great Britain is spending more than $14.00 per capita annually and the United States nearly $5.00 per capita. Such being the case, he asked why do these nations not scrap their navies and he answered that there is no international court to ensure protection to them from those who may not follow their lead.

The address of more than an hour gave an altogether interesting and informative resumé of the various attempts, from time to time, to limit the hazards of war and of the various diplomatic chess moves made by each nation to protect its own interests, especially in a maritime manner.

He took his hearers back to the victory of Trafalgar and showed how the British navy had developed into, what the late President Roosevelt once characterized as "the greatest civilizing agency in the world's history." A sincere vote of thanks was tendered Dr. Munro at the conclusion of his address.

Dr. F. H. Sexton, President of the Nova Scotia Technical College, in proposing the toast to the E.I.C., said an engineer is too literal minded and is so taken up with his work that he has not developed an imagination, a thing Prof. Sexton thought very necessary and desirable. He told a story to emphasize this need for imagination and then proceeded to pay tribute to the E.I.C. for its part in the development of the engineering profession and the part played by it in fostering the Professional Associations and helping them to be successful organizations.

H. F. Bennett, A.M.E.I.C., immediate past chairman, in response to the toast, thanked Dr. Sexton for his kindly references to The Institute and expressed The Institute's appreciation of all the felicitations addressed to it by other speakers. He brought out the fact that engineers are surely coming into their own, in the near future, and gave as an illustration of it that at two hydro power sites in Nova Scotia to-day tablets have been erected which contain the names of the engineers who had developed and constructed them.

Mr. Bennett's remarks were accorded a hearty reception.

Favours were received from the Canadian General Electric Company, The British Empire Steel Corporation, Canadian Westinghouse Company and the Canada Cement Company. The thanks of the members were voted to each donor.

A touching reference was made by Prof. Copp to the fact that two of our most respect members, Prof. D. W. Munn and Mr. J. F. Lumsden, had died during the year and letters of condolence were ordered sent to their families.

A vote of thanks was tendered the joint committee for the excellent conduct of the banquet, the entertainment provided and the excellent nature of the decorations.

The bond of unity so desired in engineering bodies could not have been better shown than in the manner, spirit and cordiality of all in this unique gathering.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

Geophysical Methods Applied to Foundations

The Lethbridge Branch held its regular meeting on December 14th, when J. E. Duncan of the geological staff of the Canadian Western Natural Gas, Light, Heat and Power Company gave a talk on "Geophysical Methods Applied to Foundations."

Mr. Duncan outlined various methods used in geophysical work, and gave references to various texts on the subject.

The use of electrical and electro magnetic methods and their correlation with geological information was discussed.

Special Meeting, January 4th

A special meeting of corporate members was held on January 4th, to attend to various business matters. The usual excellent dinner provided by the Marquis hotel preceded the business session.

The principal item on the agenda was the report of Councillor G. S. Brown, A.M.E.I.C., who represented the Branch at the Plenary Council meeting in October. Two hours of report and discussion showed the interest the members took in the general affairs of The Institute. Following this, thorough discussion was had of certain proposed amendments submitted by Headquarters and the Hamilton Branch.

A special committee's report on proposed changes in the Branch by-laws was submitted and after due consideration was adopted by the meeting and referred to Council for its approval.

Joint Meeting

On January 11th, the district annual meeting of the Alberta Professional Engineers Association was held at the Marquis hotel, with R. B. Baxter of the Calgary Power Company, President of the Association, in charge.

In his remarks at the close of the dinner, Mr. Baxter outlined the year's progress in the Association's affairs, particularly in regard to the unifying of the Association with The Engineering Institute of Canada, and also in regard to certain amendments which it is proposed to make to the present act.

The principal speaker of the evening was Horace L. Seymour, Town Planning Commissioner of the Province of Alberta, who spoke on "A Year of Town Planning in Alberta."

Since the creation of the Town Planning Commission in March, 1929, great progress has been made, said Mr. Seymour, and already four cities and thirteen towns have appointed local town planning commissions to study their problems and make recommendations to the municipal governments.

The provincial commission's activities have also been extended to the rural parts of the province, and farmers are able to benefit by its services in laying out their groups of farm buildings. School districts present their problems for consideration. Main highway development is also considered in regard to building lines, suitability of public service buildings and above all the bill-board. This last institution which has grown to be the curse of the highways in the United States is now under regulation in this province.

Mr. Seymour discussed the technical matters involved in making a survey of a community for planning purposes, and illustrated his remarks by references to what has already been accomplished in certain towns in the province.

Attending the meeting were several city officials and councillors and several of the most influential business men of the city. They took an interested and spirited part in the discussion which followed, and it is expected that town planning will become a live issue here shortly.

The Lethbridge Branch of The Engineering Institute, which was well represented at the meeting, is proud of being in many cases a forum where engineering matters of local importance are discussed by engineers from all parts of the province and the business men of the city are taking advantage of this fact. The securing of Mr. Seymour for this address was due to the efforts of the local Branch which is certainly doing its part in the building up of the community.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

"The Construction, Operation and Maintenance of Unit Cars," was the subject of an illustrated address delivered by T. H. Dickson, B.A., B.Sc., A.M.E.I.C., at a supper meeting of the Branch held in the Y.M.C.A. on December 12th. M. J. Murphy, A.M.E.I.C., chairman of the Branch, presided. Immediately following the supper two very enjoyable vocal selections were rendered by Mr. R. B. Metzler.

The Construction, Operation and Maintenance of Unit Cars

A unit car, Mr. Dickson stated, might be defined as any self-propelled rail car, which operates in regular train service either alone or coupled to one or more trailer cars. A number of causes have contributed to the development of this type of equipment, among which might be mentioned, losses in operation of most branch lines with steam train operation; increased cost of ton mile operation; failure of freight, passenger and express revenue to increase in proportion to the increase in operation costs, and finally decrease in passenger revenue due to increasing competition from busses and private autos.

Various types of unit cars have been tried with varying success.

The "gas-mechanical" is really an automobile with flanged wheels. It consists of an auto engine with gear drive to one or more axles. This type requires little attention and is quite economical. Unless carefully handled, however, there is liable to be objectionable jolting when changing gears or accelerating.

With the object of producing a smoother running car, the "gas-electric" was developed. It differs from the "gas-mechanical" in that the mechanical connection between the engine and driving wheels is replaced by an electrical drive made up by coupling a d.c. generator to the engine. Current from this generator, carried through the necessary control equipment, is supplied to motors geared to the axles. While the addition of the electric drive was an immense improvement, it made the car much more expensive and also increased the cost of maintenance.

The "storage battery car," in its limited field has been quite successful. The cleanliness and quietness of this car make it attractive, but it has serious disadvantages. The speed is limited and the mileage is also limited, and as a car usually operates over a run where its battery capacity is all needed to make the trip in fair weather, there is little reserve of power for bad weather. Furthermore, the cost of battery replacement is quite high.

"Distillate electric cars" have been tried, but the saving in cost of fuel has been nearly balanced by the increased cost of maintenance, as the engines have more valve trouble, require more frequent decarbonizing and require very accurate setting of the carburetors.

The "oil-electric" or Diesel engine with electric drive, is the most recent development, and has been found highly economical and satisfactory, especially for long runs and heavy service. The non-stop record from Vancouver to Montreal is held by this type of car, the 2,937 miles having been covered in 67 hours.

Diverting from the subject of unit cars, Mr. Dickson described in detail the massive, high speed oil-electric locomotive, which has a tractive force of twice that of the most powerful steam passenger locomotive in operation in Canada.

A vote of thanks, moved by A. S. Gunn, A.M.E.I.C., seconded by F. B. Fripp, A.M.E.I.C., was tendered the speaker by the presiding chairman.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

Annual Dinner

The annual dinner of the Peterborough Branch was held on Tuesday, November 19th, 1929, at the Empress hotel, Peterborough.

Among the guests were included Brigadier-General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., president of The Institute; R. J. Durley, M.E.I.C., general secretary of The Institute; E. T. Sterne, president of the Association of Professional Engineers of Ontario; A. J. Grant, M.E.I.C., chief engineer Welland Ship canal; C. E. Sisson, M.E.I.C., works engineer, Davenport Works, Canadian General Electric Co., Toronto; Rev. W. McDonald, secretary of the Peterborough Ministerial Association; and Dr. C. B. Waite, representing the Peterborough Medical Association.

R. C. Flitton, A.M.E.I.C., president of the local Branch, proved a capable master of ceremonies. Following the banquet, he introduced the programme by a brief address, in which he reviewed the aims of The Engineering Institute, and the possibilities it holds for the profession.

"This occasion marks the tenth anniversary of the inauguration of the Peterborough Branch of The Institute," he declared. Continuing, he commented on the sincerely-felt absence of the late Professor Gillespie, a special friend of the local Branch.

In proposing the toast to The Institute, W. M. Cruthers, A.M.E.I.C, said, "The Engineering Institute of Canada is unique among the other national organizations, in that it includes in its members, engineers practising all branches of the profession." He said further that The Institute was assisting greatly in the engineering development of Canada, having Branches stretching from Halifax to Victoria.

Brigadier-General Mitchell, responding, complimented the local Branch on the evening's gathering. "Your Branch is unique for many reasons. But to mention only a few; it has more younger members in proportion to its total strength than any other Branch in the province, and lists more graduates of S.P.S., University of Toronto.

"Peterborough, as the centre of eastern Ontario, has a diversity of engineering carried on here. There are railways and canals which benefit directly from your Branch."

He recalled a visit paid here by himself in 1922, and complimented Peterborough on producing three eminent Past-Presidents of The Institute in recent years. Comparing conditions in the country to those existing seven years ago, he noted a decided change for the better. "We had great cause to be thankful for many things then, but have much greater cause now after five years of general prosperity. We can look down from the top of the hill at the way we have come, and we must admit that we are in far better shape now.

"Let us see that we take our part in helping this country, not only as engineers but also as citizens—so that it will become not only a better place to live in, but something that we can hand on with pride to posterity."

The general secretary of The Institute, R. J. Durley, spoke of the service given engineers by the information bureau conducted by The Institute. He also stressed the value of organization, and dealt with the relationship between The Engineering Institute and the Association of Professional Engineers of Ontario. He said that both were aiming at the same purpose—increasing the scope of engineering, and expressed the hope that the future would bring them even closer together.

E. T. Sterne, president of the Association of Professional Engineers of Ontario, said, "I come as a non-member to pay tribute to The Engineering Institute." He said that the organization which he represented felt that while the two were working on common ground, it was necessary to avoid duplication. He said that each had separate duties to perform, but that they had a unity of thought.

P. P. Westbye, M.E.I.C., proposed the toast to "The Branches." In so doing, he referred briefly to the mission and benefits of the Branch as a unit promoting the interests of The Engineering Institute of Canada as well as the individual members.

The representative of the Niagara Peninsula Branch, A. J. Grant, M.E.I.C., chief engineer on the new Welland ship canal, expressed his pleasure at being present among his old friends of the local Branch, and thanked them for nominating him to the office of president of The Institute. "No man can be alone in any great work and he cannot succeed without the assistance and help of loyal men with him," said Mr. Grant, speaking of his experiences as an engineer.

C. E. Sisson, M.E.I.C., former member of the local Branch, conveyed the greetings from the Toronto Branch.

The toast to "The Sister Professions" was ably proposed by H. R. Sills Jr.E.I.C., and was responded to by Rev. W. McDonald for the Ministerial Association, and Dr. C. B. Waite for the Medical Association, the other professional representatives not being present.

The programme was enlivened at intervals by musical and humorous items by Messrs. Hunter, Bishop and Taylor and other Students and Junior members of the Branch. A skit featuring the radio broadcast of the "Voice of the Muskeg" at a meeting of an imaginary new branch of The Institute at Fort Churchill, proved an entertaining item.

Recent Developments in Hydraulic Turbines

At a regular meeting of the Branch held on Thursday, December 12, 1929, under the chairmanship of A. E. Caddy, M.E.I.C., H. S. Van Patter, A.M.E.I.C., hydraulic engineer of the Dominion Engineering Works, Montreal, gave an address on the above subject.

Some 300,000 h.p. per annum of water turbines are installed in Canada, and owing to the fact that the head seldom exceeds 300 feet, the great majority are of the reaction type. The speaker stated that the cost of the turbine itself was a comparatively small percentage of the total cost of a hydro-electric plant ranging from 3 to 6 per cent.

The two general types of reaction turbines, the Francis and the propeller type were described, and their different characteristics explained. The demand for higher speeds had led to the development of the propeller type runner, which has advantages in manufacture and operation but has a higher thrust and overspeed.

A comparison was made between two typical installations, the Cedars Rapids plant with Francis type and Great Falls Manitoba Power, with propeller type machines. The possibility of efficient operation of the propeller type turbines at low heads is a great advantage in some cases.

Some initial difficulties with pitting of the throat ring and draft tube liner have been overcome by slight design changes, and there seems no reason why the propeller type, properly designed cannot be used for still higher heads.

The subject of regulation was briefly touched on, and a chart on the Great Falls plant showed a maximum variation of about three twentieths of a cycle.

Other designs such as the Kaplan, Escher Wyss, Nagier and Moody were mentioned and a description given of the Kaplan movable blade propeller type turbine which is being built in Europe in sizes up to 35,000 h.p. at 35-foot head.

The address was well illustrated by slides and was concluded by an interesting demonstration by means of a model, of the Dominion Engineering Works hand operated, movable blade type runner, which has advantages in obtaining the maximum output under seasonal variations in head.

Details of construction and manufacturing facilities of Dominion Engineering Works were described and illustrated.

A hearty vote of thanks was proposed by R. C. Flitton, A.M.E.I.C.

The Construction of a Modern Locomotive

A particularly interesting and informative address on the modern locomotive was given by Mr. W. A. Newman, chief mechanical engineer of the Canadian Pacific Railway, at a regular meeting of the Peterborough Branch held on January 9th, 1930, under the chairmanship of M. V. Powell, Jr.E.I.C.

Introducing his subject by contrasting the traffic requirements of today with those of ten years ago, the speaker pointed out the increased demand of some 50 per cent on the locomotive, due to the change from wooden to steel cars, and the increase in number of cars per train from 8 to 10, 12, or 14.

Quicker schedules are necessary and bus and aeroplane competition has to be met. Similar conditions exist in freight service.

Mr. Newman then proceeded to indicate the various methods of attaining greater output from the locomotive, showing first a chart depicting the gradual increase in number of wheels, from the 4-4-0 up to the 4-12-2 type.

The problem is essentially one of greater boiler capacity, but the increase in number of axles is limited by track curvature. The weight on the drivers must be four times the tractive effort at the rim and the weight per axle has been raised from 35,000 lbs. 25 years ago to a maximum of 75,000 lbs. today. Owing to balancing difficulties affecting the track, a limit of 63,000 lbs. per axle in good practice has been set by the C.P.R. Hence, only refinement in design is available to increase the "sustained capacity" of the locomotive.

The speaker then described some of these developments such as the improved arrangement of boiler tubes, superheater (which has given 25 per cent economy), feed water heater (15 per cent), mechanical stokers, unit construction, and the use of alloy steels. As examples of "unit construction," the C.P.R. uses a single nickel steel casting, weighing 105,000 lbs. rough and 65,000 lbs. machined, for the complete frame and cylinders, and the tender base is also a one-piece alloy steel casting.

This design allows a substantial saving in weight, which can be put into additional boiler capacity.

The use of alloy steels for forgings, castings, boiler plate, etc., is a comparatively recent development, pioneered by the C.P.R. in 1926 and based on their higher elastic limit and ability to stand abuse.

Approximately 28 per cent increase in boiler pressure has been rendered possible by nickel steel plate, and the C.P.R. is now operating locomotives at 280 lbs. per sq. inch, this being the highest in regular service.

Mr. Newman described and illustrated by slides, some of the latest C.P.R. passenger and freight engines and details of their design and construction. He concluded by outlining the possibilities for still further development, such as higher pressures (for example the Schmidt system), use of multi-cylinders, the turbo-locomotive, and the electric and Diesel electric locomotive.

A moving picture film showed the details of construction of a large locomotive in the Angus shops of the C.P.R. at Montreal.

At the close of his address, the interest aroused was amply demonstrated by the large number of questions answered by Mr. Newman. The vote of thanks was proposed by P. P. Westbye, M.E.I.C., and heartily endorsed.

Saint John Branch

E. J. Owens, A.M.E.I.C., Secretary-Treasurer.

On November 21st the members of this Branch had the pleasure of listening to a very interesting paper by R. A. Lawther of the Saint John River Power Company. Mr. Lawther is the engineer in charge of the erection of the transmission line from Grand Falls to Dalhousie.

Mr. Lawther took for his subject the construction of the above transmission line. This line is 112 miles in length and is located near the highway of the International Railway. It occupies a separate right-of-way of its own 100 feet wide. Power is to be transmitted over this line at a pressure of 132,000 volts. The initial load to be transmitted is 40,000 h.p., while the ultimate capacity of the line is 60,000 h.p. The line consists of a single circuit carried on steel towers 60 feet high and has two ground wires.

Mr. Lawther presented a paper on this subject at the Maritime Professional Meeting in Moncton last summer, which was published in September issue of the Engineering Journal. In reading his paper he used a good many slides to illustrate it.

At the conclusion of the paper a hearty vote of thanks was tendered the speaker on motion of S. R. Weston, M.E.I.C., seconded by J. N. Lamb, Jr.E.I.C.

The tremendous increase in output over a period of eight years from 1921 to 1929, and another large increase anticipated in 1930, warranted the expenditure of approximately $800,000 by the New Brunswick Power Company, Ltd. in the construction of an additional unit to their plant. Such was a statement made last evening by J. D. Garey, A.M.E.I.C., chief engineer of the company, in an illustrated lecture on the new plant, delivered before a large meeting of the Saint John Branch of The Engineering Institute of Canada, held in the company's offices at the corner of Dock and Union streets. The lecture, which depicted by means of lantern slides the construction of the new plant in Smythe street and the extension of the intake pipes 145 feet out to the harbour line, was interestedly followed by the members of The Institute, following which refreshments were served by the company, assisted by the office staff, after which an inspection of the plant was made under the guidance of Mr. Garey and W. H. Swift Jr., manager of the company.

During the lecture Mr. Garey showed a chart giving the increases enjoyed by the company since 1921. He explained as the pictures showing the foundation and construction work of the plant at various stages were flashed across the screen, that the recently completed unit was one of four to be erected by the company, the others to be added as the increased output required them. He gave as his reason for the increase the policy of the company which held out to the citizens "assured service."

At one stage of his lecture he said that he had been asked to announce that the Federal Light and Traction Company were not thinking of disposing of the plant, as rumors had it, but were going to continue to give "assured service" as in the past, and were also prepared to take care of any growth to be experienced as time went on.

One point stressed by Mr. Garey was the precaution taken by the company in the building of their new plant to eliminate the smoke nuisance, through the installation of special equipment. He explained that the plant comprised a power capacity for 7,500 kv.a.

At the conclusion of the lecture, a hearty vote of thanks moved by Geoffrey Stead, M.E.I.C., was extended to Mr. Garey by the chairman, E. A. Thomas. F. P. Vaughan, M.E.I.C., moved a vote of thanks to the New Brunswick Power Company for the courtesies extended to The Institute. This was seconded by A. A. Turnbull, A.M.E.I.C. Mr. Swift in his reply to the motion, extended an invitation to the members to make an inspection of the plant.

As the men entered the plant the first thing to meet their gaze was the 10,000 h.p. generator, while on the same landing was stationed the various meters, showing a 7,500 h.p. load at 10 o'clock at night. On the next landing below the men were shown the pulverized fuel system, whereby the accurate weight of coal was taken mechanically, following which it was crushed in two large pulverizers and then shot up through large pipes into the furnace, where it was sprayed over the great blazing pit by forced draft.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

December Meeting

The December meeting of the Saskatchewan Branch was held at the Kitchener hotel, Regina, on Wednesday, December 18th, about forty-five members and guests being in attendance. The meeting was preceded by a dinner, Chairman H. R. Mackenzie, A.M.E.I.C., presiding.

Engineers' Legislation

The Legislation Committee reported satisfactory progress on the engineers' bill which is to be presented to the forthcoming session of the provincial legislature which is expected to meet early in January. Considerable interest centres in this bill due to the fact that on two former occasions bills were introduced into the legislature, each meeting with defeat, also that at the present time Saskatchewan is one of the two provinces which have no legislation incorporating the engineers although they were the first province to seek such legislation following the preparation of a model draft bill by The Institute in 1919. The Legislation Committee of this Branch is being augmented by representatives from the electrical and mining engineers of the province and from other engineers not members of The Institute, and this committee will co-operate with the government in the preparation and introduction of the bill.

Civil Service Enquiry Commission

The following resolution was passed by the Branch:—

"Resolved that this Branch of The Engineering Institute of Canada lend encouragement to the engineering services in the employ of the government of the province of Saskatchewan in their presentation of a classification and salary schedule to the Civil Service Enquiry Commission, and to this end that the matter be left in the hands of the Executive Committee for such action as may be necessary."

The Einstein Theory

On the occasion of this meeting, R. N. Blackburn, M.E.I.C., delivered a very interesting address on the Einstein Theory illustrated by a number of diagrams.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The annual meeting was held on January 3rd, 1930, at 8 p.m. in the Y.W.C.A. rooms, Queen street east. J. H. Jenkinson, A.M.E.I.C., chairman, called the meeting to order and after the minutes had been read, the Nominating Committee reported the result of the election. The executive for 1930 is as follows:

Chairman	C. H. E. Rounthwaite, A.M.E.I.C.
Vice-Chairman	A. H. Russell, A.M.E.I.C.
Secretary-Treasurer	A. A. Rose, A.M.E.I.C.
Executive resident:	
(2 years)	J. W. LeB. Ross, M.E.I.C.
(1 year)	R. A. Campbell, A.M.E.I.C.
Executive non-resident:	
(2 years)	J. M. Silliman, A.M.E.I.C.
(1 year)	J. G. Dickenson, A.M.E.I.C.
Ex-officio	J. H. Jenkinson, A.M.E.I.C. A. E. Pickering, M.E.I.C.

Mr. J. H. Jenkinson, the retiring chairman, in a short address expressed his appreciation for the help of the members and executive during the past year. He pointed out the difficulty of getting local papers and wished the new executive every success for 1930.

Mr. C. H. E. Rounthwaite, A.M.E.I.C., chairman-elect, took the chair and expressed his thanks for the honour conferred on him by his being elected chairman. He hoped that 1930 would be a most successful year and urged that all do whatever they could to that end.

The secretary-treasurer's report was read and adopted. It showed the Branch to be in a healthy financial condition.

L. R. Brown, A.M.E.I.C., and A. E. Pickering, M.E.I.C., were appointed auditors for 1930.

On behalf of the Branch, Mr. J. H. Jenkinson presented Mr. A. H. Russell, A.M.E.I.C., the retiring secretary, with a desk set as a token of their appreciation of the faithful service he had rendered the Branch. During his four years as secretary-treasurer Mr. Russell has been most untiring in his service to The Engineering Institute. Mr. Russell then thanked the members for their remembrance and expressed his appreciation for the co-operation of the various executives during his term of office and his belief that the good work would continue.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
Archie B. Crealock, A.M.E.I.C., Branch News Editor.

On the evening of Thursday, December 19th, 1929, the members of the Toronto Branch were presented with a paper prepared by R. R. Deans, vice-president of the Canadian Inspection and Testing Company, Limited. Unfortunately Mr. Deans was not able to present his paper in person and it was delivered by Mr. R. W. Hurlburt of that company.

The paper delivered was a very interesting one and described in detail the subject of "The Value of Accurate Testing and Inspection." The speaker in his paper brought out how the life of a structure is dependent not only on good design but also on the quality of the materials used and the workmanship; and how the testing and inspecting engineer was responsible for seeing that the material was up to standard and that the workmanship was carried out in the right manner. The speaker then elaborated on the duties of the testing engineer showing how varied was his work, not only having to deal with the common place materials of construction but also with the new materials which are making their way into our constructional activities. The method of testing the various materials was then explained. Taking the rolling of steel the speaker explained how when an order is placed in an inspector's hand, he studies the contract and specifications and all the elements that may affect the carrying out of the work and the complete check at all times during the process of manufacture, the physical and chemical tests that are made and the visual inspection of the material before shipment. The speaker also explained some recent tests of rail steel rolled from the so-called hot top or big end up ingot and how they found that this method of pouring steel in hot top moulds produces sounder and more uniform steel and that in spite of the extra expense due to the fact that there are royalties to contend with that on high class steels it is now becoming almost universal to use the big end up ingot. The speaker then described the inspection of steel castings at the foundry and illustrated by actual experience some of the difficulties that had to be overcome. Following this the method of inspection in the fabricating shops was dealt with and then the field inspection of the erection. The difficulties incidental to both bridge and building work were dealt with and the differences between the two explained.

In describing the inspection of concrete the speaker showed how the methods had changed greatly during the past few years especially from the standpoint of the Inspection Company. A description of the present-day inspection was given showing how all the materials were tested and how a complete check is made from the proportioning of the materials to the taking of cylinder tests to show the strength of the concrete that has been placed.

In concluding his address the speaker showed examples covering brick tests which were of interest to the members present. The address was illustrated with lantern slides showing the result of a number of tests made by the speaker. The meeting concluded by a hearty vote of thanks being tendered to both Mr. Hurlburt and Mr. Deans and expressing regret at the inability of Mr. Deans to be present to personally present his paper.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Vacant

MECHANICAL ENGINEER, graduate, Canadian or English preferred, to enter mechanical department of large metallurgical concern operating in province of Quebec. Work will be along lines mechanical maintenance and plant extension. Young graduates with two or three years experience preferred. Apply to Box No. 454-V.

DRAUGHTSMAN wanted by a large company in the province of Quebec, skilled in mechanical and structural design. Single man with two or three years experience out of college preferred. Apply to Box No. 456-V.

ELECTRICAL ENGINEER—Graduate with two or three years experience. Westinghouse or General Electric test floor experience desirable. Opening is along lines of maintenance and construction work with large metallurgical plant in the Province of Quebec. Permanent connection with bright future for right applicant. Apply to Box No. 472-V.

STRUCTURAL DRAUGHTSMEN, experienced in detailing steel for industrial plants, city buildings or bridges, for a bridge company located in Winnipeg. Give age, experience, whether married or single, and other particulars to Box No. 474-V.

DRAUGHTSMEN—Two first-class draughtsmen, experience must include water tube boilers, air heaters and economizers. Apply, giving full particulars as to nationality, age, if married, and salary expected, to Box No. 481-V.

DRAUGHTSMAN, familiar with timber construction and gold milling practice. Apply, giving particulars of experience, salary expected and date available, to Box 484-V.

HYDRO-ELECTRIC ENGINEER, graduate, experienced in operation of hydro-electric power developments, to take charge as operating engineer, with supervision of five systems. State age, if single or married, university and year of graduation, general experience with design experience, if any, and salary expected and when available. Apply to Box No. 485-V.

DRAUGHTSMAN, experienced on materials handling equipment, location Ontario. Apply to Box No. 486-V.

DRAUGHTSMAN with experience in electrical layout work for position with engineering company in Montreal. Apply to Box No. 488-V.

Situations Vacant

TECHNICAL ASSISTANT for large firm in Montreal, engineering training desirable, with knowledge of French and stenography. Apply to Box No. 489-V.

MECHANICAL ENGINEER, about 35 years of age, with experience in pulp and paper mill maintenance, and to take charge of small construction work in connection with mill. Location Western Province. Apply to Box No. 492-V.

CHEMICAL ENGINEER. Large newsprint company in St. Maurice Valley desires recent graduate in chemical, electrical or mining engineering, who would like to make a permanent connection with the industry. Good living conditions. Apply to Box No. 495-V.

ELECTRICAL ENGINEERS. Wanted, two young electrical engineers with about two years experience since graduation, for three to four months survey of large distribution and transmission system in province of Quebec. Work may result in permanent employment. State experience and salary expected. Apply to Box No. 496-V.

SALES ENGINEERS. Two experienced industrial paint salesmen wanted by a large paint manufacturing company; one for Toronto City, one for London and Border Cities. Applicants should state fully experience, names of three references. Apply Box No. 497-V.

DESIGNING ENGINEER, capable of handling details problems or general layout work in a large newsprint mill centrally located. Only men with at least five years' experience in this line need apply. State fully experience and salary expected. Apply to Box No. 498-V.

TOWN MANAGER—A new mill town in northern Quebec requires a young civil engineer as town manager. French-Canadian with fluent knowledge of French and English essential. Previous experience in municipal work preferable. State full particulars in application. Apply to Box No. 500-V.

CIVIL ENGINEER, to act as principal assistant to chief engineer on large work. Must have had extensive experience on large contracts, particularly harbour works. Must be capable of designing wharves and docks. Executive ability most essential. Apply, giving full particulars as to experience, salary expected and earliest date available, to Box No. 501-V.

Situations Vacant

DESIGNING DRAUGHTSMAN, wanted by a large pulp and paper mill, ideally situated. The work will comprise general drawings and details for building construction and alterations. Applicant should be able to design reinforced concrete and structural steel. State age, education, experience, salary desired, and other particulars. Apply to Box No. 503-V.

MECHANICAL DRAUGHTSMAN, wanted immediately for general draughting. Preferably one with two or more years experience in draughting room of some large industrial concern. Permanent position with excellent opportunity for advancement. Location, Montreal. Apply to Box No. 504-V.

Situations Wanted

ELECTRICAL ENGINEER, graduate '24, M.Sc., E.E. Six years experience in construction and design and hydro stations and sub-stations. Was for two years in charge of engineering design, including large outdoor sub-stations, switchboards, etc. Two and a half years in South and Central America. At present employed; desires change to position offering scope for initiative and advancement. Married; age 30; location immaterial. Apply to Box No. 7-W.

RETIRED LIEUT.-COMMANDER, Canadian, aged 32, A.M.E.I.C. Specialized in engineering from executive rank. Two years and six months chief engineer marine 31,500 s.h.p. Desires position with manufacturing or business concern in Montreal-management. Apply to Box No. 106-W.

CIVIL ENGINEER, graduate '26, with fair knowledge of French. Experience as instrumentman on surveys, maintenance engineer on railway construction, and resident engineer on railway construction. Available at once. Apply to Box No. 149-W.

ELECTRICAL ENGINEER, B.Sc., E.E., A.M.E.I.C., Canadian, age 29, single, graduate Canadian university 1924. Have been with large power company in U.S.A. since graduation, ten months on sub-stations, remainder of time on design, construction and operation of overhead and underground distribution and transmission system. At present employed by same company. Would like to return to Canada. Available on reasonable notice. Apply to Box 236-W.

CIVIL ENGINEER, with office in Toronto and extensive connection, is in a position to act as agent for contractors' equipment, building materials or allied lines, or would consider position as sales engineer with large manufacturer or distributor. Apply to Box No. 311-W.

CONSTRUCTION ENGINEER, with twenty years' experience in general construction work and design of docks, wharves, steel, reinforced concrete and timber, buildings for industrial plants, office buildings, housing developments, substations, garages, etc. Apply to Box No. 319-W.

Situations Wanted

INDUSTRIAL ENGINEER, thirty-five years of age, graduate of a well-known university, twelve years' experience in design, construction, maintenance and changes in production methods in industrial plants, including several years in pulp and paper industry in complete charge in large mills of all engineering, maintenance and development work; still engaged; desires to establish new connection. Apply to Box No. 320-W.

CHEMICAL ENGINEER, McGill graduate, nine years commercial and technical experience, with good knowledge of chemical manufacturing methods and industrial economics, desires position in which stability is prime consideration. Qualified by training and personality to act as assistant to executive who must relieve himself of details requiring efficient and tactful handling or to undertake industrial and chemical development or research. At present employed. Apply to Box No. 321-W.

CIVIL ENGINEER, university graduate, with extensive experience of winter surveys, desires position. Available immediately. Location immaterial, northwestern Ontario preferred. Apply to Box 322-W.

CIVIL ENGINEER, graduate three and a half years standing, desires spare time work in evenings and Saturday afternoons. Neat draughtsman. Typing. Apply to Box No. 323-W.

CIVIL ENGINEER, A.M.E.I.C., twenty years experience field and office, in railway, highway, concrete construction, water conservation, etc., desires position with prospects of permanency. At present employed but available on short notice. Will go anywhere if terms satisfactory. Apply to Box No. 327-W.

ELECTRICAL ENGINEER, age 31, two years test course, the British Thompson, Houston Co. Ltd. Four years experience on erection, construction, maintenance and repairs of electrical apparatus. Diploma E.E. Bristol University '23. Seeks an opening with a public utility or power company. Apply to Box No. 328-W.

CIVIL ENGINEER, B.A.Sc., A.M.E.I.C., M.P.E.O., age 37, desires a permanent position as chief draughtsman or plant engineer, preferably in Toronto or district. Seventeen years experience with consulting engineers on industrial, structural and railway work, hydro-electric plants and pulp and paper mills. Some mechanical and electrical experience. Apply to Box No. 332-W.

ELECTRICAL ENGINEER, graduate Queen's University '28, with experience in steel tower transmission line construction, railway construction, contour surveying, and eighteen months testing experience with the General Electric Company at Schenectady, would like to secure employment in Canada. Apply to Box No. 333-W.

ELECTRICAL ENGINEER, B.Sc., age 25, three summers experience as assistant city engineer, one and a half years on the survey, layout, construction and inspection of a hydro-electric power line. At present employed, but desires a position with a power or public utility company. Apply to Box No. 335-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country; twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Province. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, graduate '29, desires engineering position with possibilities of advancement. Work in hydro-electric, construction, municipal, railroad, or mining preferred. Past experience consists chiefly of survey work. Location in western provinces preferred. Apply to Box No. 338-W.

CIVIL ENGINEER, B.Sc., fifteen years experience, including surveying, construction, mining and tunnelling. Available at once. Will go anywhere, but prefer Eastern Canada. Apply to Box No. 346-W.

MECHANICAL ENGINEER, Jr.E.I.C., Irish, age 28, graduate '27, seeks connection in British Columbia, varied outdoor and indoor experience. During vacation and since graduation in mechanical, electrical and civil engineering. Versatile, intelligent, and quick to learn. Fast and accurate with slide rule transit T-square or electrical equipment. Prefer maintenance or research work or any opening with opportunity for advancement. Apply to Box No. 349-W.

CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Aplyy to Box No. 352-W.

SUPERINTENDENT, competent electrical superintendent, wishes position with large industrial or power supply company. New construction programme preferred. Experienced in engineering, designing and electrical construction of power houses, sub-stations and industrial control work. Available on short notice. Apply to Box No. 353-W.

Preliminary Notice

of Applications for Admission and for Transfer

January 23rd, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in March 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BARNETT—HENRY EDGAR, of 213 Park Place, Peterborough, Ont., Born at London, England, Jan. 3rd, 1908; Educ., B.Sc. (Eng.), 1928, M.Sc. (Eng.), 1930, Univ. of London; at present in test dept., Canadian General Electric Co. Ltd., Peterborough, Ont.
References: L. DeW. Magie, W. M. Cruthers, A. B. Gates, B. L. Barns, V. S. Foster, W. E. Ross.

CRASE—GEORGE H., of Toronto, Ont., Born at Butte, Montana, U.S.A., Sept. 27th, 1892; Educ., B.C.E., Univ. of Mich., 1915. Night school of Economics, Univ. of Pittsburgh, 1917; 1915-16, dftsman., 1917, dftsman., Pittsburg Des Moines Steel Co.; 1918-24, with Canadian Des Moines Steel Co., Chatham, Ont., as contracting engr. and district sales mgr. i/c of Canadian work—design, estimating and contracting for struct'l. steel, steel plate, and water works; 1924 to date, with Horton Steel Works, Ltd., Bridgeburg, Ont., as district sales mgr., i/c of Ontario sales—design, estimating and contracting for steel plate work.
References: T. H. Hogg, W. Storrie, R. L. Hearn, F. A. Robertson, C. H. Scheman, F. A. Dallyn.

FARMER—RUPERT WHITLEY, of 6720 Sherbrooke Street West, Montreal, Que., Born at Glen St. John, Barbados, B.W.I., April 28th, 1896; Educ., B.Sc., McGill Univ., 1921; 1921 (3 mos.), testing lab., Ames Holden Rubber Co.; 1921, demonstrator, McGill Survey School; 1923-27, instr'man., C.N.R.—helper to asst. engr. i/c St. Lawrence Division, C.N.R., mtce. of way work, estimating and dftng; 1927 to date, on engrg. staff, Montreal Light, Heat & Power Cons., Montreal.
References: H. M. MacKay, R. DeL. French, W. Walker, L. L. O'Sullivan, W. McG. Gardner.

GENTLES—ALLAN SUMMERHAYES, of Vancouver, B.C., Born at Montreal, Que., Aug. 27th, 1891; Educ., B.Sc., McGill Univ., 1914; 1906-10, struct'l. dept., Dominion Bridge Company, detailing, designing, estimating, checking, and summer 1911, detail checker with same company; 1912 (summer), struct'l. designing, asst. to consltg. engr., V. C. Suckow, C.E.; 1913 (summer), i/c alignment No. 1 Elev. addition, Montreal Harbour Comm.; 1914, field engr., Mines Branch, Dept. of Mines; 1915, asst. design engr., 1916, res. engr. of bridges, Halifax Ocean Terminals; 1916-18, Lieut., Can. Engrs., C.E.F.; 1919, design engr., Dominion Bridge Company, Winnipeg; 1919-21, sales engr., 1921-22, sales mgr., 1922-24, chief engr. and asst. gen. mgr., Can. Northwest Steel Co., Vancouver; 1924-26, sales mgr. and mgr. struct'l. shop, Vulcan Iron Works, Vancouver; 1926, in business as steel contractor, Vancouver; at present, manager, Pacific Division, Dominion Bridge Company, Vancouver, B.C.
References: F. P. Shearwood, H. M. MacKay, G. A. Walkem, W. C. Thomson, D. C. Tennant.

McGUGAN—ANGUS, of 6685 Monkland Avenue, Montreal, Que., Born at Glasgow, Scotland, Jan. 28th, 1900; Educ., 1914-21 (evening classes), Royal Technical College, Glasgow. Cert. in Mech'l. Engrg. City and Guilds of London Inst.; Student Member, Inst. of Engrs. and Shipbldrs., Scotland, 1920; 1914-17, ap'ticeship mech'l. engr., and 1918-21, works and drawing office, Fairfield Shipbldg. & Engrg. Co. Ltd., Govan, Scotland; 1917-18, air mechanic, R.A.F.; 1921-22, erection and shop trials of marine reciprocating steam and oil engines, Fairfield Shipbldg. & Engrg. Co.; 1922-23, inspr. of steam and hydraulic tests, valves and boiler mountings, James Turnbull & Sons, Glasgow; 1923-26, engr. officer in charge of main engines and boilers on regular watch S.S. Marburn and Marloch, Can. Pac. Steamships Ltd.; 1926 to date, with Williams & Wilson Ltd., Montreal, as asst. designing engr. and erection supt., including charge of erection of grain elevator for Canada Malting, Montreal; charge of detail drawings for coal and ash handling equipment for C.P.R. and C.N.R., also progress inspection of these contracts; asst. designer of elevating and conveying machinery, pulp and paper mill finishing room equipment.
References: R. White, F. A. Combe, L. H. Laffoley, C. S. Kane, R. B. Jones.

POTTINGER—ALEXANDER, of 486 Wilson Street, Hamilton, Ont., Born at Shetland Islands, Scotland, July 10th, 1905; Educ., B.A.Sc., Univ. of B.C., 1927; 1927-29, engrg. ap'tice, and at present, elect'l. dftsman., Canadian Westinghouse Company, Hamilton, Ont.
References: H. U. Hart, W. F. McLaren, H. A. Ricker, D. W. Callander, E. M. Coles, E. G. Grant.

SHERWOOD—CHARLES MAX, of Hamilton, Ont., Born at Linton, Ind., U.S.A., Feb. 1st, 1906; Educ., B.S. in Civil Engrg., Rose Polytech. Institute, Terre Haute, Ind., 1926; 1926-27, dftsman., bridge dept., chief engr's office, Big Four R.R., Cincinnati, Ohio; 1927-28, bridge inspr., constrn., divn. engr's office, Big Four R.R., Galion, Ohio; 1928 (Jan.-July), dftsman., bridge dept., Board of Wayne County Road Commissioners, Detroit, Mich.; 1928-29, designer, bridge dept., chief engr's office, Big Four R.R., Cincinnati, Ohio; 1929 (Apr.-Sept.), constrn. dept., Can. International Paper Co., Temiskaming, Que.; Sept. 1929 to date, asst. engr., estimating and office work, Can. Engineering and Contracting Co. Ltd., Hamilton, Ont.
References: W. B. Ford, F. W. Paulin, W. Hollingsworth, J. J. MacKay, L. S. Dixon, P. N. Libby, W. J. Bruce.

SIMMONS—WILLIAM RAYMOND, of Montreal, Que., Born at Bracebridge, Ont., Dec. 21st, 1903; Educ., B.A.Sc., Univ. of Toronto, 1927; 1927-29, test course, General Electric Company, Schenectady, N.Y.; at present, elect'l. engrg. dept., i/c of automatic substations, Montreal Tramways Company, Montreal.
References: K. B. Thornton, M. L. de Angelis, R. M. Hannaford, W. McG. Gardner.

WEICKER—JULIUS JOHN, of Cobourg, Ont., Born at Tavistock, Ont., March 13th, 1897; Educ., B.A.Sc., Univ. of Toronto, 1920; 1920-24, demonstrator in hydraulics, Univ. of Toronto; 1920-24 (Apr.-Sept. each year), design and constrn. work on waterworks projects, filtration plants, for F. W. Thorold Co. Ltd., Toronto; 1924-26, res. engr. on sewer, pavement and street rly. constrn. for James Proctor & Redfern, Ltd., Toronto; 1926, supt. and engr. on sewer and pavement constrn. for A. Cavotti & Son, Toronto; 1926-28, engr. on design and constrn. on sewers, water mains and pavements for A. W. Connor & Co., and in 1928 res. engr. for paving and sewer constrn. in Village of Millbrook for same firm; 1929, consltg. engr. to United Counties of Northumberland and Durham; Villages of Brighton, Warkworth and Orono, and the Town of Bowmanville; at present, consltg. engr., Cobourg, Ont.
References: R. W. Angus, F. W. Thorold, E. M. Proctor, A. W. Connor, H. Thorne, W. H. Riehl.

WILLIAMS—EDWARD CLIFFORD, of Peterborough, Ont., Born at Hamera, New Zealand, July 3rd, 1900; Educ., Canterbury College, Christchurch, N.Z., 1921-25; Pass Cert. in Elect'l. Engrg., Grade II, City and Guilds of London Inst., Cert., Gordon Inst. Technology, Geelong, N.Z.; 1922 (Jan.-Aug.), lineman, Teawamutu Power Board, N.Z.; 1922-23, leading lineman on constrn. of outdoor substations, Central Power Board, N.Z.; 1923 (Apr.-Dec.), lines foreman i/c all linework during reticulation for Nelson City Council, N.Z.; 1926 (Feb.-July), mtce. elect'n., Ford Motor Co., Geelong, N.Z.; 1926-27, foreman in charge of install'n. of plant for Co-op. Phosphate Co., Geelong, N.Z.; 1927 (Aug.-Dec.), mtce. of direct current plant for B. J. Neilson, Melbourne, Australia; 1927-29, elect'n. i/c mtce. and conversion from single to three phase of plant for Bosella Preserving & Mfg. Co., Melbourne, Australia; at present, students' test course, Canadian General Electric Company, Ltd., Peterborough, Ont.
References: L. DeW. Magie, W. M. Cruthers, A. B. Gates, W. E. Ross, V. S. Foster, B. L. Barns.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

FORD-SMITH—PERCY, of Ancaster, Ont., Born at Wolverhampton, Eng., Aug. 10th, 1881; Educ., 1896-1902, evening student, Royal Technical Institute, Salford, Eng., in connection with apprenticeship with Smith & Coventry, Ltd., Gresley Iron Works, Manchester, Eng., machine tool mfrs. and gauge makers, 4 years in different depts. in shop and 3 years in drawing office; 1902-05, mechanic, dftsman. and foreman with various machine tool firms in New England and Middle West states; 1905-09, works mgr. and chief engr., F. Ford-Smith Co., Orsall Hall Iron Works, Salford, Manchester, Eng.; 1909-10, chief dftsman., London Machine Tool Co., Ltd., Hamilton, Ont.; 1910 to date, founded the Ford-Smith Machine Co., Ltd., Hamilton, Ont., special machinery, machine tool, die and gauge mfrs., and, at present, gen. mgr. and president of company.
References: E. H. Darling, L. W. Gill, H. U. Hart, J. J. MacKay, R. K. Palmer.

REDFERN—WESLEY BLAINE, of Toronto, Ont., Born at Owen Sound, Ont., Dec. 11th, 1886; Educ., B.A.Sc. (Hon.), Univ. of Toronto, 1909; 1909-12, on staff of Willis Chipman, R.C.; 1912-15, town engr., Steelton, Ont.; 1916-19, overseas, Can. Engrs. and Royal Art.; 1919 to date, member of firm, James Proctor & Redfern, Ltd., Consltg. Engrs., Toronto, Ont., in charge of engrg. projects, including constrn. of waterworks and sewerage systems, pavements, bridges, dams, etc.
References: C. H. Mitchell, T. H. Hogg, E. M. Proctor, C. H. Scheman, J. R. W. Ambrose.

WILSON—JOHN S., of Dryden, Ont., Born at Green River, Ont., March 6th, 1892; Educ., B.A.Sc., Univ. of Toronto, 1920; 1906-14, mech'l. work in various saw-mills during all vacations; several years in charge of steam plants, holding Ontario 1st class Stationary Cert. since 1920; 1915-19, overseas, C.F.A., Lieut., M.C.; 1920-21, asst. engr., 1921-25, chief engr., and 1925 to date, gen. mgr., Dryden Paper Co. Ltd., Dryden, Ont.
References: H. G. Acres, E. Wilson, B. S. McKenzie, W. B. Redfern, R. L. Hearn.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

CHAUSSEE—PIERRE MAURICE, of Montreal, Que., Born at Letellier, Man., Aug. 1st, 1896; Educ., 1912-13-14, Montreal Technical Institute; 1914, with Northern Electric Co.; 1914-16, elect'l dept., Dominion Guarantee Co. Ltd.; 1916-17, ticker service system, Montreal Quotation Company; 1917-20, with Electrical Commission of Montreal; 1920-27, chief dftsman., and 1927 to date, engr. of elect'l. dept., Montreal Water Board.
References: C. J. Desbaillets, F. Y. Dorrance, G. E. Templeman, J. F. Brett, J. A. Jette, A. Leroux.

DOWNES—MICHAEL AUGUSTINE, of 3985 Laval Avenue, Montreal, Que., Born at Montreal, August 4th, 1889; Educ., B.Sc., McGill Univ. 1912; 1912-13, dfting., Dominion Bridge Company; 1913-15, struct'l. designing, Ross & Macdonald; 1915-17, asst. engr., sewer dept., City of Montreal; 1917-18, asst. engr., mains and services, gas distribution, Montreal Light, Heat & Power Cons.; 1918-20, 1921-23, asst. supt., McGill Observatory; 1920-21, asst. engr., General Combustion Co. of Canada; 1923 to date, asst. engr., Technical Service, City of Montreal.
References: G. R. MacLeod, J. G. Caron, W. T. Jamieson, W. Dickson, J. Weir.

HADLEY—WILLIAM FRASER, of 17 Main Street, Hull, Que., Born at Chatham, Ont., May 29th, 1894; Educ., Diploma (Hons.), R.M.C., 1914; 1914-15, Univ. of Toronto; 1915-17, Lieut., 1917-19, Capt., R.C.E.; 1915-16, asst. to director of work and bldgs., Dept. Militia and Defence, i/c of camps and barracks, Ottawa area; 1916-19, asst. director of signalling, Dept. Militia and Defence, i/c of all signalling, military telephones, telegraphs etc., in Canada; 1920 to date, manager of Scott Estate, Hull, Que., supervised various surveys on Ottawa River for lawsuits (1920-25), and at present looking after all estate building and construction.
References: C. R. Coutlee, G. G. Gale, F. H. Emra, A. C. Caldwell, L. B. Rochester.

HILL—GEORGE RIXON, of Virden, Man., Born at Peterborough, Ont., Dec. 4th, 1888; 1906-09, rodman on land and rly. surveys; 1910-14, instr'man. and dftsman. on constrn. and location surveys, C.P.R.; Season 1914, engr. on prelim. and constrn. road surveys, Manitoba Good Roads Board; 1915 to date, municipal engr. i/c of road constrn. in Western Manitoba under the district engr. of the Good Roads Board—employed jointly by six rural municipalities, i/c of design and constrn. of reinforced concrete culverts and treated timber bridges up to 24 ft. spans; i/c of design, location and constrn. of roads not built under the provisions of the Manitoba Good Roads Act.
References: W. A. James, A. McGillivray, A. J. Taunton, E. W. M. James, W. A. Mather.

MITCHELL—FRANK LESLIE, of Iroquois Falls, Ont., Born at Jamaica, B.W.I., June 21st, 1894; Educ., B.Sc., McGill Univ., 1921; 1914 (summer), survey for Ontario Hydro Electric, Chippawa Power development; 1920 (summer), chemist in raw sugar manufacture control; 1914-19, overseas; Lieut., Can. Inf. and Can. Engrs.; 1921-22, tester in control and asst. chemical engr., 1922-23, chem. engr. i/c physical control dept., 1923-24, asst. sulphite supt., 1924-28, sulphite supt., and Jan. 1929 to date, asst. mgr. of operations, Abitibi Power & Paper Company, Iroquois Falls, Ont. (May 1927 to Jan. 1929, in executive charge of development, Abitibi Fibre Company.)
References: H. J. Buncke, A. A. MacDiarmid, W. G. Mitchell, L. E. Kendall, W. B. Crombie.

POWELL—MORLEY VINCENT, of 370 London Street, Peterborough, Ont., Born at Peterborough, Oct. 11th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1922; 1922-23, demonstrating in hydraulic and thermodynamic lab., Univ. of Toronto; 1923 to date, mech'l. design of elect'l. generators and motors, at Peterborough plant of the Canadian General Electric Co. Ltd.
References: L. DeW. Magie, F Bowness, B. L. Barns, B. Ottewell, A. B. Gates, W. E. Ross, W. M. Cruthers.

TOOKER—GUY LANGRISHE, of Vancouver, B.C., Born at Tenby, South Wales, Sept. 18th, 1884; Educ., 1899-1902, Prince of Wales College, Charlottetown, P.E.I.; 1902-04, ap'ticed to The Locomotive & Machine Co., Montreal; 1904-08, rodman, topog'r., leveller and transitman, Transcont. Rly. (Quebec); 1908-10, transitman on surveys of harbour and townsite, G. T. R. Rly. (Prince Rupert;) 1910-11, with Ritchie, Agnew & Co., Civil Engrs. and Surveyors, as asst. engr. on surveys and constrn. of water and sewerage systems for City of Prince Rupert; 1911-12, i/c of parties making surveys for the proposed future water supply and hydro-electric development for same city; 1912-13, with Prince Rupert Hydro-Electric Company, as asst. engr. i/c of parties making complete topographical, drainage area and transmission line surveys for proposed developments of the Kh-ta-da and Falls Rivers, and later supervising constrn. of rock-filled crib dam across the Falls River; 1913-15, right of way surveys, G. T. P. Rly.; 1915-19, overseas, C. E. F.; 1919-20, leveller on prelim. and location surveys, Vancouver Is., C. N. R.; 1922 (May-Nov.), dftsman. on right of way surveys of main line; 1922-24, and May 1925 to Feb. 1926, with Noel Humphrys & Co., Civil Engrs., and Surveyors, as instr'man. and asst. to Mr. Humphrys on land and subdivision surveys, also prelim. and location surveys for logging rlys.; Oct. 1924 to May 1925, and 1926 (Mar.-June), C. N. R. right of way dept., asst. surveyor on land ties and general survey work; 1926-29, instr'man. on layout and constrn. of concrete sidewalks and pavements, and from June 1929 to date, asst. engr. on design and constrn. of Macadamized roads throughout the Greater Vancouver area, for engrg. dept., City Hall, Vancouver, B.C.
References: D. O. Lewis, W. P. Wilgar, W. B. Young, R. Rome, D. McMillan.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BLACKMORE—CYRIL LESLIE, of Deer Lake, Nfld., Born at Tilt Cove, Nfld., June 14th, 1898; Educ., B.Sc., McGill Univ., 1927; 1920-21, constrn. work at Laurentide Power; 1921-23, elect'l. constrn. work on new units, Shawinigan Water & Power Company; 1924 (4 mos.), elect'l. constrn. work on new machines, International Paper Co., Three Rivers, 1927-29, elect'l. constrn. and gen. course in paper making, and at present elect'l. engr. in charge of installn. of apparatus in power house extension for same company at Deer Lake, Nfld.
References: H. C. Brown, H. K. Wyman, C. V. Christie, E. Brown, R. L. Weldon, H. E. Bates.

JOHNSON—WILLIAM JAMES, of Lachine, Que., Born at Slocan, B.C., April 7th, 1901; Educ., B.Sc., McGill Univ., 1923; 1923-25, in dfting room, and from 1925 to date, res. engr. on constrn. of grain elevators, for John S. Metcalf Co. Ltd., Montreal.
References: H. Rolph, L. Coke-Hill, E. Brown, E. G. M. Cape, J. B. Stirling, W. B. McLean.

JONES—J. H. MOWBRAY, of Liverpool, N.S., Born at Sault Ste Marie, Ont., Aug. 24th, 1905; Educ., B.A. Sc., Univ. of Toronto, 1927; 1924, forestry dept., 1925, hydraulic dept., and 1927-28, asst. to cost engr., Spanish River Pulp and Paper Mills; 1928, engr. and dftsman., Abitibi Power & Paper Co. Ltd., Sault Ste Marie Divn.; 1928, asst. to chief engr., 1929, acting res. engr., and at present res. engr., Mersey Paper Co. Ltd., Liverpool, N.S.
References: G. H. Kohl, C. H. L. Jones, J. L. Lang, G. F. Hardy, J. D. Jones, F. Smallwood, J. W. LeB. Ross.

MATSON—BRUCE COOK, of 444 Gladstone Avenue, Toronto, Ont., Born at Toronto, July 22nd, 1902; Educ., B.A. Sc. (Hon.), Univ. of Toronto, 1924; Summer work: 1921, lab. asst., City of Toronto Testing Lab.; 1922-23, dfting., G. W. Rayner, M.E.I.C., Toronto; 1924, i/c party, surveying and drilling, Hanover Cement Co., Beachville, Ont.; 1924-25, asst. engr., Bloor Street subway, Toronto, for the Foundation Company; 1925-26, plant engr., Iroquois Sand & Gravel Co., Agincourt, Ont.; 1925-26, also sales engr., John Maloney Ltd., Toronto; 1926-29, plant engr. and sales mgr., The Beachville White Lime Co., and Hydrated White Lime Co., Beachville; 1927-29, mgr., Innerkip Lime & Stone Co., Woodstock & Guelph, Ont.; At present, engr., Innerkip Lime & Stone Co., Woodstock, and sales engr., Maloney Supply Co , Toronto.
References: G. W. Rayner, J. M. Gordon, T. R. Loudon, G. G. Powell, J. A. Vance, W. G. Ure.

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Radio Communication as An Aid to Aviation in Canada

Major W. Arthur Steel, M.C., A.M.E.I.C.,
The Royal Canadian Corps of Signals.

Paper presented before the Annual General Meeting of The Engineering Institute of Canada, Ottawa, Ont., February 13th, 1930.

During the war science produced many new and important inventions but it is doubtful if any of them have served a more useful purpose, in the succeeding years of peace, than the two outstanding developments of aviation and radio communication. It is not the intention here to touch on the subject of aircraft development during the war. That has already been fully covered by other writers, but it should be remembered that the radio industry as well as aircraft, owes its rapid expansion to the war. The demands of the armies of all countries forced the introduction and development of the thermionic valve, or vacuum tube as it is sometimes called in America, and resulted in the development for military purposes of light and efficient portable sets with astonishingly long ranges. Many of these sets were developed especially for use in military aircraft and it is not surprising to learn, therefore, that the first combined use of these two developments in Canada was in connection with the aviation activities of the Department of National Defence.

When the Dominion Forestry Department and the Air Board first undertook experiments on the use of aeroplanes for forest patrol work, it soon became evident that some form of communication between the aircraft and their base station was essential. Radio alone could supply this demand. In 1920 experiments were begun in Alberta and so great was their success that a steady development has been taking place from year to year until today the three western provinces of Manitoba, Saskatchewan and Alberta are covered by a system of radio stations serving the aircraft engaged on forestry duty. In Ontario a similar development has taken place and an extensive service is in operation there under the control of the Ontario Forestry Department.

During the past few years aircraft in Canada have expanded their field of operations and passengers, express and air mails are now being carried, on a commercial scale, to many distant parts of the country. This service has produced new demands for communication and an earnest attempt is being made to step into the breach and supply the demand. This service requires a very widespread ground system for the collection and distribution of meteorological information, as well as for ground traffic. In addition, since night flying and regular schedules are essential, the service demands a system of Aids to Aerial Navigation comprising both radio and light beacons. How these demands are being met in Canada will be described in detail in a later part of this paper.

Very recently aircraft have been put to a further extensive use in connection with aerial exploration work in the Northwest Territories, Northern Quebec and other outlying parts of Canada. The newspapers have very recently been full of reports about one party of explorers whose planes were lost in the vicinity of Victoria Island in the eastern Arctic. All of this information was brought out to civilization by means of radio, but the planes used by this party were not themselves radio equipped. The result was that the friends of the lost fliers spent many anxious weeks before the party finally reached a Hudson's Bay post which was in touch with the outside by means of radiotelegraphy. This at once brings up the question, what steps are to be taken to safeguard this very essential exploration work, first, — by providing communication in case of other similar unavoidable accidents or forced landings, second,—by establishing aids to aerial navigation in the Northwest Territories.

It would, therefore, seem advisable to treat this extensive subject under the following headings:

(a) Civil government air operations.
(b) Civil aviation and air mail routes.
(c) Northern explorations.
(d) Military aviation.

Each subject will be roughly divided into two parts, the first covering the work already underway, and the second, contemplated future developments.

In connection with the subject of civil aviation and air mail routes, a short résumé has been included of the work being done in other countries of the world, in order to emphasize the reasons for the choice of the system that has been decided upon for Canada.

Two maps are attached covering parts (a) and (b) above. In addition, numerous photographs have been reproduced showing graphically details of the types of

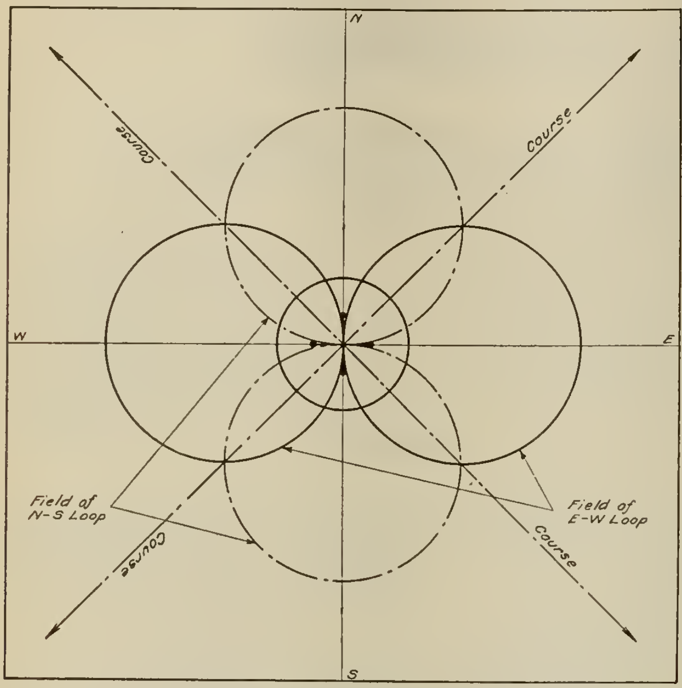


Figure No. 1.—Diagram showing Theoretical Field Strength Pattern of Two Crossed Coils or Loops when Energized with Equal Power at Same Radio Frequency.

equipment in use and the nature of the country in which this work is being carried out.

Civil Government Air Operations

Under this heading are grouped all aircraft operations, whether federal or provincial, which are being carried out for civil government departments. This work is almost entirely in connection with forestry patrols, although a certain amount of smuggling preventive flying is either planned or already underway. The greater part of this civil government flying is under the control of the Royal Canadian Air Force, however, the Ontario Forestry Department maintain a large fleet of aircraft and have an extensive flying and radio service throughout northern Ontario. These two systems will be described separately and in the order given.

Federal Government Operations

The Royal Canadian Air Force does not maintain a Signal Service of its own but has entrusted its communication problems to the Royal Canadian Corps of Signals. This scheme has been in operation now for over seven years with satisfactory results. The operation of the system may be briefly outlined as follows—The Engineering and Stores sections of the Royal Canadian Signals are responsible for the provision and operation of all signal and radio equipment, and for the design and construction of base radio stations and special aircraft radio apparatus. Operational stores for these radio services are also supplied through the Royal Canadian Signals Stores Branch. All officers and men required for the operation of these communication services are obtained through the Signal Service and are given a thorough course of training at the Royal Canadian Signals Depot before being posted to flying stations.

Wherever the Air Force are co-operating with the Forestry Service, the same general system of communication is adopted. In general the units of both the Flying Service and the Forest Protection Service are located together at strategic points throughout the area to be protected. At each of these places permanent ground radio stations are established, so that the headquarters of the services and all of the individual patrol stations, are constantly in touch with one another. These radio stations are used both by the Royal Canadian Air Force and by the forestry officials.

The aircraft employed on the work are divided into two classes:—

(a) Detection or patrol aircraft.
(b) Suppression aircraft.

The detection machines are equipped with radio transmitting sets, capable of both telegraph and telephone transmission, and they are therefore constantly in touch with their base stations while on patrol. No attempt has been made up to date to equip the planes with receiving apparatus, due to the necessity of reducing to a minimum the weight to be carried on these small machines. The suppression aircraft are not usually fitted with radio equipment.

The procedure at each individual station may be briefly summarized as follows:—

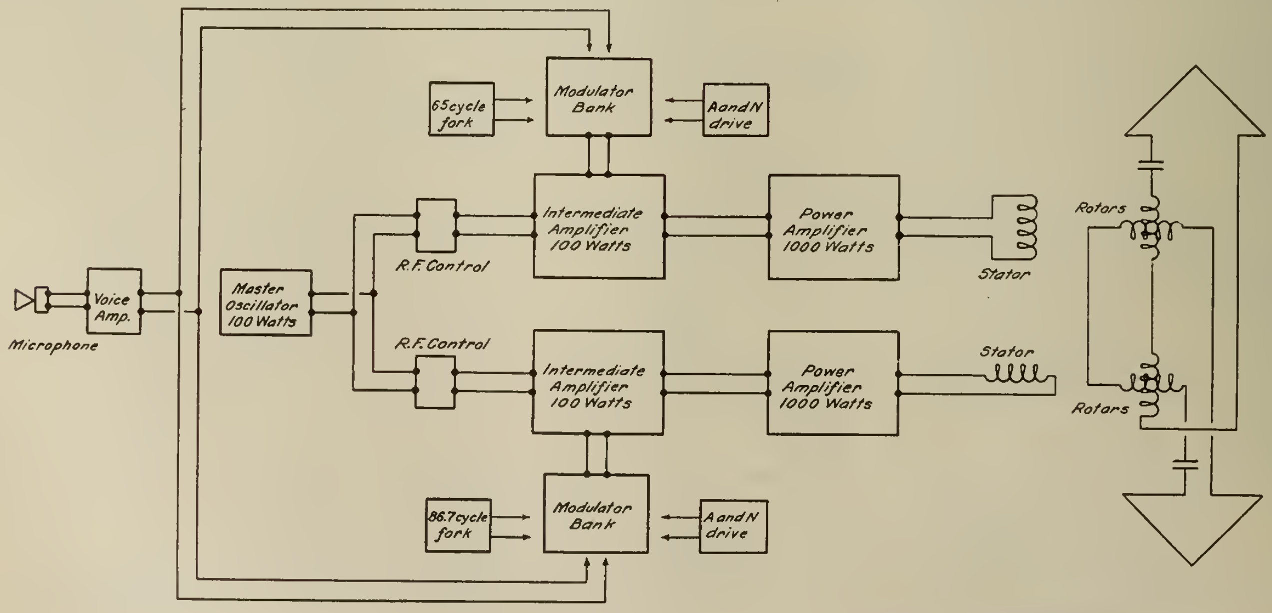


Figure No. 2.—Schematic Diagram of Arrangements of Parts of Canadian Radio Beacon.

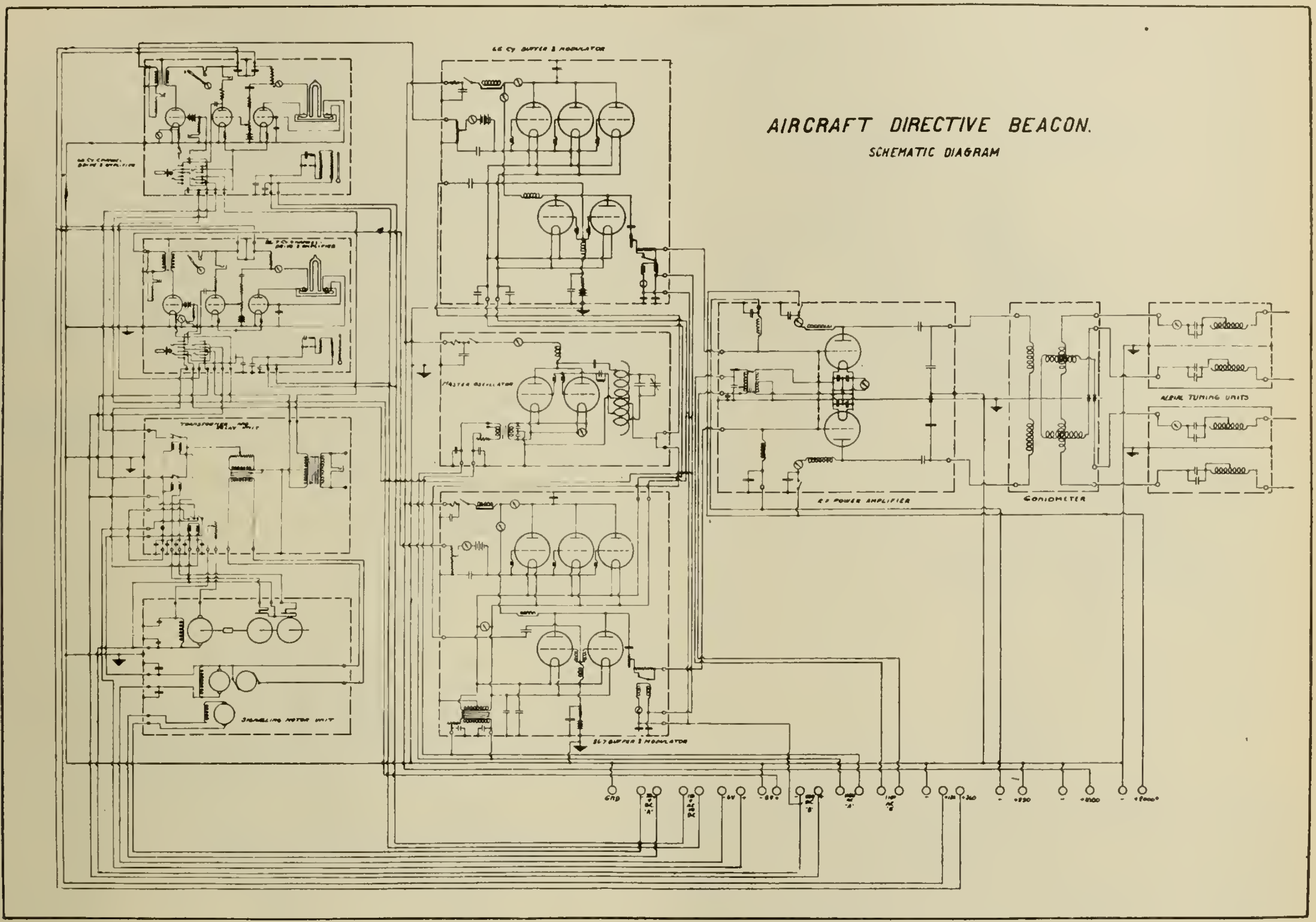


Figure No. 3.—Schematic Wiring Diagram of Aircraft Directive Beacon.

The area covered by the station is carefully divided into areas or patrols, and the general route to be followed on each patrol is marked on the area map. These maps are mounted on the walls of the operating room, and small distinguishing flags are used for the various pilots and patrols. At each report from a pilot his particular flag is moved to the new location given so that a glance at the map will show the station officials the approximate location of all planes in the air at any time. Pilots usually report every 15 or 20 minutes and, when more than one machine is in the air at once, the times for calling are arranged so as to avoid interference. The system not only provides information on conditions on the ground, but helps to insure the safety of pilots as well. It is for this reason that the pilots are instructed to give their exact location every time they come on to report. Should a man fail to report at his proper time, and there is reason to suspect that he has encountered trouble and has been forced to make a landing, the station officials know within a few minutes flying, where to look for him. Under ordinary circumstances a pilot should be able to come on and give his location, even during the time he is gliding down and searching for a suitable spot to make a forced landing. In actual practice this has very frequently happened. The receiving set on the ground station is manned from the time the first plane leaves until the last plane returns to the station. This is to insure that should any such emergency arise it will be possible for the pilots to operate their sets and give information or ask for assistance at any time. Should such an emergency arise, and it is necessary for one pilot to come on at the exact time that another patrol should be making its report, the pilots are instructed to use telegraphy rather than telephony, since telegraph signals are easily copied through strong speech or other jamming.

When information of special importance has to be transmitted, or in the case of names of places likely to be misunderstood, all pilots are instructed to give the information by voice first, but to repeat it immediately afterwards using the telegraph key. This insures the gist of the information getting through, no matter what the static is like, since the telegraph signals are much stronger than the speech. Names of places, proper names and figures are the only things which are liable to be misread or misunderstood. The repetition of map locations by telegraphy is intended to insure that mistakes will not occur.

During the summer season each base transmits by radio to headquarters a daily synopsis of the weather conditions during the previous twenty-four hours, together with the probable fire hazard as nearly as it can be judged. From this information and from radio reports received from patrolling aircraft, Forestry officials at Headquarters decide upon the area to be patrolled on the following day. Upon receipt of this information the officer commanding the Air Force sends out by radio his orders for the desired patrols.

In addition to this work the administration of both the flying and forestry detachments, the ordering of

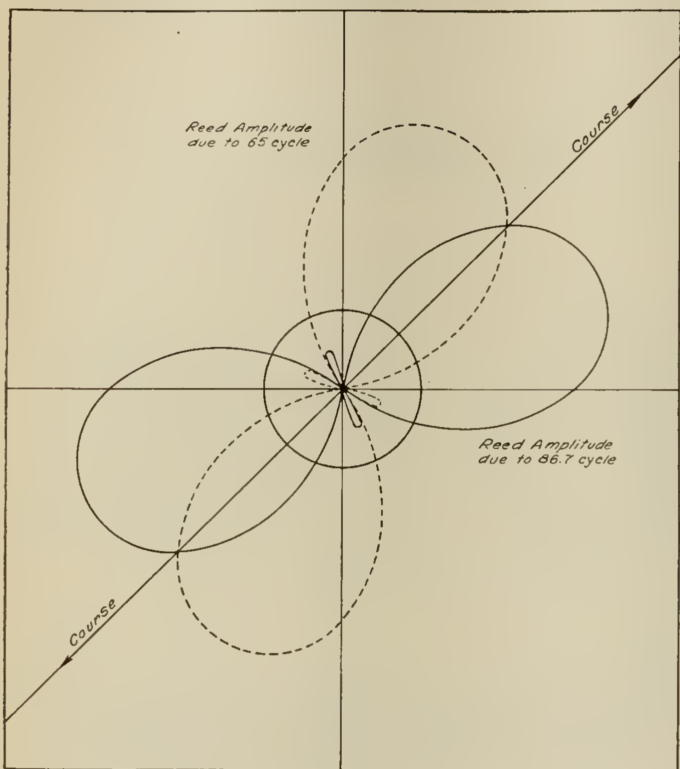


Figure No.4

provisions and technical stores, and the general communication required by detached units, is all performed by the ground stations. In certain localities where telegraph or telephone communication is already available, a large percentage of the general routine work mentioned above is handed over to the Commercial Service in order to speed up the operation of the radio system. However all matters pertaining to operations, and urgent messages of any nature, are handled by radio.

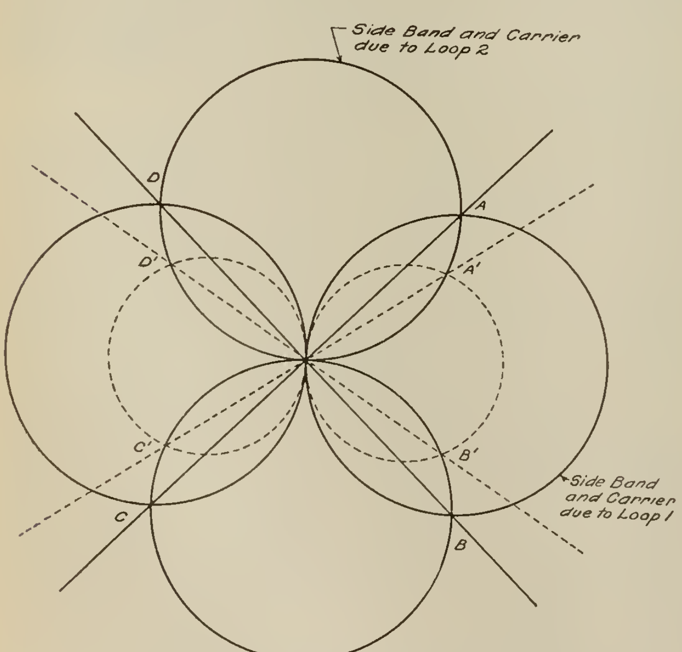


Figure No. 5.

Types of Equipment in Use

Ground Stations

As a result of the experience gained during the past few years the Signal Service has designed two standard types of ground stations for use on forestry work. The type of apparatus installed on any station depends upon the distance, but in general, a 100-watt set is used for distances up to 150 miles and a 500-watt set where longer ranges have to be covered. In the design of all this apparatus particular attention has been paid to the question of reliability, and, as far as possible, equipment and parts procurable in Canada have been used. The problems of repairs and replacements have therefore been reduced to a minimum. As previously mentioned these sets are only used for ground communication and not for ground to air work.

The 100-watt sets are fully automatic in operation and do not employ a station battery. A small automatic

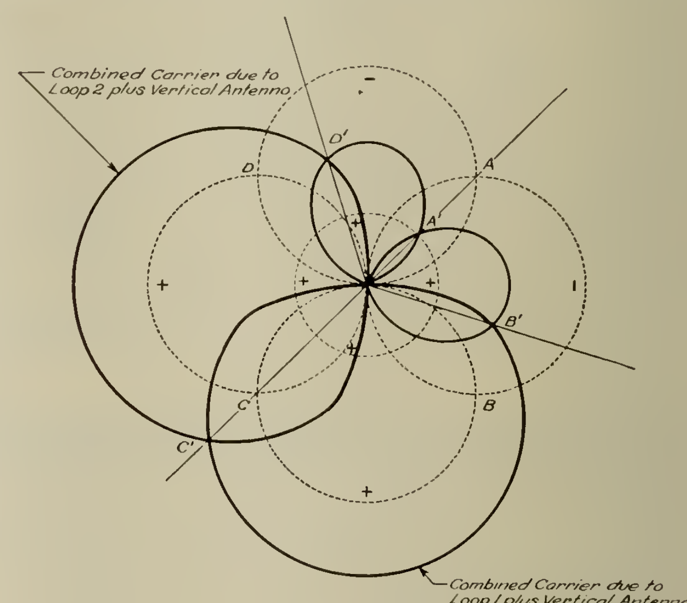


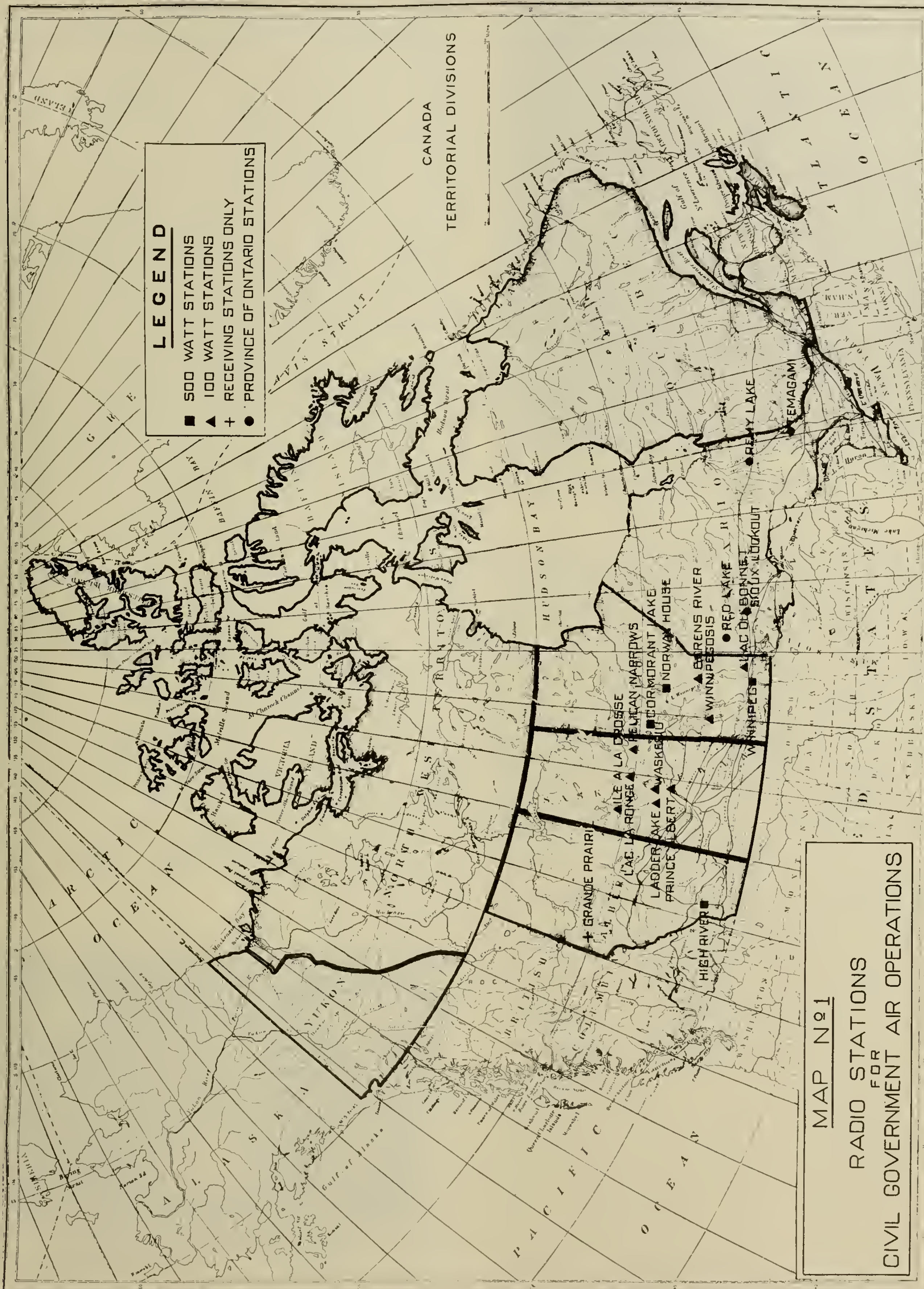
Figure No. 6.

gas engine is used, controlled directly from the operating table. The parts of the set are so arranged that it is very easily transported, and can be moved by plane if necessary. It can be erected by a crew of two men and may be installed in any type of building in any locality.

The larger sets are capable of putting from 500 to 1,000 watts into the antenna. The equipment is so arranged that the power output may be adjusted to suit the distance to be covered and the atmospheric conditions prevailing at the time. The stations are self contained in every way. The source of power is a 3-k.w. coal oil engine-generator set, with a 125-volt high capacity station storage battery for purposes of voltage regulation, and as a stand-by in case of emergency. The battery normally supplies the lighting for both the radio station and the camp. In case of a breakdown to the engine the battery can carry the essential load for about one week. Due to the capacity of the set, and the use of a station storage battery, special buildings are required wherever these larger sets are used.

Aircraft Radio Equipment

The use of radio equipment in aircraft is quite a problem. The set must be light, easy to operate and as nearly as possible foolproof, since once the aircraft leaves the ground the pilot is unable to carry out adjustments or repairs



LEGEND
■ 500 WATT STATIONS
▲ 100 WATT STATIONS
+ RECEIVING STATIONS ONLY
● PROVINCE OF ONTARIO STATIONS
CANADA
TERRITORIAL DIVISIONS
MAP Nº 1
RADIO STATIONS
FOR
CIVIL GOVERNMENT AIR OPERATIONS
GRANDE PRAIRIE
HIGH RIVER
LAC LA RONGE
ILE A LA CROSSE
LADDER LAKE
PRINCE ALBERT
WASKESIU
PELICAN NARROWS
CORMORANT LAKE
NORWAY HOUSE
BERENS RIVER
WINNIPEGOSIS
WINNIPEG
RED LAKE
LAC DU BONNET
SIOUX LOOKOUT
REMY LAKE
TEMAGAMI
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
DAVIS STRAIT

Figure No. 7.

Figure No. 8.—Wavelength Control Panel of CT21 Aircraft Transmitter.

without landing. As previously stated, no attempt has been made as yet to provide reception in the plane. Since the pilot cannot, therefore, be certain that his messages are being received, particular attention has been paid to the provision of suitable meters to enable him to determine when his set is working normally.

The aircraft sets now in use have been specially designed and built by Signals for this service. In order to minimize installation troubles in different types of aircraft, the number of parts have been kept to a minimum and the total overall weight is lower than that of any other aircraft radio apparatus now on the market. The experience of the past three years would indicate that the operational troubles from this apparatus were very few indeed. The following list of equipment includes all parts necessary for a complete installation in any plane:—

(1) Transmitter, containing all valves, wavelength controls and power switches.
(2) A 1,500-volt generator mounted on one of the wings and driven by a small windmill.
(3) The aerial reel for manipulating the trailing wire antenna used with the transmitter.
(4) The telegraph key, microphone and coiled spring suspensions for the transmitter.
(5) A small leak-proof storage battery for lighting the filaments of the valves in the set.

The total weight of this apparatus is 70 pounds.

Since the pilot has to be made responsible for the operation of the radio telephone set in the air, all of the equipment just described must be installed in the cockpit, together with the flying and engine controls. This requires some manipulation as great care has to be taken to see that those parts in which valves are mounted are protected from jars and bumps, which are unavoidable during the period that the plane is taxiing on the ground. It was recognized from the start that the average pilot, being in general unfamiliar with both the theory and operation of radio sets, would in all probability be unable to make the necessary adjustments for wavelength and resonance while in the air. Therefore the technical personnel would be called upon to test and adjust everything on the ground before the plane went up. Once in the air it would then only be necessary for the pilot to let out his aerial and throw over his transmitting switch in order to put the equipment into operation. To facilitate this test work, the stations were provided with complete equipment to duplicate on the ground the conditions met with when the aeroplane was in flight. The provision of this test apparatus proved to be a very wise precaution, as highly satisfactory results have been obtained in operation.

One of the main difficulties to be overcome in connection with radio-telephony from the air is the elimination of outside noises, due to the operation of the engine and the rush of the air. A very complete test on different types of microphones was made during the installation of this system, and, while several microphones gave excellent modulation, there was only one type which was free from the effect of extraneous noises. This type is known as the anti-noise microphone, and is manufactured by the Magnavox Company of Oakland, California. In this device, the diaphragm is connected to the microphone button by means of a brass link about half an inch long. The combination is then mounted in the frame in such a way that the outside noises can strike with equal strength on the two sides of the diaphragm and are, therefore, balanced out. The speech, however, being impressed on one side only, is transmitted without loss to the microphone button. Excellent results have been obtained with this instrument, and so perfect is the noise elimination that, when static is not present, the circuit compares favourably with a long-distance telephone line.

Operation of the Radio Systems

The attached map shows the locations of the various stations engaged on forestry work in Canada. It will be noted that there are three separate subdivisions in the west, in addition to the system operated by the Ontario government in northern Ontario.

These subdivisions are operating in conjunction with the three mid-western provinces and are referred to as the Manitoba, Saskatchewan and Alberta systems. While operating independently within themselves, the three systems are tied in together through the medium of the ground radio stations.

The best indication of the usefulness of any system of communication can be gathered from reports of the work done and the traffic handled. The following tables are included merely as an indication of the extent of the operations up to date.

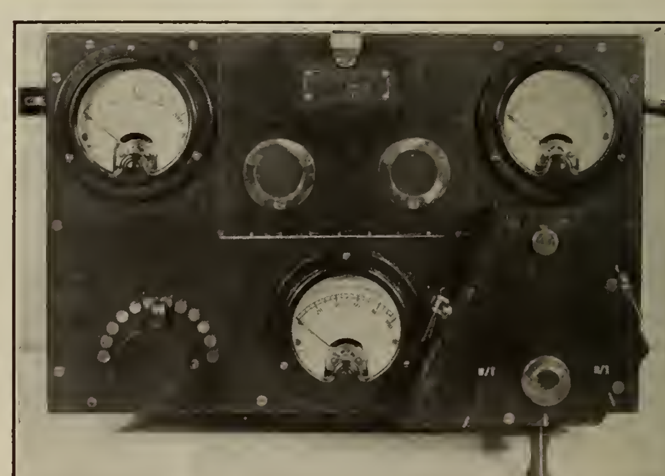


Figure No. 9.—View of Meter and Switch Panel, Aircraft Transmitter, Type CT21, developed by The Royal Canadian Signals for the Air Force.

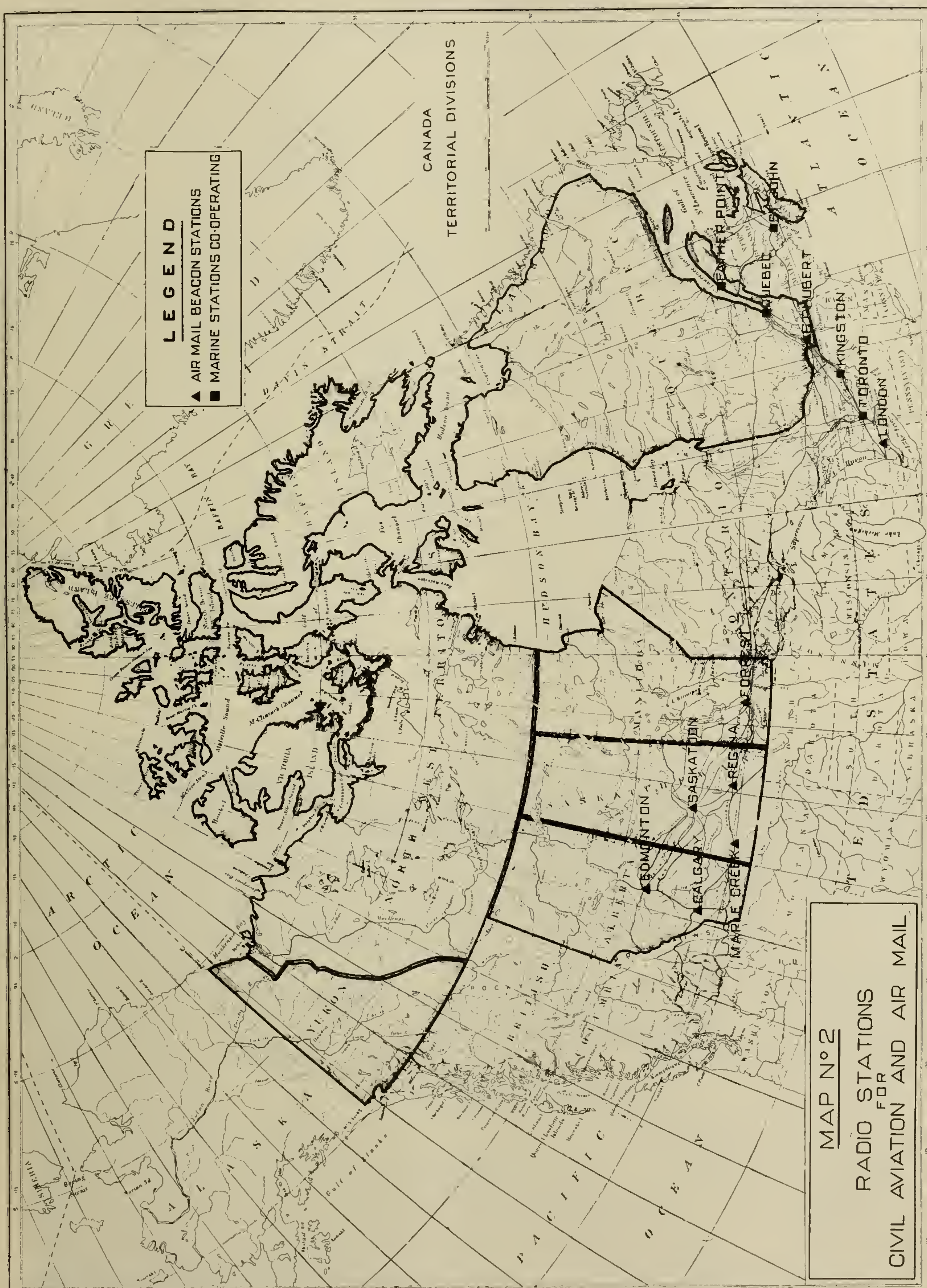

LEGEND
AIR MAIL BEACON STATIONS
MARINE STATIONS CO-OPERATING
CANADA
TERRITORIAL DIVISIONS
MAP No 2
RADIO STATIONS
FOR
CIVIL AVIATION AND AIR MAIL
FATHER POINT
QUEBEC
ST. JOHN
PT. HUBERT
KINGSTON
TORONTO
LONDON
FOREST
REGINA
SASKATOON
EDMONTON
CALGARY
MAPLE CREEK
HUDSON BAY
DAVIS STRAIT
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
YUKON
ALASKA
ALBERTA
MANITOBA
ONTARIO
QUEBEC
UNITED STATES
VICTORIA ISLAND

Figure No. 10.

Table No. I.—Traffic Report—Saskatchewan Radio System

Year	Messages Handled		Words Handled	
	Govt.	Commercial	Govt.	Commercial
1928	2,240	197	104,663	4,885
1929 (to October)	13,638	3,892	386,106	96,124

The following actual cases, copied from the logs of the different stations, will serve as an illustration of the importance of radio as a means of communication in an aerial forest protective unit.

Table No. 2.—Traffic Report—Manitoba Radio System

Year	Messages Handled		Words Handled	
	Govt.	Commercial	Govt.	Commercial
1927	13,621	323	655,683	10,690
1928	19,791	1,120	667,669	276,151
1929 (to October)	25,996	4,318	753,847	37,611

Experiences in the Air

On the 22nd of July one of the summer bases was ordered to carry out a patrol over a certain area on the following day. At 9.45 a.m. the next morning a detection plane left the base on patrol. Half an hour later at 10.15 a.m. a radio message was received from the pilot reporting a fire of some ten acres in area and giving full information as to location, landing facilities, etc At 10.35 a.m., twenty minutes after the receipt of this report, a suppression machine left the base carrying two fire rangers, fire fighting equipment and food to the scene of the fire. A landing

Table No. 3.—Operating Report—Manitoba and Saskatchewan Radio Systems

Year	Words Handled	Hours Operation		Fuel consumed (American gallons)
		Transmitter	Power Plant.	
1926	589,488	641	4,276	2,716
1927	710,255	763	5,348	3,672
1928	772,332	1,254	5,457	3,896
1929 (to Oct.)	1,139,953			

was effected in the vicinity of the fire and actual fighting commenced before the detection plane had returned to the base. Under the old system where the detection planes were not equipped with radio the fire would not have been reported to the base until the detection plane had completed the patrol and returned to its base; probably three hours after the fire had been sighted.

On another occasion during a period of severe fire hazard a detection machine was out on patrol reporting at frequent intervals on the condition of fires on which crews were already working and at the same time keeping a sharp lookout for new smokes. During the course of the patrol the pilot reported one fire out and a new fire burning in good timber in the same vicinity, but at a point about twenty miles distant. Full information was given as to size, location, approximate rate at which spreading, and accessibility by air. Within an hour and a half from the time the radio report was received a suppression plane with two fire rangers and equipment had landed within 300 feet of the fire. The plane then left for the fire reported as being out, a landing was effected and extra men and equip-

Figure No. 11.—Pelican Narrows, Saskatchewan.
This base can only be reached by canoe or air in summer. All heavy freight goes in by sled in winter.

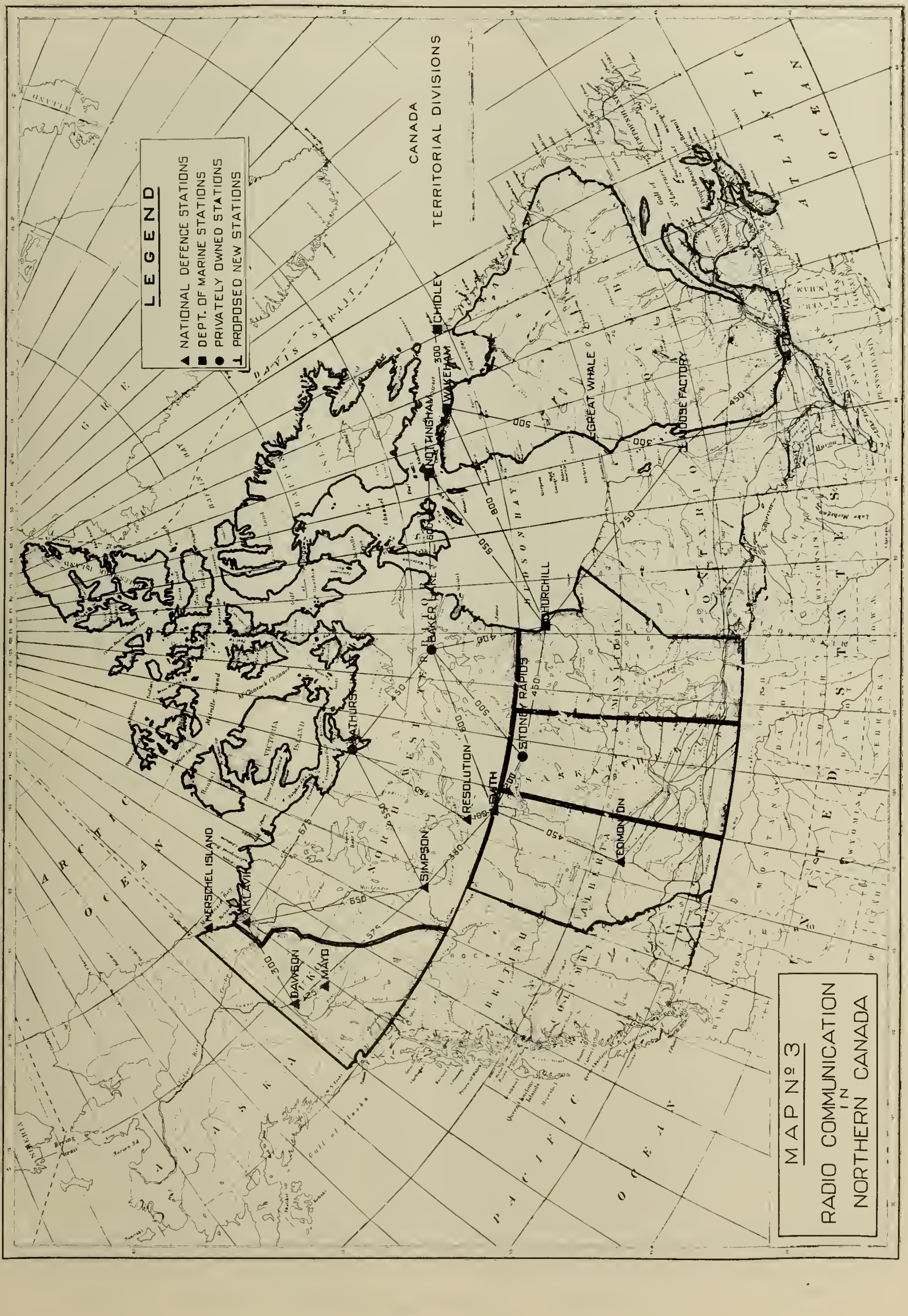

LEGEND
NATIONAL DEFENCE STATIONS
DEPT. OF MARINE STATIONS
PRIVATELY OWNED STATIONS
PROPOSED NEW STATIONS
CANADA
TERRITORIAL DIVISIONS
MAP Nº 3
RADIO COMMUNICATION
IN
NORTHERN CANADA
HERSCHEL ISLAND
AKLAVIK
DAWSON
MAYO
SIMPSON
RESOLUTION
SMITH
STONEY RAPIDS
EDMONTON
BATHURST
BAKER
CHURCHILL
NOTTINGHAM
WAKEHAM
CHIDLEY
GREAT WHALE
MOOSE FACTORY
OTTAWA
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
ALASKA
VICTORIA ISLAND

Figure No. 12.

Figure No. 13.—Cormorant Lake Air Base, Northern Manitoba, showing the Radio Station.

ment brought from there to the new fire. Many such cases occur each season where delays amounting to several hours and occasionally a day or more are eliminated by the use of radio. Apart from the time element which is perhaps one of the most vital factors in fire suppression, radio reports giving information on the condition of fires burning and the progress of fire fighting crews are of great assistance to the chief ranger in the handling of the whole fire fighting organization in his district.

As an example of the rapidity with which information is handled the following example is given: During a patrol from Cormorant lake the pilot was copied in Winnipeg all the way south as far as Lake Winnipegosis. At 12.15 p.m. he reported a class B fire, that is, one between 10 and 20 acres in extent. The pilot gave the location and all necessary details,—these were received in Winnipeg at 12.30 p.m., whereupon the pilot landed. A telegram was sent from Winnipegosis at 12.40 and received in Winnipeg at 3.30 p.m. Thus the radio effected a saving of three hours in connection with this particular fire.

In April 1929, aircraft *YR* from Lac du Bonnet station was patrolling in the Dogskin river area. Reports had been coming in steadily since the plane left at 9.50 a.m., but at 4.30 in the afternoon the engine suddenly developed magneto trouble and the pilot had to make a very rapid landing. However he had just time to come on, report his position, state that the magneto was not working and ask that a new one be sent out at once. As the weather was cold and snow was still covering the ground in that area, there was no time to be lost, if the pilot was to be rescued from a bad night in the woods. A Fairchild cabin machine was run out, a new magneto loaded on board and in half an hour was on its way to the location given by the pilot in his last message. Suffice it to say that both machines were back at their base by the time darkness had set in.

Winter Operation and Commercial Traffic

For the past few years most of the stations in the Manitoba and Saskatchewan areas have been kept open during the winter for the convenience of the traders, trappers and local inhabitants. Arrangements have been made for these stations to handle commercial traffic, clearing to the telegraph companies either through Cormorant lake to The Pas, or direct to Winnipeg. The use made of these stations has been very encouraging, and, while the business taken in does not begin to cover the cost of operating the stations, it is felt that the value of this service in opening up and developing the country cannot be measured in dollars and cents. In 1928, the commercial traffic handled amounted to 1,317 messages with a total value of $2,625.21.

Future Developments

Future developments in this service will depend to some extent on the re-organization following the taking over of the natural resources by the provinces. If the present system of forest patrols is maintained, an expansion of the area to be protected will be followed at once by an increase in the number of ground radio stations required. The most important extensions at present outstanding are at Cold lake near the Saskatchewan-Alberta boundary, and in the Reindeer lake district. It is also probable that some new stations may be erected shortly in the area east of lake Winnipeg, between Norway house and Island lake. Additional service is required in the Peace river district north and west of Grand Prairie, but it is not known whether this will be proceeded with in 1930.

Steps are now being taken to inaugurate in 1930 an aerial preventive service in the Gulf of St. Lawrence. A base station will be established on Anticosti island and radio equipped flying boats will operate in the gulf in conjunction with the revenue boats of the Preventive Service. This service should prove highly successful.

The Ontario Government Radio System

The province of Ontario maintains its own flying service for the protection of the provincial forest areas. In connection with this service an extensive and highly efficient radio system has been developed. At the beginning, ground stations only were installed but, as the system developed, air to ground communication was introduced with great success. It is understood that in the near future all the planes will be in radio contact with their base stations during patrols.

From Sioux Lookout, the headquarters of the flying and forestry services in the western part of the province, to Remy lake and Timagami on the eastern side, there are a total of eighteen stations. The map does not show all of these on account of the small scale used, but the stations shown serve to emphasize the extent of the area covered.

These stations all work in the wavelength band from 50 to 200 meters. For purposes of control and to minimize interference, they are operated in three groups corresponding to the Hudson, Cochrane and North Bay districts as shown below:—

Hudson Group
Sioux Lookout (Two stations)
Wingiskus Lake
Gold Pines
Red Lake
Goose Island
Swain's Lake
Jackson Manion
Cat Lake
Crow River
Fort Hope
Savant Lake
Caribou Lake
Armstrong

Cochrane Group.
Stimson
Little Abitibi

North Bay Group.
Maple Mountain
Elk Lake
Timagami.

In the Hudson district, a total of thirteen stations were operated, including two, one at Gold Pines and another at Sioux Lookout, which were used very largely for commercial work. In the Cochrane district, two stations

Figure No. 14.—A Typical Bit of the Area to be patrolled in the Foothills of the Rockies. Radio is Essential Here as Landings are Difficult.

Figure No. 15—Not a Forced Landing, Just an Ordinary One in Hudson's Straits. Note the Radio Generator on Starboard Side of Fuselage.

were operated and in the North Bay district three. This was one more than in the previous season.

From the point of view of operation there is considerable difference between the eastern and western stations. In the Hudson Inspectorate communication is largely required between district and ranger headquarters, this service being necessary because of the lack of land line communication of any kind throughout the area in question. For the same reason, the demand for a commercial service has also arisen.

In the two small eastern units, however, the use of radio is more definitely restricted to a specialized type of communication, in particular to communication with lookout towers. There is at present very little call for a commercial service for the eastern areas since land lines had been constructed throughout this territory prior to the establishment of the department's present organization.

In addition to the land stations described above, which are classified as "permanent" as distinguished from portable, the Ontario Forestry radio service have designed and constructed two other types of radio apparatus which it is expected will be of value in the work of the branch. These are (*a*) a portable set, (*b*) an aircraft set.

Before mentioning the portable sets it should be noted that the permanent sets weigh six hundred pounds and can be broken down into units of about two hundred pounds or less for purposes of transportation. The portable sets, however, have been especially designed for light weight and intermittent service. Two types have been developed (1) a battery operated set, (2) a gas-engine-generator set. Because of its relative simplicity, the battery set was completed first and was given an actual test on fire fighting operations during the present season. The set was found to have ample power and maintained schedules without failure. The gas-engine-generator set was completed and while it has not been actually tried on a fire fighting operation, has been given an equivalent test as regards distance and general working conditions. The set operated with entire satisfaction.

In considering these two types, it might be noted that the complete weight of either set is less than one hundred pounds, the battery driven set being the lighter of the two. In point of initial cost, the power driven set is at a disadvantage while in point of upkeep, the battery set suffers. On the whole, it would appear that the power driven outfit will be more generally desirable.

The aircraft set, which was designed and tested during the past season, differs from all other equipment in use in Ontario in that it provides for one way communication only. Considerable difficulty was encountered in obtaining material for the construction of this apparatus, owing to its special nature and to the general rapid development of the radio industry. The equipment did not therefore receive a working test until near the close of the season. The test was successful, but it is now considered that it would be desirable to lighten the apparatus and supply two-way communication.

These stations were intended primarily for government traffic but, as in the case of the Saskatchewan and Manitoba systems, commercial and private messages are accepted at a very reasonable rate, for the convenience of the inhabitants of the area.

Traffic figures for 1929 are not yet available, but the following information taken from the 1928 report, will serve to show the extensive use beng made of this service both by the Ontario government and the settlers and traders in the district.

Table No. 4.—Traffic Report—Ontario Government Radio System.

Year	Words Handled		Totals
	Government	Commercial	
1927	35,072	23,167	58,239
1928	52,289	181,566	233,855

On account of the growth in the number of stations operated during the past year it is expected that these figures will show a considerable increase for 1929.

Civil Aviation and Air Mail Routes

Commercial aviation, dependent as it is upon air mail, express and passenger carrying for its basic source of revenue, relies for its success, in large measure, upon closely maintained flying schedules by day and night. The one big hazard not yet completely overcome is the weather. Reliable engines, the use of multiple engines on the planes, numerous and well lighted flying fields and well constructed aircraft have all helped to stabilize the service, yet air traffic is often halted when meteorological conditions make the pilot uncertain that he can see landmarks or find his landing fields.

It is to reduce these uncertainties that the Directorate of Civil Aviation of the Department of National Defence has undertaken to install an extensive system of aids to

Figure No. 16.—Wakeham Bay Radio Station, Hudson's Straits Expedition.

aerial navigation throughout Canada. It is the intention of the government to provide throughout the country aids to air navigation in a manner similar to the aids to ship navigation maintained by the Department of Marine. It will then be necessary for commercial aviation companies to equip their planes with the necessary apparatus to make use of these radio aids, in the same way that shipping concerns must equip their boats with both instruments and operators. These aids include lighting of the airways for night flying, special meteorological service and radio aids. Only the radio will be dealt with here.

The possibilities of radio as an aid to air navigation include:—

(1) Communication between air and ground.
(2) Navigation over given routes.
(3) Landing in heavy fog or cloud.

From the point of view of most pilots, communication is considered to be the most essential. The pilot is anxious to receive while en route, information on weather conditions ahead and conditions at possible landing fields. The second step in the conquest of the weather hazard is the provision of a reliable system of course navigation that will permit a machine to be flown on a given route regardless of fog, mist or snow. It is not as yet possible to use radio to land a machine in fog but promising experiments along this line are underway.

Before proceeding with the details of the proposed Canadian system, the following description is given of the schemes at present in operation in Europe and in the United States.

European Systems

In Europe all planes flying on regular routes are equipped with radio-telephone transmitters and receiving sets. Two-way contact is maintained by voice between ground and air, and weather information and landing instructions are given to the pilot in this way. In addition the governments maintain a number of radio direction finding stations in connection with each of the principal airports. Upon request by radio from an aeroplane, two or more of these direction finding stations determine the direction of travel of radio waves from the plane. These bearings are combined at the base station and the position of the aeroplane calculated and transmitted by radiotelephone to the pilot. This system demands that the base station, and all the direction finding stations, shall be in constant communication, preferably by wire. An individual position can be calculated and transmitted to the plane in about a minute and a half, on the average. The big difficulty lies in the fact that, if several planes are calling for their positions at the same time, the last one may have to wait anything up to 10 minutes for this information. At busy airports this is a frequent occurrence. A further difficulty of this system is the necessity for carrying a transmitter, which means an added weight of approximately 100 pounds.

For the independent flyer, and to a certain extent for regular commercial services, a system of direction finding may be operated on the plane. Coils or loops are mounted in the wings and fuselage and the plane is swung around until the signals indicate that the axis of the machine is pointing towards the known ground transmitting station. By steering a course in the indicated direction the aeroplane can be. certain of reaching the desired point, the accuracy of the indicated direction increasing as the objective is approached. This is the well known system employed on marine vessels and on lighter-than-air craft. It is not as useful, however, on aeroplanes. On account of the noise and the electrical disturbances due to the engine ignition system, the errors are very much greater. This system is in use successfully to a certain extent, but requires very expert handling. This method of navigation has the inherent limitation that it does not prevent winddrift from shifting the aeroplane off its course: the scheme does eventually bring the machine to its destination, although by a circuitous route if there is any side wind.

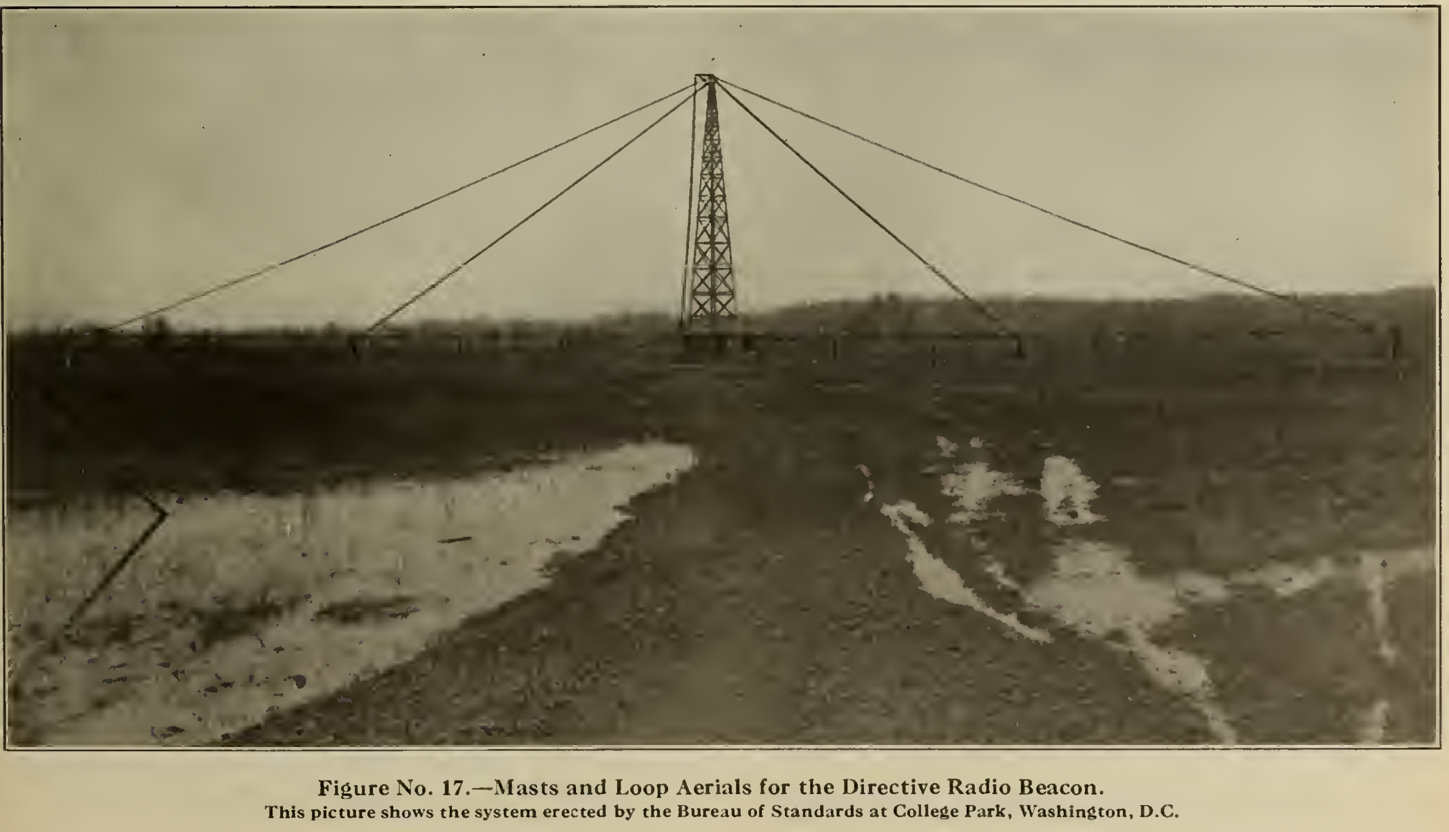


Figure No. 17.—Masts and Loop Aerials for the Directive Radio Beacon.
This picture shows the system erected by the Bureau of Standards at College Park, Washington, D.C.

Figure No. 18.—Canadian Radio Beacon Transmitter—Front View of Panels, Doors Closed. These Beacons were manufactured by the Canadian Marconi Company, Montreal.

A third method of furnishing navigational aid to aircraft is the rotating radio beacon. This is a radio transmitting station located at an airport, or at some known point on a route or junction of several routes, and provided with a rotating loop as an antenna. The loop rotates once in 60 seconds so that each one tenth second represents 0.6 degrees of rotation. The loop aerial causes a beam of radio waves to be sent out, and the rotation of the loop causes this beam to sweep continuously around the circle. A special signal indicates when the beam is pointing due north. A pilot, listening for this beacon signal in his receiving set, can determine his direction by the time elapsing between the north signal and the instant when the beam is heard with maximum or minimum intensity. The elapsed time is determined by means of a stop-watch whose dial is calibrated directly in degrees. This system only requires a receiving set in the plane and, by means of a number of these stations suitably located, the pilot could obtain his position to a fair degree of accuracy. The big disadvantage lies in the necessity for the pilot, or an observer, to continually check his direction if he is flying in bad weather or fog, or at night.

American Radio Beacon System

In the United States the Aeronautical Branch of the Department of Commerce, with the assistance of the Bureau of Standards, has developed a system of aids to air navigation to be operated in conjunction with the many air routes being developed in that country. They have recognized that the pilot's main requirements were to know weather conditions ahead of him, and to be able to fly on a direct course without the necessity of seeing landmarks or lights on the ground. The scheme involves a simple receiving set with fixed antenna on the plane, and radio telephone stations and radio beacon stations situated at suitable locations on the ground. With this system the pilot receives by radio telephone, information on weather conditions and other matters, and also the radio beacon signals to guide him along his course. All of the complicated and expensive apparatus is on the ground at the transmitting end and is maintained by the government.

The experimental work carried out on this system up to date shows that all practical requirements can be met by placing the beacons and the radio telephone stations at main airports approximately 250 miles apart. It has also been shown that the use of speech to transmit weather and other information, to the pilot while in flight, is thoroughly practicable.

The following description of these beacon stations has been taken from articles published by Dr. Dellinger, head of the Radio Branch of the Bureau of Standards, in Aeronautical Engineering, and in the Proceedings of the Institute of Radio Engineers.

"The radio beacon is a special type of radio transmitting station. Instead of having a single antenna like an ordinary radio station, it has two large loop antennae placed at right angles to one another. The two loops are energized simultaneously at exactly the same radio frequency. Each loop emits a signal which is strongest along a line which is the extension in either sense, of the plane of the loop. In a direction at right angles to the plane of the loop the signal strength is zero. The diagram of figure No. 1 shows the theoretical field strength pattern of two crossed coils or loops when energized with equal power at the same radio frequency.

It will be observed that if an aeroplane was flying along either of the dotted lines, that is, midway between the two beams of radio waves, it would receive signals of equal intensity from each of the beams. If the machine gets off of this line, it will receive a stronger signal from one loop than from the other. Interlocked cams are used to transmit a signal over each loop, the letter A (- —) being transmitted over one loop and the letter N (— -) over the other. The cams are so adjusted that if the outputs from both loops are fed equally into a common receiving system, only a long dash will be heard. Therefore if an aeroplane is flying along either of the dotted lines of figure No. 1 only a long dash will be heard. This provides an additional means of enabling the observer to decide when the signals are of equal strength, or in other words, when he is exactly on the prescribed course."

This system suffers from the same defect as the rotating loop beacon, namely that the pilot must be listening to the signals during the entire flight in order to keep the plane on its proper course. This is very fatiguing especially if static or interference is strong, as it very frequently is during bad weather when the system is most needed.

From what has already been said it is quite evident that some form of visual indicator for use in the plane is essential if the aircraft radio beacon is to be a success. This problem was attacked by both the American Signal Corps and the Bureau of Standards. Valuable work has been done by both organizations, but quite recently the Bureau of Standards has completed a system known as the double modulation beacon, together with a vibrating reed visual indicator. This system has shown great promise, and in view of the fact that a modification of this scheme has been adopted for use in Canada, a short account of the method of operation will be given.

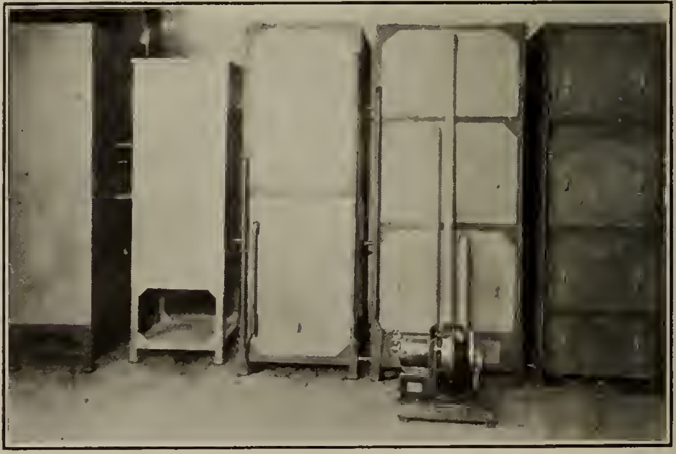


Figure No. 19.—Canadian Radio Beacon Transmitter—Back View of Shielded Cabinets showing the Blower Unit for Cooling the Intermediate Amplifier and Modulator Units.

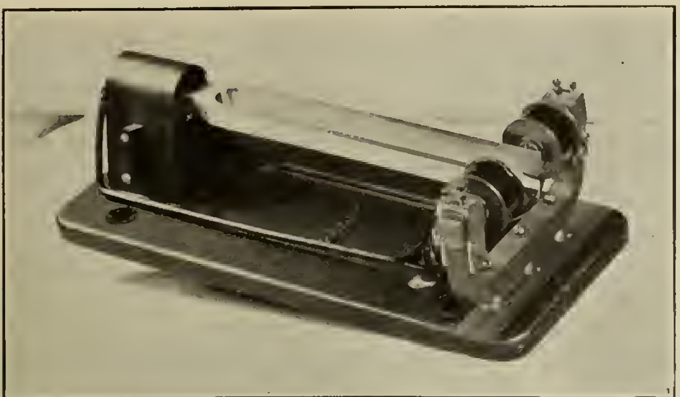


Figure No. 20.—One Tuning Fork with Electric Drive for Canadian Radio Beacon Transmitter.

In this system both loops are fed with power at the same radio frequency, but different modulation frequencies are employed for each loop. Low audio frequencies were chosen for two reasons,—first—so that a simple vibrating steel reed could be used as an indicator, and secondly, to keep to a minimum the width of the side bands transmitted. In other words, this would reduce the amount of interference which the system would cause to neighbouring services. On the plane a simple non-oscillating receiver is employed and the output of this set is fed to the indicator, which consists of small electromagnets between which two vibrating polarized steel reeds are mounted. These two reeds are tuned mechanically one to each of the two frequencies of the loop modulation voltages. In operation these reeds vibrate with equal amplitude when the plane is on its course, since the receiving set picks up equal signals from each loop. When off course, the pilot can estimate the amount of the deviation by the relative reed amplitudes. One of the main advantages of this system is that the apparatus is immune to ordinary static and magneto interference owing to the sharp mechanical tuning of the reeds.

Canadian Radio Beacon System

So much for the principle of operation, the following details of construction, together with the diagrams and photographs, illustrate the equipment designed and built in Canada by the Canadian Marconi Company in collaboration with the engineers of the Royal Canadian Corps of Signals. Figure No. 2 is a schematic diagram of the arrangements of the parts of the beacon, while figure No. 3 is a schematic wiring diagram of the set itself. The photographs are self-explanatory. The photos of the aerial system at College Park, Maryland, and the visual indicator for the aeroplane were supplied through the courtesy of Dr. Dellinger, head of the Radio Department, Bureau of Standards, Washington, D.C.

Beginning at the left of the diagram of figure No. 2 it will be noted that the transmitter consists of a master oscillator of 100 watts output feeding two intermediate amplifiers each of 100 watts. Each of the intermediate amplifiers control a power amplifier of one kilowatt rating. The output from these last stages is fed through a four coil goniometer into the two loop antennae. Tuning is provided in each leg of each loop so that an exact balance of the aerial system may be secured. The modulation frequencies are introduced into the two intermediate amplifiers, and it is in this part of the circuit that the modifications have been introduced into the Canadian apparatus. It will be observed that the two audio frequencies of 65 and 86.7 cycles are obtained from two valve driven tuning forks, the temperatures of which are held constant by means of thermostats, at 90° F. Two UX. 210 valves are used as an output amplifier for the tuning fork, the energy from this amplifier being fed into the intermediate amplifier through a bank of UX. 845 modulation valves. Means are provided to control the depth of modulation produced by the tuning fork signals. In order to provide for planes not equipped for visual indication, apparatus has been provided to convert the beacon to the aural, or A and N type. A small 500-cycle generator, together with a motor-driven set of interlocked cams, may be switched into the circuit in place of the forks and the output of the two loops, modulated with a 500-cycle signal, may be keyed as in the original American system. This modification will provide for service to visiting American aircraft equipped for the visual system, or for any of our own planes that may be flying beyond the range of operation of the visual indicator. No change is required on the aircraft receiver, as head telephones are already provided to receive the meteorological broadcast.

It has been pointed out that both telephone communication from the ground and beacon signals are required by the pilot flying on a modern air route. In the American system this is provided by a second transmitter at the airport operating on a second frequency within the range of the aircraft receiver. There are two disadvantages to this scheme. First—the cost of the second transmitter with its power plant and associated equipment. Second—the necessity for the pilot to tune his set while in the air from one frequency to another, with the accompanying possibility of mistakes being made.

To overcome these difficulties a further modification has been added to the Canadian beacons. A microphone and speech input amplifier have been included in the transmitter, together with the necessary switching, so that voice modulation of the output of each loop can be secured. In order to transmit weather reports or other information to the pilot, it is only necessary for the operator at the station to throw the switch from either of the beacon positions to "voice" and to speak over the microphone provided. No change is required in the tuning of the aeroplane receiver, and the pilot can adjust the strength of the speech by means of the volume control provided on the remote control device.

The aircraft receiver is of the high gain type employing three stages of screen grid radio frequency amplification ahead of a detector and two-valve audio amplifier. This amount of amplification is required to operate the visual indicator, since it has been found necessary to use a vertical rod type aerial on the plane to minimize "night errors," or variations in apparent direction due to reflections

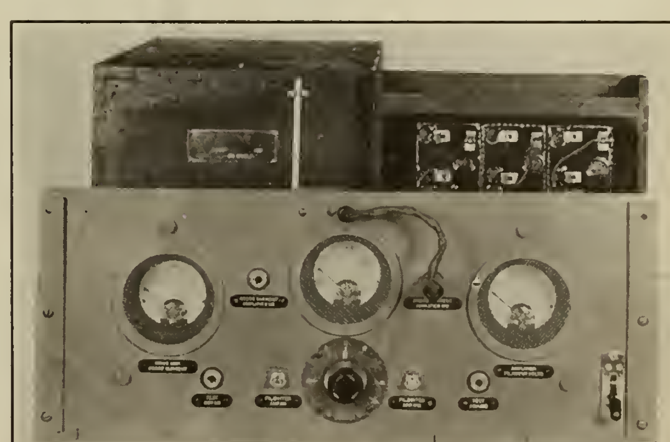


Figure No. 21.—Canadian Radio Beacon Transmitter—Front View of One Tuning Fork Panel, showing the Controls.

from the heavyside layer. This antenna consists of a streamlined metal clad rod, mounted on the fuselage of the machine and extending seven feet above the upper surface of the plane body. It is held in place by guys to the two wing tips and to the tail. The actual receiver is mounted in any convenient place in the tail of the aeroplane and the on and off switch, telephone jack and volume control are mounted in a small box on the instrument board. The visual indicator is also mounted on the instrument board in some spot where it can easily be seen. The effect of the electro-magnets on the compass has been completely eliminated by proper screening of the indicator box.

In order to obtain the maximum benefit from this receiver complete shielding of the ignition system should be employed The high and low tension wires, the spark plugs and the magneto distributor blocks should all be shielded Special shielded ignition harness has been developed by several United States firms, chief among whom is the Belden Company of Chicago . In this harness the distributor blocks are covered by metallic shields and the spark plugs are of a special type in which the shield is an integral part of the spark plug It is possible, however, to operate the receiver with a fair amount of success even without any shielding. The beacon signals are not greatly affected by the magneto disturbance but the speech will be interfered with to some extent.

The goniometer, coupling the power amplifiers to the crossed coil antennae, is used to enable the two courses mapped out by the beacon to be oriented in any direction required. The goniometer consists of four coils, two stator coils at 90 degrees to each other and two rotor coils also crossed at 90 degrees. The stator coils are connected to the plates of the power amplifiers, while the rotor coils are connected each in series with one loop antenna. The currents in the loop antennae, due to the driving voltage from each stator coil, create a resultant field in a direction such as would be produced by an imaginary antenna rotating with the goniometer rotor. Since there are two stator coils at 90 degrees, there are two such phantom antennae rotating as the two rotor coils turn together, thus allowing the equisignal zones or courses in space to be swung into any required direction.

There is a further advantage to be gained from this system. By suitable adjustments of the goniometer coils and the transmitter, two different effects may be secured. First—two of the right angle courses may be eliminated, leaving only one direction along which aircraft may fly. Second—the four courses may be retained but the angle between the two directions may be varied over quite wide limits. This is often necessary at airports where a number of radiating courses are in existence. A practical example of this is found at the air mail fields at Hadley, New Jersey, and Bellefonte, Pa. At Bellefonte, two courses at 165° are used, while at Hadley there are three courses in simultaneous use leading to Hartford, Conn., Bellefonte, Pa., and Washington, D.C. These various possibilities are illustrated diagrammatically in figures Nos. 4, 5 and 6.

The directive beacon, while it guides the pilot along the course, gives no information about the particular point on the course at which he is located at any given instant. To provide for this requirement, marker beacons are being used on the United States airways. These are small non-directive transmitting sets placed at intervals of about 25 miles. The power is usually of the order of

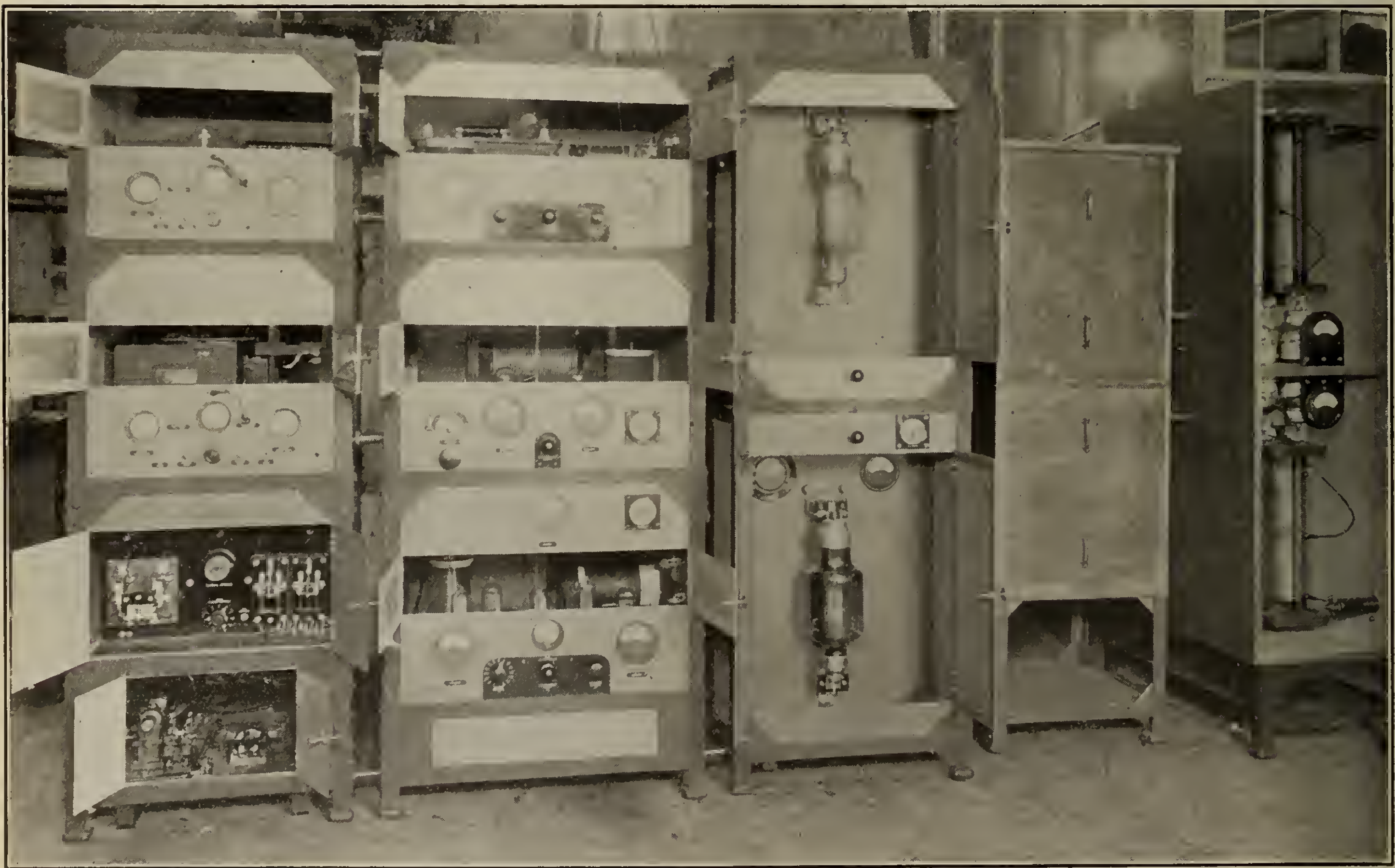


Figure No. 22.—Canadian Radio Beacon Transmitter—Front View, on Left is Tuning Fork and A and N Drive—on Right is the Loop Tuning Apparatus.

10 watts and the range to the aeroplane not over 2 or 3 miles. The output of these beacons is modulated at 120 cycles and the visual indicator is fitted with a third reed mounted alongside the other two. This reed will indicate when the plane is passing over a marker beacon, since the frequency of the carrier wave from the small transmitter is exactly the same as that used at each of the main beacons on the route. In all probability this scheme will be incorporated in the Canadian Air Mail system at some future date.

Canadian Air Mail System

The Canadian Transcontinental Air Mail system, upon which the Government is establishing complete aids to navigation, is laid out as follows. In summer the mail is taken from the steamers at Rimouski and transferred to aeroplanes flying to Montreal via Quebec and the St. Lawrence river. In winter the mail is picked up at Saint John, N.B., and taken by plane to Moncton where it is transferred to the transcontinental planes of Canadian Airways Ltd. It is then flown to Quebec via Fredericton, Edmundston and Riviere du Loup. At Quebec it is transferred to the Montreal plane and delivered to St. Hubert aerodrome. From St. Hubert the mail goes via Toronto and London to Windsor and Detroit, at which point it is handed over to the United States Transcontinental Air Mail Service which takes it as far as Minneapolis. Here it is again transferred to Canadian machines which take it to Stephenson field, Winnipeg. From Winnipeg the Western Canada Airways operate air mail planes to Calgary via Regina, Moose Jaw and Medicine Hat. At Calgary it is transferred to fast express trains for the trip through the mountains to Vancouver. In addition to this service there is an air mail route from Regina to Edmonton via Saskatoon and North Battleford. This circuit is operated in connection with the direct Winnipeg-Calgary route. It has not yet been decided which air route will be followed through the Rockies to Vancouver and, therefore, the final selection of the main transcontinental route cannot be made.

However, radio aids to air navigation are being installed on two sections of the system, namely, from Montreal to Windsor, and from Winnipeg to Calgary and Edmonton.

Map No. 2 attached will explain clearly what is being done. On the eastern half of the route a special radio-telegraph station has been erected at St. Hubert, and the Marine Department stations at Saint John, Father Point, Quebec, Kingston and Toronto are co-operating with St. Hubert in the collection and dissemination of weather information. Reports are prepared and transmitted from Saint John, Father Point, Quebec and St. Hubert before the planes leave the various stations. In this way the pilots know the weather conditions ahead of them on the route they are to follow. In addition to these reports received before departure, the Canadian Airways planes are now carrying a receiving set and an operator and, while in flight, are receiving special weather broadcasts by radio telegraphy from the stations on the different routes.

In order to permit the aerodromes to keep closely in touch with one another, a teletype line has been installed with teletype instruments at St. Hubert, Kingston, Toronto, Hamilton, London and Windsor. The meteorological department in Toronto have arranged for special observers at each of these places and weather reports may be obtained from any station at any time during the day. In addition to these special reports, a number of routine weather reports are transmitted from each station to all other stations every day. These reports give full meteorological information so that every station on the teletype system has on hand at all times a complete fyle of weather reports covering all stations on the system. This information is available for pilots or others contemplating flights over any part of the route. At St. Hubert the operator copies the regular radio weather broadcasts from Arlington, Virginia, and a weather map of the eastern half of North America is made up daily. This map is available on the station hours before the map sent out by the meteorological office in Toronto can arrive by mail.

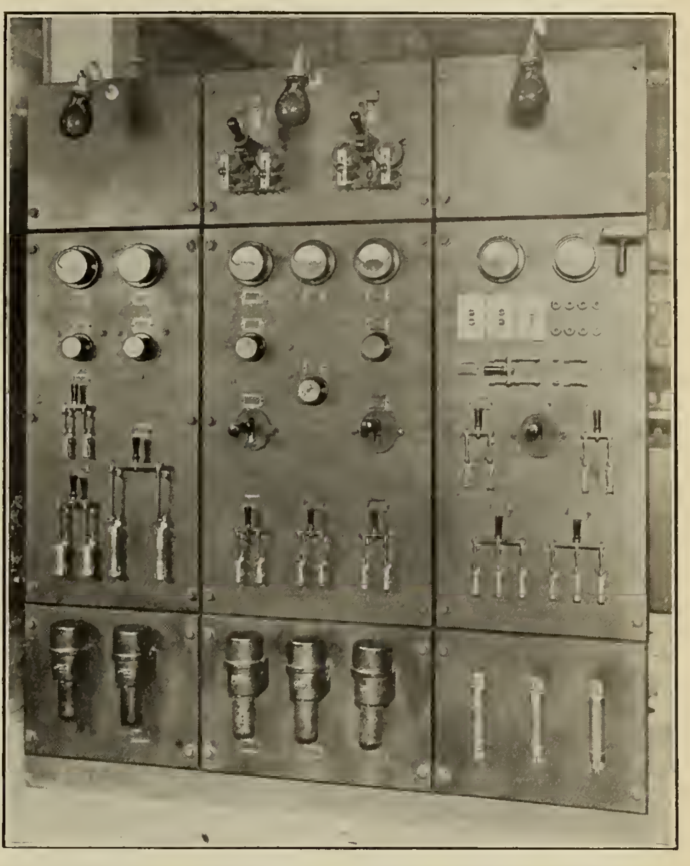


Figure No. 23.—Canadian Radio Beacon Transmitter—Power Control Panel.

On the eastern end of this route the planes are flying in daylight, but from Hamilton to Windsor and Detroit there is considerable night flying especially in the fall, winter and spring. For this reason, lighting has been installed on the route and a radio beacon will be erected at London during the coming year. It will then be possible for all planes flying between Montreal and Windsor to obtain full weather information at any time, and in addition, be able to fly by beacon over that part of the line where night flying is required.

On the western end of the system, between Winnipeg, Calgary and Edmonton, beacon stations are being installed at Forrest, Man.; Regina, Sask.; Maple Creek, Sask.; and Calgary, Alta. It is quite probable that radio beacons will also be erected at Saskatoon and Edmonton. In general these stations are being placed at 250-mile intervals, since the dependable range of the aircraft visual indicator system is 125 miles. It will be observed from the map that at Broadview, Morse and Medicine Hat the direction of the mail route changes somewhat and the beams from the beacon stations intersect at these places. It is proposed to erect marker beacons at these points and to use a third reed in the visual indicator as previously described. Until such time as these special stations can be erected, "on

Figure No. 24.—Visual Indicator with Third Reed for Marker Beacon Transmitter.

course" lights have been installed to indicate to the pilot that he must change direction.

A teletype line has been installed from Winnipeg to Calgary with instruments at Forrest, Regina, Maple Creek, Medicine Hat and Calgary. There will also be a line from Regina to Edmonton via Saskatoon. It is expected that the Winnipeg-Calgary route will be night flying entirely, but for the time being at any rate, the Regina-Edmonton service will be a daylight service only.

Observers will be provided by the meteorological department at each of the flying fields and the same routine followed as in the case of the eastern mail route. A weather report, collected over the teletype system from all other stations on the chain, will be broadcast by voice once every hour from each of the beacon stations. This can be easily arranged since they are equipped to operate as broadcasting stations as well as radio beacons. The routine to be followed on each station will be somewhat as follows. During the time when machines are in the air, the beacon signals will be shut off exactly on the hour and the weather report transmitted for the information of the pilots. At this time special messages dealing with navigational matters, or orders for the pilots from owners of machines using the route, will be broadcast. At the present time it is necessary to shut down the beacon while this broadcast is taking place but experiments are now under way to make it possible to operate both at the same time. It is hoped that this improvement will shortly be available for all ground stations and aircraft receivers.

Before leaving this part of the subject, the writer would again emphasize the fact that all aids to air navigation, comprising meteorological service, teletype line, radio beacons, lighting and emergency flying fields are all provided and maintained by the government. Air mail contractors and private or commercial aviation companies wishing to make use of these aids may do so simply by equipping their machines with a suitable receiving set with a visual indicator and head telephones. The cost of the aeroplane installation and its maintenance will, of course, have to be met by the owner of the plane, but the government radio engineers are always available to advise owners with regard to the type of apparatus required and the best methods of installation for their machines.

Northern Explorations

A glance at the map of Canada will show anyone the vast areas still to be opened up and developed. It is said that before any country can develop and be made attractive for settlers, facilities for transportation and communication must be provided. The aeroplane with its great speed and range of operation is an ideal means of transportation when one considers the geography of northern Canada. In summer the greater part of the area is covered with numerous lakes which make ideal landing grounds for seaplanes or flying boats. In the winter, the use of skis still further extends the field of operation of the aircraft. However, it has been amply demonstrated during the past that communication is of vital importance to the operation of air services, and it is for this reason that this subject has been introduced here. The interest taken by the public in the combined questions of radio, aircraft and exploration is shown by the space devoted to them in the daily papers. Attention need only be called to the extensive search for the McAlpine party, lost in the Dease straits area, and to the more recent Christmas air mail armada that made the round trip from Edmonton down the MacKenzie valley to Aklavik in the MacKenzie delta. Without communication these enterprises would be made very difficult if not impossible.

The question of developing communication in the north country is one which concerns the government very closely, in fact it might be said that the government is responsible for the provision of this very essential utility. It remains then to decide what form this communication should take in order to provide the greatest benefit, not alone for the many companies operating aircraft in that area, but for the inhabitants of the country as a whole. A great deal has been written about the wonders of short wave radio. In fact it is quite commonly considered as the panacea for all the ills of ordinary radio-telegraphy. Unfortunately this is very far from being the case, even with the more permanent stations used for point-to-point communication. Short wave radio apparatus is more intricate and requires greater precision of adjustment than the better known long wave equipment. Operators must be more carefully trained and have more experience on account of the greater tendency for signals to swing and fade, and, in addition, they must be thoroughly acquainted with the vagaries of reflection, skip-distance and night-effect in order to be able to choose the proper wavelength to use for each period of the day and season of the year. Even among radio engineers these matters are not yet reduced to standard practice, since different effects are found in different parts of the world. The application of short waves to aircraft communication is still very much in the experimental stage, and it would be very unwise to depend upon that alone in laying down a basic scheme of communications for aircrafts operating in the Northwest Territories.

Turning then to the more standard medium wave apparatus for aircraft, it may be definitely stated that a good dependable telegraph range of 250 to 300 miles can be obtained with apparatus which may be conveniently carried on the type of aircraft generally used for this exploration work. The use of telegraphy and the carrying of an operator are strongly recommended for this work for the following reasons:

(1) The ranges obtainable by telephony are too small for the weight that has to be carried.

(2) Telegraphy can be easily read through static and interference that would make speech unintelligible.

(3) Aircraft radio apparatus is delicate, since both weight and space must be kept to the absolute minimum, and must be given skilled attention if results are to be obtained.

(4) Because communication is so important to the safety of aircraft and personnel it is just as important that they should carry an operator as an engine mechanic.

Since the size of the crew to be carried is such an important item on exploration work, it is suggested that radio operators might be taken and trained as engine mechanics, since it is easier and quicker to train a man on engines than to make him first an operator and then give him all the technical skill required by a good radio man. Again, it might be pointed out that all men cannot be made into expert telegraph operators, but your radio operator has received, during his training, such an insight into technical matters that he is already well on the way to becoming a good mechanic. It should also be mentioned that modern pilots are usually first class aircraft mechanics and the mechanic in the plane is more an assistant to the pilot than an air engineer.

Map No. 3 shows the radio stations that exist at present in the north country. The approximate distances between stations have also been shown. The stations of the Marine Department are all of high power, those of the Department of National Defence of medium power, but the privately owned stations are of very low power and short range. If all the stations shown were even of medium power rating, and were equipped with modern valve receivers for aircraft reception, all the stations on the chain would be able to intercommunicate with one another, either direct or with not more than one relay. (The medium power stations of the Department of National Defence have a dependable range of 600 miles).

Turning now to the aircraft side of the problem it will be seen that, if the recommendations already made with regard to aircraft radio apparatus should be adopted, any machine flying in the area west of the Hudson's bay could be in touch with some base station at all times. In order to take in both shores of Hudson's Bay it would be necessary to erect two medium power stations, one at Moose Factory, and the other at some point on the eastern shore of the bay, such as Whale river. For satisfactory operation unified control is essential which points to the inclusion of the present privately owned stations in the network. To be of use for this purpose, the power of the stations in question would have to be increased. This system, if installed, would make flying in the north comparatively safe and could be put into operation now with apparatus already on the market. As and when short wave for aircraft becomes commercially feasible, this improvement could be added to the existing system.

No mention has yet been made of the much discussed question of emergency communication when the aeroplane has been forced to land. It is the opinion of the writer, after many years experience in aircraft radio work for the Department of National Defence, that this subject is very much over-emphasized. What is of more importance is that a careful system of communication should be worked out between aircraft and ground stations. Frequent reports should be made and at each call the position of the plane should be given. This can easily be done, without undue waste of time, if an operator is carried and telegraphy used, since repetition would seldom be necessary as is the case when voice is used. If a plane is forced to land under these conditions its position is known by the ground station within a comparatively few minutes flying time.

As an excellent example of the way this system works out in practice, the writer has taken the liberty of attaching as an appendix, an extract from the log of the Wakeham bay station of the Hudson's strait expedition. It will be remembered that this expedition spent 18 months in the Hudson's strait area exploring, by means of aircraft, the drift of the ice. All machines were radio equipped, and operated on the principle advocated by the writer.

When a machine has to make a forced landing it is very often damaged and the likelihood of the radio being put out of commission is at least as great as that of any other part of the machine. However, if an emergency power plant is needed, there are available on the market small gasoline engines under 30 pounds in weight and sufficiently powerful to supply all the energy required by the radio apparatus. In the latest type of engine, bed-plate and coupling are arranged so that the wind-driven generator can quickly be coupled to the power unit. If a trained operator is carried this re-arrangement offers no technical difficulties. It is pointed out however, that the range of a given aircraft transmitter on the ground is seldom greater than 40 per cent of its range when in the air. This is due to the high percentage of energy absorbed by the rocks, earth and vegetation.

For this system to be fully useful it would, of course, be necessary to insure that all aircraft flying into the north country would carry both an operator and the approved type of equipment. This would simply be placing the communication requirements for the operation of aircraft on the same basis as that in force for many years on ships.

Military Aviation

Flying for military purposes is not as extensively carried on in Canada as in other countries of the world. The main military flying base is located at Camp Borden, where most of the training work of the Royal Canadian Air Force is concentrated. In addition to the Camp Borden activities there is a limited amount of aircraft co-operation at the naval bases at Halifax and Esquimalt, and at certain militia summer camps throughout Canada.

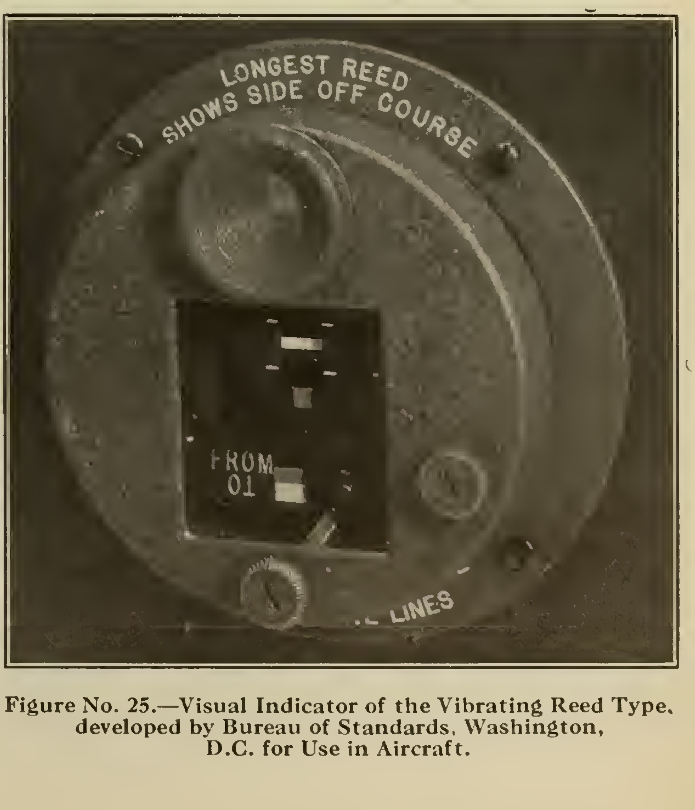


Figure No. 25.—Visual Indicator of the Vibrating Reed Type, developed by Bureau of Standards, Washington, D.C. for Use in Aircraft.

The radio communication work carried on for this service is naturally limited. Two ground stations are in operation, one at Ottawa and the other at Camp Borden. These are used to connect the Air Force headquarters with the training base. Considerable traffic is handled over this circuit.

Two types of aircraft sets are in use. For short range communication from air to ground, and for telephone communication between different machines in a flight, special sets have been developed by the Royal Air Force in England. These sets operate in the wavelength band from 50 to 120 meters and are intended solely for telephone transmission. For long range air to ground service, a special set known as the CT21 set has been developed in Canada. This set is a combined telegraph and telephone transmitter and may be operated by means of an electrical remote control so that the transmitter may be located anywhere in the aeroplane. As previously mentioned, this type of set is also used in the civil flying operations of the Department, for which work it was originally developed.

During the summer months aircraft are assigned for duty at the militia camps at Niagara, Ont.; Camp Hughes, Man.; Sarcee, Alta.; and Petawawa, Ont. These planes are equipped with radio apparatus and a portable ground station, with the necessary Signals Corps operators, is sent along to provide whatever communication may be required. Both artillery observation and army co-operation and reconnaissance schemes have been successfully carried out. The general policy of the Department, with regard to communication for our fighting aircraft, is to follow the lead given by the Air Ministry in Great Britain.

Conclusion

In conclusion the writer wishes to acknowledge valuable assistance given in the compilation of the data, photographs, diagrams and maps contained in this paper to the officers and men of the engineering staff of the Assistant Director of Signals Office, Ottawa; to the Canadian Marconi Company, Montreal; to Dr. Dellinger of the American Bureau of Standards, Washington, and to the Photographic Department of the Royal Canadian Air Force.

Appendix

The following extract from the aircraft radio log of the Wakeham bay station, Hudson's strait expedition, for the period January 8th to January 17th, 1928, constitutes an excellent example of the type of service rendered by the aeroplane radio equipment during 18 months the party were in the north.

On January 8th Squadron Leader Lawrence with his mechanic and native guide left in aircraft GCAHI for a flight from Wakeham bay to Nottingham island.

The information recorded here was sent by voice from the planes and was recorded by the operators at the base. The distance from Sugluk inlet to Wakeham bay was about 160 miles.

January 8th, 1928

1027 a.m. Machine off.

1125 a.m. "Lawrence speaking—now off Cape Weggs—Ice is level and light, only a few floes on which machine could be landed."

1142 a.m. "A few miles off Sugluk inlet—visibility is just fair."

1258 p.m. "Still on westerly course—visibility fair."

1310 p.m. "Weather is getting bad—coming back to Hall's place (Sugluk)—everything O.K."

1340 p.m. "Now over Sugluk—reeling in to land."

January 9th, 1928

1211 p.m. "Fokker HI going back to Wakeham bay—Weather bad to west."

1233 p.m. "Weather bad—landing at Little Sugluk" (40 miles east of Sugluk inlet).

1240 p.m. "Reeling in at Mr. Grassett's place—weather bad—come and have a look for us day after tomorrow if we are not back."

January 10th - 15th, 1928

Note: Weather unfit for flying.

January 16th, 1928

1055 a.m. Flying Officer Carr-Harris with mechanic and guide took off from Wakeham bay in aircraft GCAHE for Sugluk to look for Squadron Leader Lawrence.

1218 p.m. "Bucking a strong wind—we may not be able to get back tonight—listen in this afternoon however."

1237 p.m. "Can now see buildings at Little Sugluk."

1245 p.m. "Hello Nottingham and Wakeham bay—Can see HI now on ice in front of Post—she looks alright—they are making place for me to land—stand by all day."

January 17th, 1928

1203 p.m. "HI—Lawrence speaking—leaving Sugluk along with HE—weather not too good."

1206 p.m. "HE calling—left little Sugluk few minutes ago with HI—all O.K.—visibility fair."

1225 p.m. "HI—weather is thick—I really do not know where I am but Squadron Leader Lawrence is flying a compass course—HE is right behind us flying at 5,000 feet" (evidently the mechanic speaking).

1234 p.m. "Now opposite Outer island."

1240 p.m. "Thick fog ahead—we are between King George sound and Wales island."

1300 p.m. "HE—now nearing Fisher bay—it was very thick a while age—planes both together—please have good ground signals out."

1310 p.m. "Reeling in—coming in the bay."

It is easy to imagine the satisfaction felt at the base station when they knew exactly what was going on—why the machines did not return to their base at night and when to expect further word from the pilots. Is it any wonder that after a few experiences of this nature that pilots object strenuously to being sent out on patrol without their radio apparatus?

Aerial Surveying as Applied to Engineering Problems

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Paper presented before the Annual General Meeting of The Engineering Institute of Canada at Ottawa, Ont., February 13th, 1930.

Aerial surveying may be defined as being the practical application of aircraft and of the aerial photograph to the investigation and development of the country's natural resources.

Ever since man first inhabited the earth he has been trying to improve his powers of penetration into the unknown in order that he might increase his knowledge of the potential natural resources of his domain and turn that knowledge to his benefit. To the engineer especially the increase of this knowledge is most essential, and to this end he has bent every effort and has used every available instrument which offered promise of success. But due to the natural obstacles, such as trees, hills, and swamps, which retarded his progress and restricted his vision, his search for this increased knowledge was a long, tedious, uphill fight with a corresponding high cost. There was apparently no royal road to follow.

However, when the Wright Brothers, scarcely a generation ago finally succeeded in manipulating a plane a few hundred feet into the air a new field was opened to the engineer, to the geologist, the surveyor, and to all those interested in the development of the natural resources of the country. The search after increased knowledge was quickened and the frontiers were pushed back and practically eliminated; for at last man would follow the birds to the air and visualize the hitherto inaccessible country from aloft, and could increase his speed from fifty to one hundred times over that hitherto attained. By taking a camera with him he did not have to trust to memory for what he had seen—and notes written from memory are not the most satisfactory—for the ability of the camera to make instantaneous exposures and to fix a clear image on a sensitized plate or film, enabled him to obtain a record, not only of the scenes he had viewed, but also of many which he might have missed, a record that for detail and accuracy could not be approached by the most elaborate of notes or the most graphic description.

For the last seven or eight years an intensive programme of aerial mapping has been carried out in Canada, and it is probable that most engineers know in a general way something about this work. In this paper, therefore, it is not my intention to do more than touch on this phase of aerial surveying, important though it is, but rather to attempt to show the engineers of this country that in the aeroplane and the aerial photograph they have at hand a new method of surveying which can be adapted to many engineering purposes. The engineer is only interested in maps in a general way. A map must in the nature of things generalize, while the engineer must have, for his considered judgment, detailed and accurate information. In the past he has had to rely upon ground surveys and plans for this information, often at heavy expense and a great waste of time, and it is proposed to show that a very large part of the data heretofore obtained by reconnaissance and survey can be taken directly from the aerial photograph under expert stereoscopic examination. The aerial photograph will not eliminate ground surveys, but rather will control and direct them in obtaining the essential information regarding a project with the minimum expenditure of time and money.

In this paper no claims or statements will be made that are not based on experience. The methods and results referred to have been applied to and obtained from some of the largest projects carried out in Canada during the last three years. The science of aerial engineering is only in its infancy with but a short history, and the engineers of Canada must, like our surveyors, become air minded if

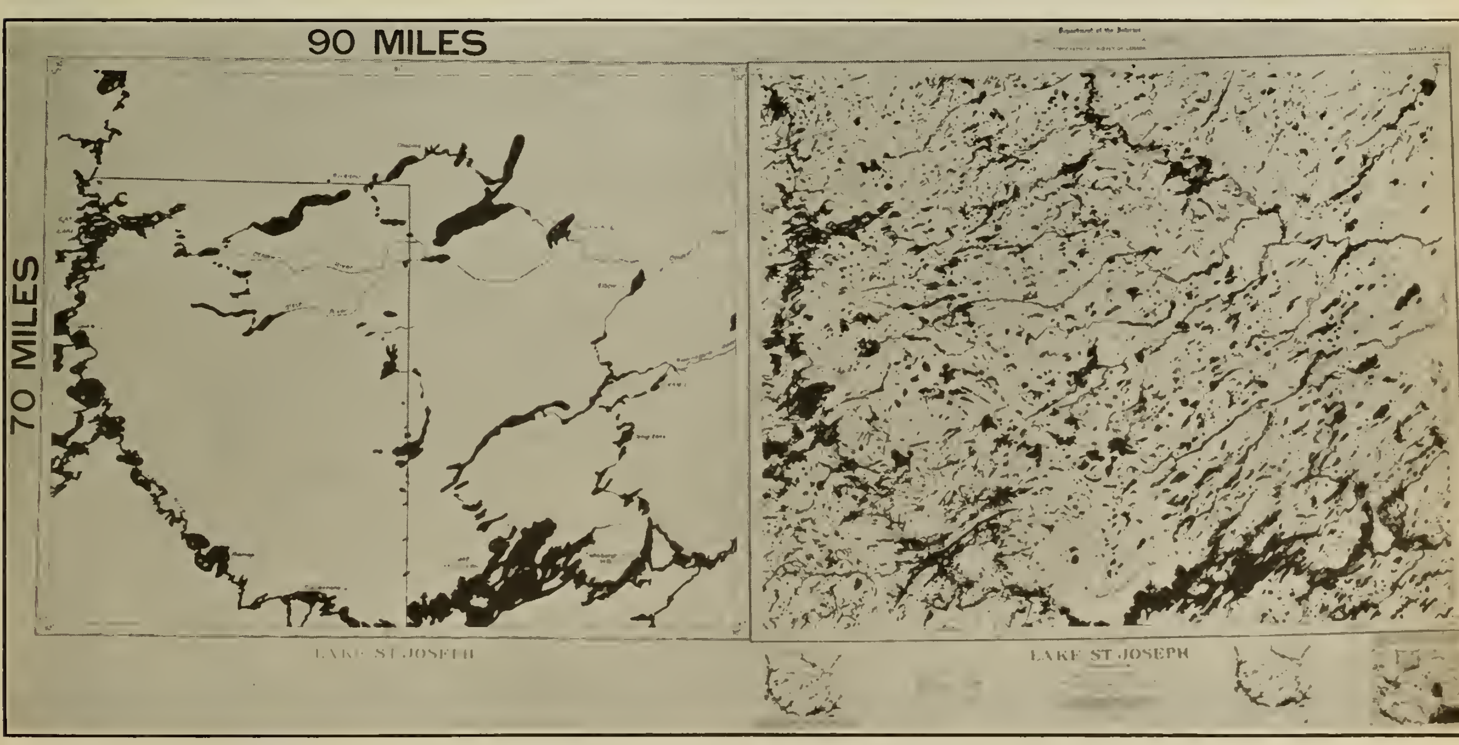


Figure No. 1.—Comparative Mapping.

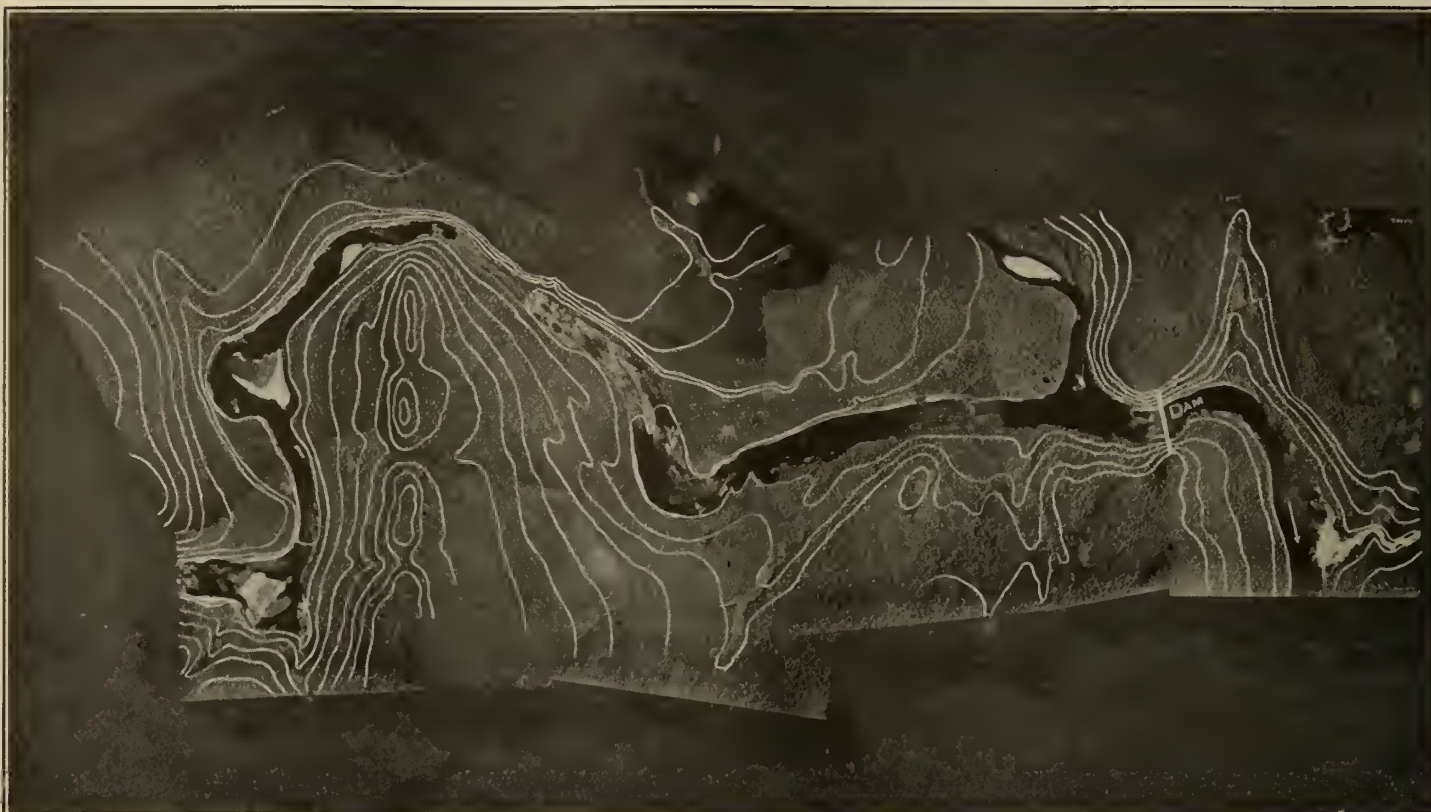


Figure No. 2.—Specimen of Mosaic of River showing Stereoscopic Form Lines.

they are to bear their proper part in the development of our country.

An examination of the progress made in developing aerial surveys during the past few years would appear to indicate that some engineers have been depending very largely on pilots and other air officials for their understanding of this new science. It is certainly a pilot's duty to see that a suitable plane is provided and that it is efficiently and economically operated, but it cannot be expected that the pilot will be a geologist, a water-power, forest, railroad, or other engineer, or all combined. This, for obvious reasons, he cannot be, nor can aerial surveys be condemned or criticized for any failure in this respect. Fortunately there appears to be a marked change taking place, and more attention is being given to the use and the study of the individual photographs, rather than depending on mosaics.

The interpretation of features shown on the individual photographs is one of the key factors of aerial surveys. In presenting an aerial photograph to an engineer he gets not a map, but an exact image of the country which awaits his interpretation.

To aid the engineer in this interpretation a stereoscope has been developed to enable him to examine the aerial photographs stereoscopically. With this instrument the relief shows up prominently and truthfully, and there are revealed to the engineer the hills and valleys, the flats and gentle slopes, the trees, rivers, and other topographical features of interest. The country is seen by him just as it is, thus enabling him to put down form lines on the photographs which can be later transferred to a plan. A closer study under the stereoscope indicates precisely where field measurements should be made in order that the form lines may be converted into true contours.

Thus we can readily visualize an engineer seated comfortably in his office examining a pair of photographs of some area of interest perhaps hundreds of miles away. He puts them under the stereoscope and instantly he is no longer in his office. He is in the air, poised over some water power development area, or the prospective route of a railroad or transmission line. There are the hills, valleys, trees and swamps. Nature has revealed her secrets to him and he gets a clear conception of the factors upon which the solution of his problem depends. Whether or not he can make use of the information he sees before him will depend to a large extent on his previous training on such work and on his ability to interpret. Now he wishes to move on. He removes his eye from the stereoscope and he is back in his office. He changes the photographs under the stereoscope and back he goes to an air position in the field only to discover that in effect he has moved, as though by magic, half a mile further on with no apparent break in the continuity. He discovers something else as well, for he realizes that even if he were in a plane over the spot he could not get as effective a view, for the stereoscope has really put him into two positions simultaneously—the right eye is in effect over the centre of the area of one photograph, and the left eye is over the centre of the adjacent area. In other words the same object is viewed from two different positions.

We see from this short description of the use of the stereoscope that immense possibilities are opened up before us. We can delete uninteresting country at a glance and can give as much time as we wish to the critical places. We can balance one alternative solution against another without actually going on the ground. In connection with the study of a large water power investigation in Canada there were at least five possible schemes, any one of which might have been adopted. The stereoscopic study of the photographs enabled all but one to be eliminated without any field work. The saving in field expenditure in this case can very readily be appreciated.

Practical Applications of Aerial Surveys Mapping

The first practical application of the aerial surveys in Canada was in connection with the mapping of mineralized areas in northern Canada.

Figure No. 3.—Specimen of Individual Photograph with Stereoscopic Form Lines.

Figure No. 4.—Aerial Stereoscope in Use.

Here we had areas of immense potential value, but very incomplete maps. Due to large numbers of lakes with intricate shore lines and a maze of islands, also to the character of the country between lakes, mapping by ordinary ground methods was practically precluded except at an exceedingly heavy expenditure. A few aerial photographs were taken over the area and all topographical features of importance stood out prominently. Methods of plotting these photographs were eventually developed and a new field was opened to the mapper. The work was rapidly extended to other fields, and it was evident that at last there was no frontier line beyond which the mapper could not go.

One of the immediate results of this wide extension of mapping was the development of a national topographic mapping system of Canada which ranks with the best in the world, and incidentally it is interesting to note that the methods for developing this mapping work were strictly

Figure No. 5.—Lower Manitou Falls, English River; Study of Falls and Timber Types.

Figure No. 6.—Chaudiere Falls, showing Flood Conditions on the Ottawa River.

Canadian. The success which has attended the development of this work in Canada is well known by engineers and need not be further discussed in this paper.

Water Power Engineering

The development of hydro-electric power in this country has been one of the most remarkable features of the last decade and promises to be of even greater importance in the future. In this field aerial engineering has had a very marked success in preliminary reconnaissance and investigation, in the preparation of final plans of storage reservoirs and pondages, in the selection and detailed study of dam sites and in draughting the general lay-out of construction. Once photographs are available along a river they are in use from the first inception of a project until the construction has finally been completed.

As an illustration let us assume that there is a proposal for developing the power resources of a river. A profile has been carried up the stream showing the head and there is adequate information with respect to the water available. Aerial photographs are then taken of the stream and its principal tributaries, or better still of the whole watershed. With these in hand the aerial engineer is prepared to produce a plan or map of the stream indicating the character of the adjacent terrain by contours or rather form lines. These form lines may not be strictly accurate as to absolute elevation, but they will adequately indicate the nature of the country for some distance back from the river. Possible dam sites will be clearly shown, together with notes on the nature of the soil and occurrence or otherwise of rock exposures. With these and the profile it is possible to study the river, in detail, to determine its possibilities for storage and pondage and to select tentatively the dam sites which appear most promising. If a consulting geologist is called to report on dam sites he will require the photographs to help him interpret the underlying formations. He may even want to fly over the district himself to help solve some of his problems. The dam sites having been selected, detailed large scale plans can be prepared of the sites themselves and the limits of flooded areas determined by a comparatively few field measurements at critical points which will serve as a control for the contour as determined in the stereoscope. If storage is being developed a contoured plan can be prepared from the photographs quickly and at a tithe of the cost of a ground survey and with greater accuracy. The transmission lines can be located as treated in detail elsewhere. Construction roads or railways can be located in their best positions, and a very excellent idea obtained of the amount of timber suitable for construction purposes which can be found adjacent to the sites. Extensive deposits of gravel, if any exist, can also be spotted from the photographs. All this can be done, at a price, by ground methods, but no ground survey will give the feeling of assurance when the final plans are being drawn that no possible contingency has been overlooked, and that the development as proposed is the best possible under the circumstances.

If a watershed is completely photographed there may be many possibilities of stream diversion either from one watershed to another or from tributary to tributary. In Canada, where streams have generally been modified or changed by glacial action, these are of frequent occurrence. When a stream is being intensively developed the conservation and use of the available water to the best advantage is of the utmost importance and it is believed that any money spent in the aerial photography and intensive investigations of a watershed as a whole would be amply repaid.

Transmission Line Location

Aerial photographs have been used on more than one occasion for the location of transmission lines, and perhaps in no field of engineering have aerial methods met with more success than in transmission line work. The conditions of a good transmission line location are comparatively simple, requiring as they do only a reasonably straight line which avoids as far as possible extremely rough country and in particular hills and gullies where footings for towers are unduly expensive, or locations in settled country where the right of way would be too costly or valuable improvements and buildings would be affected. Even so it has been found that several trial lines are usually required before a suitable location is found, and even then there may be still many angles requiring full anchor towers to carry the line. The use of aerial photographs enables the aerial engineer to project upon the photographs a line which will fulfill these requirements as completely as the local conditions will permit before putting a party in the field, and the field work narrows itself down to running and levelling only one line rather than several. Moreover he is assured that the line is being built on the best possible location, which if the line has been located by ground methods is never at all certain.

Another important consideration is the rapidity with which a final location can be determined by aerial methods. Once the line is located in the photographs it is possible to start construction with the assurance that no unforeseen difficulties will be encountered, and as many location parties as may be required can proceed with the ground location knowing that the work of each party will join the adjacent work without angles or gaps.

The technique of the aerial location is generally speaking similar to a ground location. The photographs lying between the terminal points of the line are first studied stereoscopically and the general route of the line determined. In general there will be certain definite places where the line, to avoid obstacles such as large lakes, or towns, must pass. The most favourable points for the crossing of rivers and railway lines are also determined, and between those more or less fixed points trial lines are projected. Each possible route is studied in detail and

Figure No. 7.—Timber Typing, each Square of Grid Represents Ten Acres.

compared with the other routes and the final location will be a compromise between the straightest and shortest line and the deflections which must be made to avoid obstacles.

The actual positions of the towers are not usually determined as they depend upon the profile of the ground and the sag curve laid out for the line in question. As a matter of fact, however, the aerial engineer must always keep in mind that his line is a succession of towers, and must scrutinize each hill top and valley bank, each angular point and river crossing, to make sure that a tower can economically be built there. In other words tower locations are only made at important points, leaving the intermediate towers to be located from the profile.

The location having been made the photographs are plotted in the usual way and a plan prepared giving the bearings and distances between angular points, which is given to the field engineer for the ground location. He is also supplied with a set of photographs with the line indicated thereon and he is expected to check his location by its relation to topographical features shown on the photographs. This will ensure that his ground line is actually following the photographic location. Form lines giving the general shape of the country are also shown on the plans and if necessary the best routes for the location of roads are indicated.

The advantages of the aerial method, besides the saving in time, lie chiefly in the fact that the location has been made after the fullest consideration of all the physical features of the terrain, which makes it possible to lay out a line with few angles and a corresponding saving in construction and maintenance. In settled country it is of course a very decided advantage to be in a position to make arrangements for purchasing right of way before the inhabitants of a district have been warned by the activities of survey parties that some such work is contemplated.

The practice of locating a line on a mosaic prepared from aerial photographs which has, no doubt, been tried, may offer some advantages over a ground location, but is in no way comparable with the results that can be obtained by a careful stereoscopic examination of the individual photographs. The main item of cost in any aerial work is the cost of the photographs themselves, and it is false economy to use only a part of the information, which may under expert interpretation be obtained from them.

Forestry

The second application in the development of aerial surveys in Canada was in connection with the protection and development of the forest wealth. It was stated recently in an editorial by one of our local papers that "Forest fires destroy more real Canadian wealth than a score of stock market crashes." Of course various agencies including aerial fire patrols are brought into service to protect the forests, but a vital part is played by aerial surveys in this protection. In the first place the maps produced from the aerial photographs show the natural topographical features and hence a base map is furnished upon which timbered areas may be indicated, but aerial surveys go

Figure No. 8.—Paugan Falls Power Developments, Gatineau River.

Figure No. 9.—The Canadian "Soo".

much farther, for the photograph, because of its completeness of detail and the intimate study it permits, enables the forest engineer to visualize his resources and the various factors upon which the protection of these resources depend.

Canada's forest resources are extensive, and every effort is being made to investigate them and to study carefully the best means of penetration and development. The aerial photograph showing these forests is invaluable to the forester and through its medium he is able to obtain an increased knowledge of available raw material with a dispatch, a certainty, and a finality not otherwise obtainable. It is evidence of this kind, showing in detail the location and general character of the timber, its extent and accessibility, that enables the forester to restrict the ground activities to areas of productive value, and to develop projects which have in view the establishment of pulp and paper plants and other phases of forest industry.

From the aerial photograph what is known as a "type map" is prepared. The useful or merchantable timber is indicated by one colour; another colour designates the young stands; another, the burns, and other colours delineate the swamps and water areas, and embody other information of importance. Such a type map enables the forester to concentrate his fire-protection operations upon areas of concentrated timber values. It shows the swamps, rivers, lakes, and other means of checking fires; in fact, it is only upon the basis of complete information of this character that a fire-protection system can be made effective. The type map may also afford the forester useful information relating to means and methods of utilization.

One of the most important applications of the aerial photograph is in connection with the location of logging roads. This is done by placing the vertical aerial photographs under the stereoscope and examining the relief of the country in relationship to the stands of timber, due attention being paid to swamps and other topographical features of interest. An expert interpreter is able to place the roads in the most efficient location to give the best grades, and at the same time to serve the largest number of trees. There is always present the assurance that the best location has been made as alternative locations can be compared at any time..

Railway and Road Location

In railway locations the aerial engineer does not profess to be able to take the place of a locating party, but he is able to select the most feasible route or routes from the photographs. Generally an experienced man can tell pretty closely if changes in elevation are such as to make a railway out of the question. His examination of the photographs will save cutting useless trial lines and ensure that the best possible location has been found. In rough and difficult country a preliminary reconnaissance by plane, followed by aerial photographs of the most practical looking route, is generally the best method of finding a satisfactory location.

Road location is much the same problem as railway work, but the wider range of permissible grades make it generally possible to find a suitable location on the photograph without any preliminary survey and to confine the field work entirely to the final location line.

Geodetic Surveying

One of the most interesting developments of the past year has been the application of aerial surveys to geodetic work. In the first instance an experiment was made in using the aeroplane for a general reconnaissance to select a route for triangulation and later to locate the points most suitable for triangulation stations. This proved so successful the planes were used throughout the remainder of the season for the transportation of tower building and observing parties. In fact the major portion of the transport work of one survey party was done by air with a marked saving both in time and expenditure. This saving was all the more impressive since the whole of the flying was carried out by an aerial photographic detachment in weather which was unsuitable for photography and which otherwise would have been lost time.

Other Applications of Aerial Engineering

Further applications of the aerial photograph could be discussed in detail and one might readily refer to its application to the mining and prospecting fields. As rock exposures are visible in the photograph even in a bush country the geologist's footsteps are guided at least to this extent. The structure is frequently shown up very prominently in a way quite impossible to meet with in any other way. It is sufficient to say that some of the largest mining and prospecting companies maintained large fleets of aircraft last year in various parts of Canada, even to the Arctic, for this express purpose.

One could refer to the application of the aerial photograph to soil surveys, for again the bird's eye viewpoint discloses boundaries of soil types much as it does with timber types; or one could describe under-water investigations, as the camera does penetrate the water to considerable distances below the surface.

The application is, in each case, similar to that of water power engineering in that success depends upon the training of the expert and his ability to interpret what he sees. Cases of doubt are settled by a check on the ground. As stated at the commencement aerial surveys are dependent upon interpretation of photographs with checking on the ground at doubtful or critical points.

For illustrative purposes, the aerial photograph would seem to have an exceptionally large part to play in the engineering field. Probably in no other way can the characteristics of an area or a project be more intelligently shown.

In conclusion it may be said that aerial surveys are but on the threshold of development and that engineers generally will find that this new science, which is more rapidly gaining impetus in its growth, will assist them materially in solving some of their serious engineering problems. Commercial air companies are becoming equipped with up to date aeroplanes and efficient personnel. As their business expands the efficiency will increase and the costs will be materially lowered. Canada can look with pride upon her accomplishment and her leadership in this new field, and can look forward with confidence to its future development.

Figure No. 10.—Northern Saskatchewan—Illustrating the Study of Geology by Aerial Surveys.

Report of Council for the Year 1929

On the occasion of the Forty-fourth Annual General Meeting of The Institute it may be observed that the activity in Canadian engineering work noted in previous reports has continued during the past year. Conditions as regards employment have accordingly been favourable, and many important Canadian projects, contemplated or in progress, have been available for consideration at the meetings of the Institute and its Branches. The wide range of subjects treated at these meetings is noteworthy, and in many cases the gatherings have afforded an opportunity of bringing the engineer's achievements to the attention of the general public, a most valuable feature of The Institute's work. This diversity of topics is indicative of the variety of occupation of our members, and in this connection, it is interesting to note that during the last four years The Engineering Journal has published in full one hundred and fifty-three papers, classified as to subject matter as follows:

Civil engineering and construction, with surveying	38
Mechanical engineering, including heat power and aviation	33
Electrical engineering	32
Mining, metallurgical and chemical work	21
Various, including economics, education, etc	29

The attached reports of the various Committees of The Institute are presented for discussion, and Council desires to point out that two of these deal with matters of such importance to the future of The Institute as to call for special mention.

The report of the Committee on the Relation of The Institute with the Provincial Associations of Professional Engineers, which is now submitted to the membership, was presented and adopted at the Plenary Meeting of Council in October last, and contemplates a definite policy of co-operation with the associations, primarily with a view of obtaining uniformity in the requirements for admission as between The Institute and the organizations in question. Such uniformity would remove the present anomalous conditions under which an engineer who is a member in good standing of one of these bodies is not necessarily eligible for admission to The Institute, and vice versa. In the opinion of Council, every effort should be made on behalf of The Institute to obtain agreement upon a uniform standard of qualification acceptable to all the professional bodies.

The Committee on Policy, which was appointed following a resolution of the Annual Meeting at Hamilton in February 1929, has presented a report which, while not a final one, makes a number of important recommendations. The most urgent of these, dealing with the need of additional funds, supports the proposals of the Finance Committee and the Council, all of whom are impressed with the present limitation of the activities of The Institute caused by lack of funds. Council has accordingly taken action in this matter by repeating its proposed amendment to Section 34 of the By-laws, which by increasing the annual contributions of Members, Associate Members and Juniors, would provide a substantial addition to The Institute's revenue, and would form the first step towards placing The Institute on the same footing as regards resources as some of its sister societies.

In addition to the amendment to Section 34, Council is proposing three others, including a suggested change in Section 75, dealing with the procedure in amending By-laws, and designed to avoid the possibility of sending out to ballot so many conflicting proposals to amend By-laws as to render it unlikely that anyone of them can obtain the necessary two-thirds majority.

Last year there was initiated a considerable extension of our Employment Service, which, aided by the E-I-C News, has proved very successful. The results obtained indicate that still further development could be carried out with great advantage to our membership, but this is at present impossible for financial reasons.

During the past year Council has received with regret intimation of the deaths of several eminent members of The Institute, among whom may be mentioned Willis Chipman, Peter Gillespie, James Freeman Lumsden, Arthur Wells Robinson and Emil Andrew Wallberg. Their loss is greatly deplored.

From time to time Council has been called upon for expressions of opinion on behalf of The Institute in connection with inquiries of public or professional interest. Among these may be noted the investigations of the Royal Commissions on radio broadcasting and on the salaries of technical employees in the Civil Service, and discussions on the customs regulations regarding engineering and technical books, and with regard to proposed standard forms of construction contracts. In the case of the first two, the importance of the questions involved led Council to appoint special committees; their reports, each of which involved a good deal of work, were duly submitted to the proper authorities.

The Institute was represented at the World Enginering Congress held in Japan in November by four of its members, headed by Past-President J. M. R. Fairbairn, M.E.I.C., and will be represented at the Fiftieth Anniversary Celebrations of the American Society of Mechanical Engineers in April 1930 by President C. H. Mitchell, C.B., C.M.G., C.E., D.ENG., M.E.I.C., and President-elect A. J. Grant, M.E.I.C.

Two Institute meetings were held during the year, namely the Annual General and General Professional Meeting in Hamilton on February 13th, 14th and 15th, and the Maritime Professional Meeting held in Moncton on July 30th and 31st. These were both well attended and successful gatherings.

Branch activities have been well maintained, and it is gratifying to note that the President has been able to visit personally nearly all the Branch centres from Halifax to Victoria. Visits of this kind do much to aid in developing that Dominion-wide outlook which characterizes the work of the Institute.

During the year Council has again taken action to reduce the amount of unpaid arrears of annual fees, and has also noted the considerable number of Students and Juniors who are over the age limit for their respective classes. It is expected that the measures adopted in this connection will result in marked improvement in these respects.

The Third Plenary Meeting of Council was held on October 7th, 8th and 9th, thirty-six members being in attendance, and it was gratifying to note the presence of no less than six Past-Presidents of The Institute. The counsel and experience of these senior members were of great value in dealing with the important questions of general policy which were under consideration. A report of the proceedings was published in The Engineering Journal for November, pages 594 to 598, and in the opinion of Council its perusal will aid members materially in discussing and voting on the questions now before The Institute for decision.

It is believed that the principal needs of The Institute to-day are additional funds and more general participation by our members in the activities of The Institute and its Branches. This applies particularly to the contribution of papers on engineering subjects with which a member's work and experience renders him familiar. It is only by the co-operation of our members at large that it is possible to fulfil one of the principal objects of The Institute, namely, the acquirement and interchange of professional knowledge

Meetings

Annual General Meeting

The Forty-third Annual General and General Professional Meeting was held at Headquarters in accordance with the By-laws on Thursday, January 24th, 1929, at 8.00 p.m., President Julian C. Smith, M.E.I.C., in the chair. After the approval of the minutes of the Forty-second meeting and the appointment of the scrutineers and auditors, the meeting was adjourned, to reconvene on Wednesday, February 13th at 10 a.m. at the Royal Connaught hotel, Hamilton, Ontario.

At the adjourned meeting, President Julian C. Smith, M.E.I.C., took the chair on the morning of February 13th, and the report of Council for 1928, the reports of the various committees, and the Branch reports were approved and adopted.

The Nominating Committee for 1929 was appointed.

The presentation of the medals and prizes of The Institute then took place, and this ceremony was followed by discussion on the various amendments proposed to the By-laws which continued during the afternoon session. The principal result of this discussion was the appointment of a Committee on Policy to review the activities of The Institute in collaboration with the Branches.

President Smith then delivered his valedictory address, after which the scrutineers' report was submitted, and the officers for 1929 were declared elected.

The newly-elected President, Brigadier-General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., was then conducted to the chair, and the business proceedings terminated with votes of thanks to the retiring President, the scrutineers and the Hamilton Branch.

General Professional Meeting

Three technical sessions were held on the 14th and 15th, at which fourteen professional papers were presented and discussed. Advantage was taken of the facilities afforded by the industrial development in and near Hamilton to arrange a series of interesting visits to engineering works, a very complete programme of social events was carried out, and the closing event was the annual dinner of The Institute, at which the members were addressed by Sir Robert Falconer and Sir William Hearst.

Maritime Professional Meeting

A very successful Professional Meeting was held at Moncton, on July 30th and 31st, and the members of the Moncton Branch, as hosts, arranged an admirable programme of professional and social events. Four technical papers were presented and discussed, and at the dinner which concluded the meeting, addresses were delivered by the Hon. Dr. P. J. Veniot, Postmaster-General of Canada, and Brig. Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., President of The Institute.

Roll of The Institute

During the year 1929, one hundred and seventy-six candidates were elected to various grades of The Institute. These are classified as follows: thirteen Members, thirty-six Associate Members, Twenty-four Juniors, ninety-eight Students, and five Affiliates. The elections during the year 1928 totalled three hundred and thirty-nine.

Transfers from one grade to another were as follows: Associate Members to Member, eleven; Junior to Associate Member, twenty-seven; Student to Associate Member, seven; Student to Junior, forty-two, a total of eighty-seven.

A summary of these elections is given below. The names of those elected or transferred are published each month immediately following the election, and are then added to the membership list.

Elections

	Members	Associate Members	Juniors	Students	Affiliates
January	0	6	4	20	2
February	0	0	2	0	0
March	0	0	0	17	0
April	4	4	4	2	0
May	2	2	2	10	1
June	1	4	3	6	1
July	1	4	3	0	0
August	0	0	0	0	0
September	0	2	0	0	0
October	1	0	0	7	0
November	3	13	4	16	1
December	1	1	2	20	0
	13	36	24	98	5
Total: 176					

Transfers

	A.M. to M.	Jr. to A.M.	S. to A.M.	S. to Jr.
January	0	5	2	3
February	3	5	2	6
March	0	0	0	0
April	0	2	1	6
May	3	2	0	1
June	2	3	0	8
July	1	1	1	5
August	0	0	0	0
September	1	0	0	1
October	0	2	1	0
November	1	6	0	9
December	0	1	0	3
Total: 87	11	27	7	42

Removals from the Roll

There have been removed from the membership roll, during the year nineteen hundred and twenty-nine, by resignation and for non-payment of dues, twenty-six Members, one hundred and forty-four Associate Members, twenty-two Juniors, fifty Students, and four Affiliates, a total of two hundred and forty-six.

Thirty-four reinstatements were effected, and six Life Memberships were granted.

Deceased Members

During the year 1929 the death of thirty of The Institute's members have been reported as follows:

Members

Bell, James Anthony
Chipman, Willis
Dawes, Albert
Gent, Rufus Taylor
Gillespie, Peter
Hegan, James Black
Herd, Walter
Hyslop, James
Lumsden, James Freeman
Macdonald, Charles
McDougall, John Jeremiah
Robinson, Arthur Wells
Walkem, Hugh Blake
Wallberg, Emil Andrew
Wragge, Edmund

Associate Members

Boisseau, Louis Jos. Gustave
de Coriolis, Gustave (Baron)
Gage, Charles Edwin
Heroux, Jos. Philippe
Jackson, Alan Mair
Johnson, Lancelot Llewellyn
Massey, Arthur William Kay
Meader, Joseph Cave
Munn, David Walter
Pope, Charles Arthur
Robb, Roland Wentworth Tupper
Ure, Frederick John

Junior

Smith, Robert Macfie

Student

Lewis, Frank Adrian

Affiliate

Quigley, Harry Stephen

Total Membership

The membership of The Institute at present totals four thousand six hundred and eighty-three. The corresponding number for nineteen hundred and twenty-eight was four thousand, eight hundred and twelve.

1929		1928	
Honorary Members	10	Honorary Members	10
Members	1,124	Members	1,143
Associate Members	2,248	Associate Members	2,321
Juniors	468	Juniors	450
Students	780	Students	835
Affiliates	53	Affiliates	53
	4,683		4,812

Respectfully submitted on behalf of the Council.

C. H. Mitchell, M.E.I.C., *President.*
R. J. Durley, M.E.I.C., *Secretary.*

Finance Committee

The President and Council:

Your Committee in submitting the financial statement for the year 1929, would point out that during the past three years progressive development has been taking place in the activities of The Institute and its committees, with a corresponding increase in the cost of operation, but there has been no similar increase in the income available to defray working expenses and maintain the work of the Branches.

In framing the budget for 1929, your Committee drew attention to this matter, but Council was naturally unwilling to curtail the services rendered to our members, and during the year it was further found necessary to incur certain expenditure not provided for in the budget; for example the expenses connected with the work of The Institute's Committee on the Relations of The Institute to the Professional Associations, and in preparing a report for submission to the Royal Commission on the salaries of technical employees in the Civil Service.

While the income of The Institute during 1929 somewhat exceeded anticipation, it will be seen from the attached financial statement that taking the year's operations as a whole, a deficit has resulted. Expenditure on items covered by the budget has been in accordance with the appropriations, and the deficit is due to such necessary items as are mentioned above.

Your Committee earnestly hopes that Council's proposal to increase the annual fees of Corporate Members and Juniors will receive the approval of the membership. It should be noted that our present income and expenditure per member is much lower than in any similar organization known to your Committee. If the proposal for increased fees is not approved, it will be necessary to restrict the present activities of The Institute.

In accordance with Council's instructions the accounts of members in arrears have been closely followed up, and the amount collected during 1929 is larger than was anticipated; thus the amount of revenue available under this head during 1930 will probably be somewhat reduced.

Respectfully submitted,

G. R. MacLeod, M.E.I.C., *Chairman.*

STATEMENT OF ASSETS AND LIABILITIES AS AT 31st DECEMBER, 1929

Assets

Property		$ 89,041.64
Furniture:		
Balance as at 1st January, 1929	$ 6,180.24	
Less: 10% depreciation	618.02	
		5,562.22
Library:		
Balance as at 1st January, 1929	2,724.87	
Less: 10% depreciation	272.48	
		2,452.39
Stationery—On hand		724.02
Gold Medal		45.00
Investments:		
Canada Permanent Mortgage Corporation, two shares of par value $100.00	215.00	
Montreal Light, Heat & Power Consolidated, eighteen shares of no par value	120.00	
$6,000 Montreal Tramways bonds, $5,000 5%, 1955; $1,000 5%, 1941	5,639.30	
$500 Title Trust & Guarantee Corporation certificate	500.00	
$4,000 Dominion of Canada Victory Loan bonds, 5½%, 1934	4,090.71	
		10,565.51
Accounts Receivable:		
Sundry and *Journal* advertising	4,963.93	
Advances to Branches	525.00	
	5,488.93	
Less Reserve for bad debts	488.60	
		5,000.33
Arrears of Fees, estimated		2,500.00
Cash:		
Canadian Bank of Commerce—		
Current account	761.72	
Savings account	246.18	
Petty cash	100.00	
		1,107.90
Unexpired Insurance and Prepaid Journal Expenses		
Special Funds:		
Investments	10,369.34	
Cash in Savings bank	1,786.78	
		12,156.12
Post Master—Deposit		100.00
		$129,732.10

Liabilities

Accounts Payable:		
Sundry	$ 4,011.51	
Accounts receivable—credit balances	321.47	
Reserve for Year Book	821.00	
Amounts due to Branches	490.75	
		$ 5,644.73
Loan Account:		
Canadian Bank of Commerce		2,500.00
Special Funds:		
As per schedule attached		12,156.12
Life Membership Fees:		
For investment		600.00
Surplus:		
Balance as at 1st January, 1929	111,842.58	
Add: Amount over-reserved for repairs, 1928	96.28	
		111,938.86
Deduct: Deficit for year ended 31st December, 1929	3,107.61	
		108,831.25
		$129,732.10

Montreal, 13th January, 1930.
Verified:
(Signed) Riddell, Stead, Graham & Hutchinson, C.A.
Auditors.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR ENDED DECEMBER 31st, 1929

Revenue

Membership Fees:		
Arrears	$ 5,815.23	
Current	28,078.97	
Advance	539.72	
Entrance	2,737.00	
		$ 37,170.92
Interest:		
On overdue fees	475.07	
" Victory Loan bonds	232.12	
" Montreal Tramways bonds	300.00	
" Savings bank account	16.35	
" Title Guarantee & Trust Corp. certificate	30.00	
		1,053.54
Dividends:		
Canada Permanent Mortgage Stock	24.00	
Montreal Light, Heat & Power Cons.	43.20	
		67.20
Publications:		
Journal subscriptions	8,169.15	
" advertising	29,129.17	
E.I.C News	4,955.10	
Journal sales, April 1929	363.50	
		42,616.92
Refund of Expenses of Hall		640.00
Certificates		156.64
Badges		46.40
Deficit:—Excess of expenditure over revenue for the year ended 31st December, 1929		3,107.61
		$ 84,859.23

Expenditure

Building Expense:		
Taxes, property and water	$ 1,733.33	
Fuel	474.50	
Insurance	191.50	
Light and gas	345.02	
Caretaker's wages and service	1,220.40	
Repairs and expense	481.76	
		$ 4,446.51
Office Expense:		
Salaries—Secretary and office staff	17,255.98	
Office supplies and stationery	1,430.83	
Postage and telegrams	1,293.97	
Audit	300.00	
Legal expense	55.80	
Telephone	345.30	
Messenger and express	112.37	
Miscellaneous	215.49	
		21,009.74
Publications:		
Journal	31,970.67	
E.I.C News	6,255.89	
Sundry printing	1,273.66	
		39,500.22
General Expense:		
Annual and Professional meetings	3,993.63	
Plenary Meeting of Council	2,366.25	
Committee on remuneration	978.71	
" of co-ordination	370.84	
" on policy	1.59	
Travelling expense—Secretary	1,908.36	
Branch stationery	126.66	
Students' prizes	87.04	
Library expense and magazines	1,493.01	
Depreciation furniture, 10%	618.02	
Depreciation books, 10%	272.48	
Bank exchange and discounts	243.16	
Examinations	22.50	
Papers Committees	46.35	
		12,528.60
Rebates to Branches		7,374.16
		$ 84,859.23

Special Funds

Leonard Medal

Balance as at 1st January, 1929	$ 562.16	
Add bond interest	30.00	
bank interest	1.77	
	593.93	
Less cost of medal	25.00	
		$ 568.93
Represented by:		
Title Guarantee & Trust Corp. certificate due 1933	500.00	
Balance in bank	68.93	
	$ 568.93	

Plummer Medal

Balance as at 1st January, 1929	$ 517.62	
Add bond interest	27.50	
bank interest	.46	
	$ 545.58	
Less cost of medal	25.00	
		$ 520.58
Represented by:		
Victory Loan, 1934, 5½%	500.00	
Balance in bank	20.58	
	$ 520.58	

Fund in Aid of Members' Families

Balance as at 1st January, 1929	$1,809.84	
Add bond interest	77.00	
bank interest	13.56	
cash received	50.00	
		$ 1,950.40
Represented by:		
Victory Loan, 1934, 5½%	1,400.00	
Balance in bank	550.40	
	$1,950.40	
Forward		$ 3,039.91

Special Funds

Brought Forward		$ 3,039.91

Past-Presidents' and Prize Fund

Balance as at 1st January, 1929	$4,489.84	
Subscriptions	99.85	
	$4,589.69	
Add bond interest	215.00	
bank interest	13.88	
	$4,818.57	
Less cost of medal	400.00	
		4,418.57
Represented by:		
$2,500 Dominion of Canada, C.N.R. 5%, 1954 bonds	2,489.55	
$1,500 Title Guarantee & Trust Corp. 1933	1,500.00	
Balance in bank	429.02	
	$4,418.57	

War Memorial Fund

Balance as at 1st January, 1929	$4,470.86	
Add bond interest	210.00	
bank interest	16.78	
		4,697.64
Represented by:		
$2,000 C.P.R. Collateral Trust, 5%, 1934 bonds	1,979.79	
$2,000 Dominion of Canada, 5½%, 1934 bonds	2,000.00	
Balance in bank	717.85	
	$4,697.64	
		$12,156.12

Nominating Committee—1930

The following nominations to the Nominating Committee for the year 1930 have been made by the various Branches and have been noted by Council, and are herewith presented to be announced at the Annual Meeting in accordance with the By-laws:

Chairman: A. Duperron, M.E.I.C.

Branch	*Representative*
Halifax Branch	W. A. Winfield, M.E.I.C.
Cape Breton Branch	J. R. Morrison, A.M.E.I.C.
Saint John Branch	J. L. Feeney, A.M.E.I.C.
Moncton Branch	T. L. S. Landers, M.E.I.C.
Saguenay Branch	N. D. Paine, A.M.E.I.C.
Quebec Branch	Philippe Méthé, A.M.E.I.C.
St. Maurice Valley Branch	A. A. Wickenden, A.M.E.I.C.
Montreal Branch	H. G. Thompson, A.M.E.I.C.
Ottawa Branch	D. W. McLachlan, M.E.I.C.
Peterborough Branch	W. M. Cruthers, A.M.E.I.C.
Kingston Branch	D. S. Ellis, A.M.E.I.C.
Toronto Branch	G. A. McCarthy, M.E.I.C.
Hamilton Branch	H. S. Philips, M.E.I.C.
London Branch	F. C. Ball, A.M.E.I.C.
Niagara Peninsula Branch	C. G. Moon, A.M.E.I.C.
Border Cities Branch	F. H. Kester, M.E.I.C.
Sault Ste. Marie Branch	J. L. Lang, M.E.I.C.
Lakehead Branch	F. C. Graham, A.M.E.I.C.
Winnipeg Branch	J. W. Sanger, A.M.E.I.C.
Saskatchewan Branch	H. R. MacKenzie, A.M.E.I.C.
Lethbridge Branch	N. H. Bradley, A.M.E.I.C.
Edmonton Branch	R. S. L. Wilson, M.E.I.C.
Calgary Branch	F. M. Steel, M.E.I.C.
Vancouver Branch	W. B. Greig, A.M.E.I.C.
Victoria Branch	F. L. Macpherson, M.E.I.C.

Publication Committee

The President and Council:

Your Publication Committee was left with very few duties by the absence of Transactions, but two papers which were referred to us by Headquarters were reviewed and recommendations made as to treatment. This was the sum total of our activities, other work on the general questions of publications having been allocated to other committees.

Respectfully submitted,
P. L. Pratley, M.E.I.C., *Chairman.*

Legislation Committee

The President and Council:

As a result of the ballot of the membership taken in May 1929, two of the amendments to the By-laws then proposed by Council failed to carry. One of these, when it was discussed at the Annual General Meeting, elicited a number of alternative suggestions, two of which, in accordance with the requirements of Section 75 of the By-laws, went out to ballot together with the original proposal. None of the three proposals secured the necessary two-third majority to become effective, and your Committee, recognizing that such a division of votes is liable to occur in connection with some much more important question, felt bound to recommend a further modification of Section 75, intended to avoid the occurrence of such a difficulty in future.

The amendment to Section 34 which Council proposed in 1929 regarding an increase in the annual fees of members also failed to carry, the vote being almost evenly divided. Your Committee felt that this proposal was of such importance to the future welfare of The Institute that it should be renewed this year, and has made a recommendation accordingly.

Your Committee has also considered, in accordance with Council's instructions, and has recommended, amendments to Section 13, dealing with a change in the term of office for Councillors, and Section 37, dealing with arrears of annual fees. All of these amendments have the approval of Council for submission to the Annual General Meeting, and were printed for the information of members on page 650 of the Journal for December 1929, accompanied by brief explanatory notes regarding them.

No questions of importance regarding legislation were referred to your Committee during the past year.

Respectfully submitted,
O. O. Lefebvre, M.E.I.C., *Chairman.*

Board of Examiners and Education

The President and Council:

The results of the examinations held during 1929 for admission to The Institute are as follows:—

	Examined	Passed	Failed
For admission as Junior (Schedule B)	2	1	1
For admission as Associate Member (Schedule C):			
Electrical Engineering	3	1	2
Structural Engineering	4	1	3
Civil Engineering	4	None	4
	13	3	10

The revised syllabus of examinations and specimen examination papers has been issued, and copies have been forwarded to the councils of the various provincial Associations of Professional Engineers for their information and comment.

Your Board would draw attention to the large proportion of candidates who have failed to pass The Institute's examinations. The examiners' reports indicate that in most cases this is due to lack of training in fundamental subjects, such as mathematics, physics and strength of materials, a lack which, with most men, can only be supplied by study under competent direction. It is felt that our present standards are a minimum and should not be changed. Past Boards have established the standards, issued typical examination papers, lists of text-books and done all in their power to make the path of the candidate plain and straight. Even with these helps the showing is not better but if possible worse.

Your Board deplores this condition and feels that something is wrong. We feel that in some cases the trouble is with the preparation of the candidate. We feel that Council, through its Branches, has a responsibility and duty to help these candidates.

We consider that it might be possible for prospective candidates to consult the nearest Branch secretary and discuss with him his academic qualifications or lack thereof, and through the secretary be put in touch with those members of the Branch who could and would be willing to give assistance in that part of the schedule which could not be given at either night or technical schools.

We feel that such work, done to help those young engineers who have not had the advantage of a university training, would be a real contribution to the profession.

Respectfully submitted,
C. M. McKergow, M.E.I.C., *Chairman.*

Committee on Engineering Education

The President and Council:

Engineering education as a subject for discussion seems to be somewhat in the same category as the weather, as commented on by Mark Twain when he said "Everybody talks about it but nobody ever does anything." Writers and speakers have worn the subject threadbare, mostly in discussing generalities or in attempting to prove how one curriculum offers advantages over some other curriculum.

Your Committee inspired the idea and sponsored the allocation of the Past-Presidents' Prize for the current year, in the hope that the response would give a cross-section viewpoint of the members of The Institute throughout the Dominion. The results was disappointing in that only seven papers were submitted, all of which were of a more or less general nature.

Your Committee has studied the problem of engineering education in its relation to the engineering profession and the bearing that the present method of teaching has upon the status of engineering as a profession, and has come to this definite conclusion—that the reason the engineer does not occupy the position as a professional man that is accorded to other professions lies largely in our present curricula and the fact that a cultural background is not provided. It is not to be insinuated for a moment that the system in vogue in Canada does not produce engineers of the very highest calibre, nor that the men at the heads and on the staffs of our engineering schools and colleges do not compare favourably with engineering professors in any other part of the world, but the fault lies mainly in the fact that every year a large number of men are turned out as graduates in some branch or other of engineering, believing themselves to be graduate engineers, when they are in reality science graduates. The present course, with slight modifications, may be considered as almost ideal for giving a man splendid training to fit him to take a high position in the industrial, commercial, or engineering world. A man following an engineering career, however, should be given an additional two years in his engineering course, or alternatively a much higher standard of admission to study. The two years being added would be partly in the university and partly in engineering practice. It is now many years since the leaders of the medical profession decreed that the medical course should be extended, and the tendency since then has been to increase the length of time necessary rather than to diminish it. In law we have the same situation.

One great weakness of the engineering training is that the engineer is not taught to properly articulate, either in writing or orally, and this should be considered as essential to the engineer as it is to the lawyer or to the minister. Greater attention might be given to the study of economics in the four years of the science course.

The question of student activities which was referred to your Committee has been discussed and the conclusion reached that the engineering student has received insufficient attention from The Institute to arouse his interest in its activities. This has resulted in large numbers of students graduating from universities with practically no knowledge of The Institute and to whom its development is of little concern. If the student body is not cultivated, the interest in The Institute on the part of the young men cannot be sustained. Your Committee, therefore, urgently recommends the adoption of a policy which will result in creating a student branch of The Institute or some Institute affiliation with the students in every engineering university centre in the Dominion, and that this be followed up as an Institute activity which is of vital concern to its future welfare.

It is the belief of your Committee that The Engineering Institute should take a more dominant and aggressive position in relation to the subject of engineering education, and form a more intimate contact with the universities, whereby the advice of the older and most successful engineers would be available to the universities through an Institute committee. Further, The Institute might act as a special agency between the university and industry. The Institute should also consider technical training from the junior aspect and its bearing upon industry and upon the profession. The definite suggestions of your Committee, therefore, are:—

(1) The formation of a more intimate bond between The Institute and engineering universities throughout Canada, in order that The Institute may be in a position to advise on engineering education through its older and most successful members.

(2) That steps be taken whereby The Institute becomes the definite agency—the active connecting medium—between engineering universities and industry.

(3) That a study be made by a committee on technical education in its relation to industry and to the engineering profession.

(4) That immediate steps be taken by conference with university heads with a view to adopting a six year course for engineers, or a much higher matriculation standard.

(5) That the universities be urged to give consideration to giving additional time on the curriculum to public speaking and literature.

(6) That immediate steps be taken leading to the formation of student branches of The Institute or student affiliations in every engineering university in the Dominion.

Respectfully submitted,

FRASER S. KEITH, M.E.I.C., *Chairman.*

Canadian National Committee of the International Electrotechnical Commission and the Committee on International Co-operation

The President and Council:

Only one meeting of the Canadian National Committee of the International Electrotechnical Commission has taken place during the year, this having been held at Ottawa on April 10th, 1929, at which a general discussion was held on the organization and policy and on the method of financing operations.

Documents which have been received from the different Secretariats have been distributed throughout the year for comment by the members of the Committee and the result of these comments forwarded to the appropriate Secretariats.

A meeting of the International Electrotechnical Commission was held in Japan in October 1929 and was attended by Mr. John Murphy, M.E.I.C., chairman of the Canadian National Committee. The next plenary meeting of the I.E.C. will be held in Stockholm in June 1930.

At Tokyo, during the recent World Engineering Congress and the Sectional Meeting of the World Power Conference, there were many happenings of considerable interest to the members of The Engineering Institute of Canada.

Canadian participation in those meetings, insofar as the presentation of papers and personal attendance were concerned, was very meagre—altogether too meagre, in the writer's opinion, when the magnitude and importance of Canada's engineering developments and the standing of her engineers is kept in mind. Delegates to those meetings, as well as the officers in charge of them gazed upon the thousands of delegates from thirties and the 800 papers listed on the programmes and asked, (a) "How many delegates are here from your country," and, (b) "How many papers were prepared in your country?" Canada's answers to those questions could be given "without detaining the questioners."

Co-operation, international co-operation, was the keynote of the proceedings in Tokyo. The Japanese Imperial family and the Prime Minister and the members of his government encouraged and personally assisted the Japanese engineers in many ways to make the meetings successful.

The meetings were held in the temporary Parliament buildings and the opening and closing ceremonies were carried out with much pomp and ceremony. In the writer's opinion the best of the closing addresses was made by our Past-President Dr. J. M. R. Fairbairn, M.E.I.C. The large American delegation in attendance with the personal and official approval of that eminent engineer the Hon. Herbert Hoover, President of the United States of America, was the most prominent one at the Tokyo meetings. Next in importance and in point of numbers was the British delegation. Practically all the proceedings were carried out in English.

The Japanese engineers also held special meetings at which architectural, civil, chemical, electrical, mechanical and mining engineers from other countries were each given a chance to see what was being done in their own spheres of action in Japan. The Japanese electrical engineers have prepared standard specifications, printed in English, which might be used as models in any country. Their chairman was asked to tell how the immense amount of work, which those specifications represented, had been carried out? He replied:—"We—200 of us—worked three hours every evening from 6 to 9 o'clock until the work was finished." Such enthusiasm is not usually encountered in Canada.

To the electricians at the Tokyo meetings two very sad messages came; one contained news of the death of Mr. John W. Lieb of New York, an associate of Edison from his pioneering days, and, one of the world's most capable and best known electrical engineers.

The other message was from Milan, Italy, where Mr. Guido Semenza died suddenly on November 7th as the outcome of a protracted illness. Mr. Semenza was one of the most lovable men in the world. He was the Junior Past-President of the International Electrotechnical Commission; he had acted in a consulting capacity for important undertakings all over the world.

Since the earthquake and fire in 1923 the destroyed portions of Tokyo and Yokohama have been rebuilt and are now perfect models of beautiful modern cities. The courage and the progressive spirit of the Japanese is astonishing. Their hospitality was almost overwhelming.

Respectfully submitted,
John Murphy, M.E.I.C., *Chairman.*

Gzowski Medal Committee

The President and Council:

Your Committee, having carefully studied all of the papers eligible for consideration for the award of the Gzowski Medal for this year, has concluded that no one of them is of a sufficiently high order of merit to have earned for its author the award of this esteemed medal.

The Committee therefore recommends that no award of this medal be made for this medal year.

The Committee, however, respectfully directs your attention to the fact that in its opinion most of the papers covered by its study are of real value to The Institute, in that they have afforded the membership an opportunity of broadening the scope of their knowledge of Canadian engineering practices and works of interest, which otherwise would not have been available. Your Committee feels, therefore, that The Institute is much indebted to the authors of these very excellent papers.

Respectfully submitted,
W. C. Adams, M.E.I.C., *Chairman.*

Leonard Medal Committee

Your Committee has found great difficulty in reporting because of the large number of excellent papers before it for consideration, but no one of these was of such outstanding merit as to warrant the award of the medal.

Respectfully submitted,
F. W. Gray, M.E.I.C., *Chairman.*

Plummer Medal Committee

The President and Council:

Your Committee has examined the various papers which came under the Plummer Medal classification for the season 1928-1929 and it is the majority opinion of the Committee that the Plummer Medal for the period should be awarded to Mr. A. S. Wall, M.E.I.C., for his paper entitled "Arc Welding in Structural Fabrication," published in The Engineering Journal in July 1929.

It is the opinion of the Committee that Mr. Wall's paper deals with a metallurgical subject and it represents a considerable amount of original work by the author; it is well presented, and it deals with a subject of increasing importance.

Your Committee has, therefore, much pleasure in recommending the award of the "Plummer Medal" to Mr. Wall.

Respectfully submitted,
J. R. Donald, M.E.I.C., *Chairman.*

Honour Roll and War Trophies Committee

The President and Council:

During the year 1929 the list of names for the Memorial covering those who served with units not included in the Canadian Expeditionary Force, was forwarded to the War Office in London for checking. This list has lately been returned, and when a few further verifications are made the list for the Memorial will be complete.

The work on the Record is being proceeded with.

Respectfully submitted,
Charles J. Armstrong, M.E.I.C.. *Chairman.*

Report of The E.I.C. Members of the Main Committee of the Canadian Engineering Standards Association

The President and Council:

The Institute nominees on the Main Committee of the C.E.S.A. are now as follows:—

F. B. Brown, M.E.I.C., retires March 1930.

P. L. Pratley, M.E.I.C., retires March 1931.

C. J. Mackenzie, M.E.I.C., retires March 1932.

Mr. Pratley has succeeded Professor C. M. McKergow, M.E.I.C.

The Main Committee of the Association is still operating as the Associate Committee on Engineering Standards of the National Research Council, and it is expected that the Association will be assigned quarters in the new Research building, contract for which has recently been let.

General support from industrial interests has again been forthcoming during the past year and up to December 31st, 1929, the sum of $5,420 has been received as subscriptions. The sustaining memberships have been put on a more stable basis and the securing of support from industry is under the direction of a Financial Committee which has recently been organized by the C.E.S.A. executive. The members of this Committee are as follows:

Mr. P. F. Sise, M.E.I.C., (chairman), Northern Electric Co. Ltd.
Mr. G. H. Duggan, M.E.I.C., president, Dominion Bridge Co. Ltd.
Mr. D. C. Durland, president, Canadian General Electric Co. Ltd.
Mr. R. H. McMaster, president, Steel Company of Canada, Ltd.
Mr. P. J. Myler, president, Canadian Westinghouse Co. Ltd.

The co-operation from the press and technical publications has been a feature of the year's work and many publications have given quite extensive reviews of the specifications issued by the Association during the past year. The Association wishes to again record its appreciation of the helpful co-operation which has been given by the members of the different working committees and from the different representatives of the industries.

The sale of specifications has shown a marked increase and it is evident that their practical value is becoming recognized. One of the features has been the requests received from different technical libraries for complete sets.

The third year book of the Association was issued during the year and widely distributed, and the quarterly bulletin continues to serve a very useful purpose.

Publications Issued During 1929

C2-1929. Standards for Single-Phase Distribution Transformers. This is a revised edition of C2-1920 which was entitled "Standard Requirements for Distribution Type Transformers." This revision takes into account the experience gained by the operation of the specification since it was first published and it is believed that it more closely meets the present situation and will clear up much of the misunderstanding which has prevailed in connection with this type of apparatus.

A6-1929. Standard Specification for Steel Highway Bridges. This is the second edition of the specification which was first issued in 1922 and the chief feature is the raising of the unit stress for axial tension from 16,000 to 18,000 lbs. per square inch, which has necessitated revision in corresponding stresses. All references to eyebars have been deleted; specifications for materials have been brought up to date and a specification for silicon structural steel has been added. The specification for bridge paint and all references thereto have been deleted until a more satisfactory understanding can be reached with the paint manufacturers.

A23-1929. Standard Specification for Concrete and Reinforced Concrete. This is one of the most important specifications that has been issued by the Association since its incorporation. Special acknowledgment is given to the work which was done by the late Professor Gillespie, who was chairman of the committee which prepared this specification. The specification is divided into three parts, the first intended primarily for the use of the contractor, and the second for the guidance of designers. The third part comprises specifications for materials and methods of testing, supplemented by drawings, a glossary, and a list of algebraic symbols. Several of the specifications already issued by the Association have been reprinted in the appendices. This publication has been very favourably received and many reviews have appeared in technical publications. Enquiries for copies have been received from all parts of the world

G24-1929. Standard Specification for Sampling for Check Analysis of Steel Billets, Bars and Shapes. It is felt that this specification will clear up much misunderstanding between manufacturers and mill inspectors. Detailed information is given as to the best methods of sampling and a diagram showing proper location of drill holes for sampling has been included.

G25-1929. Standard Specification for Carbon Steel Billets and Bars of Forging Quality. It is hoped that this specification will clear up much misunderstanding as to the terms used in the buying and selling of this particular quality of steel, and the specification has been framed in as simple a manner as possible and contains only those requirements which are considered absolutely necessary to clear up any doubt as to the properties of the material concerned. The specification is essentially general in its purport and is not intended to cover any specialized requirement.

G26-1929. Commercial-Quality Hot-Rolled Bar Steels.
G27-1929. Commercial Cold-Finished Bar Steels and Cold-Finished Shafting. These specifications have been issued in one volume to replace specification No. G8-1923 which was issued under the general title of Commercial Bar Steels. Experience since the issuance of the first edition has indicated the advisability of issuing this specification in two parts, on the basis of the process of manufacture. Specification G27 makes it clear that cold-finished material covers shafting, as there has been considerable misunderstanding on this point.

G28-1929. Standard Specification for Carbon Steel Castings. This specification has been prepared by the committee after a most intensive study of the situation. It includes a special section dealing with heat-treatment of castings subject to heavy duty, such as rotating parts of machines, housings, etc., and an endeavour has been made to give the most up-to-date information. The committee has recommended that hollow drill tests be taken on all important castings, for the reason that they give a good indication of the quality of the annealing. The adoption of this specification is strongly urged on designing engineers, purchasing agents, inspectors and foundrymen, whose close co-operation is necessary to ensure castings which will give reliable service.

B29-1929. Established List of Machine Screws. This is the first of a series of standards or established lists which it is proposed to issue under the general title of "Established Lists of Dimensional Standards." It is proposed to issue these different lists in pamphlet form which can be conveniently filed in a binder which has been prepared by the Association and thus enable them to be conveniently used by draughtsmen, designing engineers, or purchasing agents. The chief feature of the Established List of Machine Screws is the reduction in the number of varieties from 43 to 21. Eleven different diameters of screws are listed with a fine and a coarse thread in all sizes but one, medium fit being adopted throughout, and it is felt that this will give a range which should meet every practical requirement and the adoption of the list is strongly recommended by the Association.

Work in Progress

Civil Engineering and Construction

Specifications for Concrete and Reinforced Concrete and a revised edition of the specification for Steel Highway Bridges have been issued during the year.

The specification for Steel Structures for Buildings is now being revised and it is hoped to have it issued early in 1930. This will constitute the second edition and its chief feature will be the raising of the working unit stress.

A revised edition of the specification for Reinforcing Materials for Concrete is now in preparation and it is proposed to issue it in three separate booklets, one covering each type of reinforcement. This will be issued early in 1930.

A committee has been organized to consider the question of preparing specifications for Wood Piles and Wood Pile Driving, and arrangements have been made for the first meeting of this committee early in the new year.

Mechanical Engineering

The Established List of Machine Screws was issued during the year and it is now proposed to proceed with the preparation of similar lists relating to cap screws, set screws, binder screws, plough bolts, etc.

Electrical Engineering

In the preparation of the second edition of the Canadian Electrical Code, great difficulty has been experienced in getting unanimity of opinion, but the Code is now in final proof form and it is expected to have it issued early in January 1930. A great deal of new material has been added and quite radical revisions have been made and it is expected that the second edition will be about 50 per cent larger than the first edition. During the year the Code has been adopted by the Workmen's Compensation Board of Alberta, and it is hoped that official adoption by the province will be obtained in the near future.

With reference to Part II of the Code, covering specifications for electrical apparatus, a panel has now been formed and it is expected to send out shortly a draft specification for preliminary review by this panel.

With reference to Part III, covering outside wiring rules, a representative panel has been organized and this panel held its first meeting in May, 1929. The work has been divided and assigned to four sub-panels as follows:

(1) Overhead systems.
(2) Underground systems.
(3) Inductive co-ordination.
(4) Grounding and conductive co-ordination.

In addition, a correlating sub-panel, consisting of the chairmen of the sub-panels, the chairman of the panel itself, and the C.E.S.A. secretary has been organized to assist in carrying out the work. Several meetings of this sub-panel have been held and the sub-panels are now at work.

The Committee on Transformers is now working on a specification covering Power Transformers, having recently completed the revised edition of the specification for Distribution Transformers. The specification for Power Transformers has now reached the second draft and is before the committee for comment.

A committee was organized during the year to consider the question of specifications for transformer and switch oils, and one meeting has been held at which it was decided to collect data on specifications which are now in use and addressing these to the members of the committee for review and comment.

Ferrous Metals

As noted in "Publications issued during 1929," five specifications covering Sampling for Check Analysis of Steel Billets, Bars and Shapes; Carbon Steel Billets and Bars of Forging Quality; Commercial-Quality Hot-Rolled Bar Steels and Commercial Cold-Finished Bar Steels and Cold-Finished Shafting; and Carbon Steel Castings, have been issued during the year and it is felt that these publications will be of great service to those interested in the manufacturing or purchasing of steel.

Co-operation with standardizing bodies in other countries has been continued. The latest country to organize a standardizing body has been Roumania, and national bodies are now organized in twenty-two different countries throughout the world.

Respectfully submitted,
F. B. Brown, M.E.I.C.
P. L. Pratley, M.E.I.C.
C. J. MacKenzie, M.E.I.C.

Awards of Students' and Juniors' Prizes

The reports of the examiners appointed in the various zones to judge the papers submitted for the Prizes for Students and Juniors were approved by Council at its meeting on January 14th, 1930, and make the following awards:—

H. N. Ruttan Prize—Western Provinces: No award; one paper received.

John Galbraith Prize—Province of Ontario: To M. V. Powell, Jr.E.I.C., for his paper on "Fabricated Steel Construction for Large Electric Generators."

Phelps Johnson Prize—Province of Quebec (English): To. E. Gray-Donald, Jr.E.I.C., for his paper on "Distribution Transformers."

Ernest Marceau Prize—Province of Quebec (French): No award; no papers received.

Martin Murphy Prize—Maritime Provinces: No award; no papers received.

Past-Presidents' Prize Committee

The President and Council:

Your committee charged with the duty of judging the papers on Engineering Education submitted in competition for the Past-Presidents' Prize has carefully reviewed the seven papers sent in.

Four of these were of a creditable nature but none was of such outstanding excellence as to warrant your committee in recommending it for this important prize. It is, therefore, suggested that no award be made for the papers presented this year, but that a further opportunity be granted members for winning the prize on the subject of Engineering Education, with specific limitations as to the effect of the present system of engineering education upon the status of the engineering profession.

Respectfully submitted,
Fraser S. Keith, M.E.I.C., *Chairman.*

Service Bureau Committee

The President and Council:

One of the principal functions of this Committee is to further the development of The Institute's Employment Bureau, whose activities naturally deal with employers seeking men as well as with men seeking positions. In carrying on the work of the Bureau your Committee's policy has been not to confine its operations to members of The Institute, although these, of course, take up the greater part of the time of the staff. In fact, during the past year, some thirty per cent of the total number of applicants for positions have been non-members of The Institute and a considerable number of these have secured employment, a result which has aided our relations with employers and has led to a considerable number of applications for admission to The Institute.

The Institute's Bureau, like other similar organizations, finds that only a small proportion of the persons benefitting by its operations inform us as to their success in obtaining positions, and it is probable that those who do send in information are not more than twenty-five per cent of the total. During the past six months, for example, we have heard directly from 52 applicants who have been placed, which indicates that during this period at least 200 positions have been filled through the activities of the Bureau. From the above it will be seen that it is only possible to estimate the number of men who have secured appointments.

For the 17 months that have elapsed since enlargement of The Institute's Employment Service, our records are:—

Members' advertisements published in the E. I. C. News	183
Replies received	392
Members' records forwarded to prospective employers	382
Vacant positions registered	486
Replies received to advertisements of vacant positions	1699
Men notified of vacancies	347

In addition to the correspondence connected with this work, a large number of personal interviews take place, usually averaging from thirty to forty per week. A considerable number of these interviews have been with young technical men from the British Isles and from the continent of Europe, many of whom have obtained positions without undue delay and have been grateful for the assistance received. As a rule, they have been of a very desirable type and when their acquaintanceship in Canada is sufficient to enable them to obtain the necessary number of sponsors, will be desirable additions to the membership of The Institute.

Your Committee would draw attention to the comparatively small number of our members who register with the Bureau and place their professional records on file. Up to date, only 345 members have done this. The work of the Bureau would be greatly aided if we had on file the professional records of the members, for use when the Bureau is notified of vacancies. Unless a member registers, the latest information available regarding him is usually that contained in his application for admission or transfer.

Your Committee feels that the results obtained from the Bureau's work during the past year have been extremely encouraging, and indicate that the operations of the Bureau might be greatly developed. The activities of the Employment Bureau, like those of other departments of The Institute, are limited by lack of funds. More of the time of our staff should be available for the Bureau's work, it should be possible to maintain closer personal touch with prospective employers and large engineering firms, and such measures, with possibly the appointment of suitable part-time representatives with local offices at such points as Halifax, Toronto, Winnipeg and Vancouver would, in your Committee's opinion, enable our service to be further extended and improved, with corresponding advantages to our membership.

Respectfully submitted,

T. R. Loudon, M.E.I.C., *Chairman.*

Library and House Committee

The President and Council:

Following the policy of previous years, the funds available for the library have been largely devoted to the purchase and binding of technical periodicals, the sets of which are of permanent value. Book purchases have been practically confined to standard text-books specially requested by members, but a considerable number of review copies have been presented by publishers and duly acknowledged in The Engineering Journal. The number of library accessions during 1929 was 714, including books, periodicals, government and other reports and society transactions.

The information service has been extensively used, 854 requests (written or verbal) having been received, while twenty bibliographies and a large number of photostat copies of articles have been prepared and forwarded to members. Your Committee believes that if the facilities for obtaining information were more clearly realized by members, a considerable increase in the activities of this department would result.

The Institute premises have been kept in good order and the necessary minor repairs, painting, etc. executed. No extensive repairs or alterations took place during the year.

Respectfully submitted,

W. C. Adams, M.E.I.C., *Chairman.*

Committee on Publicity

The President and Council:

Following the appointment of your Committee at the Plenary Meeting of Council last fall, a meeting of the Committee was held and consideration given to the subject entrusted to this Committee by Council. In a letter to Council dated November 13th, 1928, five suggestions were made, as follows:—

(1) That the Council establish either a permanent Publicity Committee of the Council, or attach the duties of such a committee to the present Publications Committee.

(2) That Council sponsor the establishment of a Publicity Committee in each Branch of The Institute.

(3) That each Branch be written, asking for a summary of their publicity activities, and to submit any suggestions they may have to offer whereby Council can be of assistance to them in that connection.

(4) That the Council keep up a continuous effort to give greater publicity to engineering affairs through the local Branches.

(5) That the Publicity Committee, after hearing from the Branches on the subject, be authorized to make a further report, after having advantage of the information from every Branch of The Institute, and thus be in a favourable position to make constructive suggestions.

At a meeting of Council held on November 16th the letter was considered, and it was agreed that the Committee be continued with a view to carrying out the third and fifth suggestions, no action being taken with regard to the second and fourth.

During the months intervening your Committee has made a study of the publicity situation, after having communicated with all Branches to find what their activities were in this connection. A summary of the replies of the Branches is as follows:—

Halifax—Publicity not actively followed previous to 1929. A committee recently appointed. Newspaper contact established. Looking for more Branch publicity.

Saint John—Publicity covered by separate committee. Friendly relations with newspapers. Always have good account of meetings. Invite to annual dinner. Papers always send representatives to meetings.

Moncton—Supper meetings. Special invitations to men likely to be interested in the address. Write-up of meetings handed to the press.

Saguenay—No attempt at publicity. Lectures open to public.

St. Maurice Valley—Always secure reports of meetings published in the local press.

Montreal—Have publicity committee. Send notices to the press. Chairman telephones various papers who usually send representatives.

Ottawa—Has evidently reduced the question of branch publicity to an exact science, and introduced most of the successful publicity methods in keeping the activities of the Branch and its members before the public. Maintain a committee of two on publicity, which is a sub-committee of the Proceedings Committee. This committee, should either local paper fail to send a reporter, prepares an account of meeting ready for type-setting. This committee suggests more Canadian press despatches from Headquarters to appear in local press throughout Canada.

Peterborough—General public invited to lectures and meetings. Sometimes more outsiders than members present at meetings. Favourable relations with local press. Reporter generally present to cover meetings. Front page write-up. Send complimentary tickets to press for dinners. Suggests that an endeavour be made to build up a systematic cordial relationship or working arrangement with the press.

Kingston—Consider doing all publicity possible. Invite general public when papers of general interest are presented. The press supplied with abstract of address. Generally reproduced. Have endeavoured to take stand on questions of local interest but failed, due to lack of unanimity. Appreciate suggestions from other Branches.

Hamilton—Has engineering advisory committee to act with Chamber of Commerce. Branch news editor endeavours to get articles for local papers. Invitations occasionally sent to city council and members of Chamber of Commerce to attend meetings.

London—Reporters of local papers invited to all meetings and are given information of interest. Auxiliary mailing list containing names of men who might be interested.

Niagara Peninsula—Members conduct visiting newspaper men to local engineering projects. Branch meetings open to those who wish to attend. Have large complimentary mailing list. One meeting a year places The Institute before the public. Secretary feels greater results possible. Suggest short articles "What the engineer means to our present civilization," for distribution to Branches for local publication. Suggest author of such articles be paid.

Border Cities—Publicity committee established. Secures write-up of meetings before and after—sometimes nearly an entire column. Member of Branch acts on directorate of Chamber of Commerce. Invite representative citizens to meetings. Endeavour to secure prominent outside speakers.

Sault Ste. Marie—Secretary prepares reports of meetings and accounts of important lectures. Local papers always publish.

Winnipeg—Secretary makes notes at meetings, and following meetings prepares reports which are usually published verbatim by the press.

Saskatchewan—Secretary keeps in touch with local press, who receive notices of meetings and write-up following. Suggest news of importance sent to Headquarters by wire, to be transmitted to Canadian press.

Lethbridge—Branch invites leading business men to meetings. Has many affiliates not connected with engineering. Public invited to meetings, particularly when outside speakers are secured. Full reports of Branch meetings appear in local press. One member of Branch writes copy.

Edmonton—Admit not using effective publicity. Secretary to get write-up in local papers. Wants suggestions from committee.

Calgary—Appreciate advantage of publicity. Newspapers receive and usually publish notices of meetings. Generally get satisfactory publicity. Members invited to represent Engineering Institute at other professional annual gatherings. Endeavour to obtain summaries of addresses from speakers in advance for press.

Vancouver—Little to report. Notify press of meetings. No suggestions to offer.

Victoria—No suggestions to offer. Publicity consists of notices of lectures in local press and report after.

Four Branches did not reply to either of two communications.

From the above it is seen that publicity activities of the Branches run all the way from zero to practically 100 per cent, with much left to be desired in most Branches. Generally speaking, the question of publicity is left for the most part to the Branch secretary. It is the belief of this Committee that the Branch secretary already has duties sufficient or more than sufficient as a contribution from one member, and that he should not be asked to assume the responsibility of looking after this important phase of Branch activity. It is obvious then, that every Branch should have its own publicity committee, composed of men who will take their appointment seriously and who will not only form a friendly contact with the local paper or papers, and get the activities of the Branch before the public, but who will be ever on the alert to keep the local press supplied with articles from the Engineering Journal which would be of interest to the public.

It is apparent to your Committee that the object of securing greater recognition of the engineers by the public will not be attained by even the most studied effort in this direction by all the Branches, but must have in addition an inspiration from a central committee. To follow the matter to a logical conclusion it would therefore appear necessary that any central or Headquarters committee on publicity should have at its disposal funds to carry out a publicity programme.

The major item in this connection would be to pay for the services of a man devoting part or full time—preferably the latter—to preparing articles and despatches and making arrangements to have these appear in the press throughout Canada. The Committee's duties would be to draw up a general plan, and the publicist engaged would carry out this plan under the direction of the General Secretary. Your Committee, therefore, would recommend for the serious consideration of Council, the following:—

(1) The establishment of a permanent publicity committee whose duty would be to present a definite publicity campaign both through Headquarters and through the Branches.

(2) That a publicity committee of at least two be established in every Branch.

(3) That provision be made in the budget for the engagement of the services of a man familiar with newspaper publicity and capable of carrying out a campaign calculated to bring the engineer more prominently to the notice of the public.

Reference was made by the Committee on Policy to this Committee of attaining a greater appreciation of the profession by the public, and we submit that this can only be accomplished by keeping the public better informed as to what the engineer is doing and has done, and emphasizing at all times the importance of his achievement in municipal, provincial, and national development.

The above report was presented to the Plenary Meeting of Council on October 8th, and by them referred to the Finance Committee, who reported that at present, funds are not available for carrying out its recommendations.

Respectfully submitted,

FRASER S. KEITH, M.E.I.C., *Chairman.*

Committee on Policy

The President and Council:

Your Committee on Policy was appointed in April 1929 following a resolution of the Annual General Meeting at Hamilton, it being understood that its work would be carried on in as close collaboration as possible with the various Branches of The Institute.

Your Committee accordingly transmitted to the various Branches of The Institute a number of questions bearing on the constitution, organization and working of The Institute, and, after holding seven meetings, presented an interim report at the Plenary Meeting of Council on October 9th, 1929, submitting at the same time the various expressions of opinion which had been received from the Branches. This resulted in a lengthy discussion by Council, and it is hoped that further expressions of opinion will take place during discussion at the Annual General Meeting of 1930; these no doubt will be available for the guidance of your Committee in preparing its final report.

The questions forwarded to the Branches were as follows:

(1) Review of aims and objects of Institute as set forth in Section 1 of the By-laws. Do they need any change or amendments?
(2) Present classes of membership. Are any changes desirable in nomenclature or in qualifications for admission?
(3) Are criticisms of the present publications of The Institute supported by the majority of our members, and if so, what changes are desirable?
(4) Organization of Council and Officers. Is a two-year terms for councillors desirable?
(5) Activities of The Institute and its Branches. What can be done to give better service to our members?
(6) Encouragement of the Student class. Formation of Student sections. Financial and other assistance for these.
(7) Finance. Desirability of change in rebate system as proposed by Lethbridge Branch.
(8) Finance. Need of additional revenue.
(9) General policy of The Institute. Should we aim at maintaining our present high standards for admission, or consider the admission to corporate membership of persons less fully qualified than at present?

The following notes form a brief record of the discussion of these various points at the Plenary Meeting of Council

(1) Modification in statement of aims and objects of The Institute. In this matter your Committee recommended no change, and this opinion was concurred in by the Branches, although it was suggested that it might be possible to give a broader interpretation of the objects as set forth in Section 1 of the By-laws.

(2) Changes in nomenclature and qualifications for various classes of membership. In regard to this matter the opinions of the Branches generally expressed satisfaction with the present arrangement, although four Branches would recommend the replacement of the present name "Member" by the term "Fellow" and the present term "Associate Member" by "Member," this being a change suggested by the report made at the Plenary Meeting of 1928 by Mr. Shearwood's Committee on Grades of Membership. Your Committee, however, did not feel justified in making any definite recommendations regarding this matter, as it was felt that it should be left in abeyance pending developments arising from the report of Mr. S. G. Porter's Committee on the Relations of The Institute with the Professional Associations. It is evident that any arrangement entered into with these Associations for uniformity in requirements for admission to The Institute (as contemplated by Mr. Porter's Committee), might require possible modification of our present classes of membership both as regards nomenclature and qualifications. It may be remarked that there are really two separate points which arise in this connection:

(a) Is it desirable to modify our classes of membership and our requirements for admission to them so as to give a wider corporate membership than is at present the case, and
(b) Will it be necessary to change the number and nomenclature of our present classes of membership to facilitate closer relationship with the various Professional Associations?

Council concurred in the Committee's view, and did not think it wise to make any definite recommendation at this time.

(3) Publications of The Institute. In its interim report presented at the Plenary Meeting, your Committee recommended that the Journal should be continued in its present size, and that any suggestions as to improvements should receive careful consideration. It was not considered desirable to undertake the publication of Transactions but your Committee did advise the continuation of the publication of the E-I-C News.

At the Plenary Meeting Council devoted considerable time to this important question. The views of a number of Branches were presented and were largely concerned with detailed criticism and Council referred the question with the criticisms received to a special committee under the chairmanship of Dean C. J. MacKenzie, M.E.I.C., of Saskatoon, which committee after due deliberation reported as follows:

"In the opinion of the Committee there must always be a certain amount of compromise in the publications of a society with interests so varied as those of The Engineering Institute of Canada.

"Three questions have been considered: (1) Are Transactions desirable? The meeting has already gone on record regarding this point. Transactions are not only desirable, but absolutely necessary if The Institute is to maintain its position as a scientific body.

(2) Is the Journal necessary in addition to the Transactions? The answer is yes. A monthly journal is essential as the means of informing our members as to the activities of The Institute and its Branches.

(3) Is the E-I-C News necessary in addition to the Journal and the Transactions? The answer is emphatically yes. Believing that these three things are desirable and necessary the Committee makes the following recommendations:

(1) That The Engineering Journal be continued.
(2) That the E-I-C News be continued.
(3) That an effort be made to publish Transactions of a high grade.
(4) That a committee under the chairmanship of Mr. W. C. Adams, M.E.I.C., with power to select two other members, be appointed to investigate the whole situation.

"The Committee also suggests that Mr. Adams' committee consider the possibility of getting the Journal published by an outside publisher which in the opinion of the committee would relieve Headquarters of a good deal of work, and would possibly result in a considerable monetary saving which might be applied to the publication of Transactions."

The small committee suggested by the above report was duly appointed by Council under the chairmanship of Mr. W. C. Adams, but has not yet reported in detail, although it submitted an interim report to Council on December 3rd, stating that it is inadvisable to turn over the publication of the Journal to any existing publishing house. Mr. Adams' committee is continuing its work and will no doubt present its final report to Council at a later date.

(4) Regarding the organization of the Council and Officers, your Committee draw attention to the desirability

of obtaining greater continuity in the membership of Council by arranging for a minimum term of two years. Effect has been given to this recommendation by Council in the amendment proposed to Section 13 of the By-laws, and the suggestion met with a considerable degree of support from the Branches.

(5) In regard to question No. 5, dealing with the activities of the Institute and its Branches, your Committee has made no special recommendations, but the discussion at the Plenary Meeting and the opinions expressed by Branch executive committees embodied several suggestions, among others the possibility of arranging for visits to Branches by the President and Secretary during the winter rather than during the summer; the desirability of developing further arrangements for visiting speakers, particularly in connection with the smaller Branches; broadening the scope of The Institute's employment and information services, and action by Council to secure better salaries for members.

At the Plenary Meeting the discussion emphasized the facts that Branch activities are principally dependent on the initiative of the Branches themselves, and that the great need of The Institute is a much greater degree of co-operation by members in contributing papers of high quality for presentation at the meetings of The Institute and its Branches.

(6) In regard to question No. 6, the encouragement of the Student class, the Branch executive committees are all impressed with the importance of this, but it is realized that the formation of Student sections is not possible or desirable at all Branches. Much may be done if prominent members of The Institute can be brought into touch with the graduating classes at the universities.

(7) Your Committee has not been able to make any definite recommendation as regards the proposal coming from the Lethbridge Branch to change the present system of payment of rebates to the Branches. The consensus of Branch opinions did not seem favourable to this proposition, and your Committee did not recommend immediate action, since the whole question of funds available for Branch activities depends upon the decision to be given by the members on the proposed increase in annual fees. Should this increase be approved this year, funds will be available in 1931 for additional resources for the Branches.

(8) With reference to the need of additional revenue for The Institute, your Committee throughout its studies has been impressed with the fact that many developments in The Institute's work which are eminently desirable cannot be carried out for lack of funds. This subject will no doubt be covered by the report of the Finance Committee, and your Committee heartily supports the proposed amendment to Section 34 of the By-laws which will come before the Annual Meeting for discussion.

(9) In its interim report your Committee did not make any recommendation regarding the general policy of The Institute, as it was felt that the future development of The Institute depends on the course of events following the work of Mr. Porter's Committee on the Relations of The Institute with the various Professional Associations. When The Institute develops its proposal for uniformity in standards of admission, and if this course leads to close relations or confederation with the Professional Associations, the future line of development of The Institute will be more definite. Your Committee feels, however, that serious consideration should be given at this time to the fact that The Institute's membership is practically stationary at a time when the country is prosperous and engineering work is rapidly developing. In your Committee's opinion this is largely due to the fact that engineers feel bound to join the Professional Associations and in many cases for financial reasons are unable to become or remain members of The Institute as well. This question should receive careful consideration by the membership of The Institute in discussing the proposals of Mr. Porter's Committee.

Your Committee would deprecate any change in the regulations for admission to The Institute which would admit to corporate membership persons less fully qualified than at present, and would support such suggestions as will fully maintain our professional status.

Respectfully submitted,

O. O. Lefebvre, M.E.I.C, *Chairman.*

Committee on Relations of The Engineering Institute of Canada with the Provincial Associations of Professional Engineers

The President and Council:

Your Committee on the Relations of The Engineering Institute with the various provincial associations of professional engineers met at The Institute's Headquarters on October 5th, 1929, and adopted the following progress report and recommendations for your consideration.

Your committee was appointed at the Plenary Meeting of council in October 1927 and consists of the following members:—

G. R. MacLeod,	Montreal, Que.	D. L. McLean,	Winnipeg, Man.
A. R. Decary,	Quebec, Que.	W. M. Scott,	Winnipeg, Man.
F. R. Faulkner,	Halifax, N.S.	L. A. Thornton,	Regina, Sask.
H. W. L. Doane,	Halifax, N.S.	H. R. MacKenzie,	Regina, Sask.
H. W. McKeil,	Sackville, N.B.	S. G. Porter,	Calgary, Alta.
A. Gray,	Saint John, N.B.	R. J. Gibb,	Edmonton, Alta.
H. J. Lamb,	Toronto, Ont.	G. A. Walkem,	Vancouver, B.C.
A. D. LePan,	Toronto, Ont.	P. Philip,	Victoria, B.C.

The members in attendance at the meeting of the committee on October 5th, 1929, when this report was adopted were:—

S. G. Porter, chairman.
G. R. MacLeod
F. R. Faulkner
H. W. L. Doane
H. W. McKiel
A. D. LePan
D. L. McLean
R. S. L. Wilson (acting for R. J. Gibb)
G. A. Walkem
together with
Brig.-Gen. C. H. Mitchell, president of The Institute
and
R. J. Durley, general secretary of The Institute.

The problems with which this committee is dealing are of a nature that cannot be settled hastily. Progress therefore is necessarily slow, but we feel that substantial progress has been made. In response to our suggestion, during the past year, committees, to confer with members of our committee, have been appointed by the provincial associations in all the provinces where engineering professions acts are in effect, and in most, if not all the provinces, informal discussions have taken place between their committees and members of our committee.

The solution of the problems confronting us will require much careful thought and the exercise of a considerable amount of patience. The interests of many independent bodies are involved, and many conflicting views are to be harmonized. It is thought, therefore, that a general statement of the arguments which justify the existence of this committee may be in order.

Associations of professional engineers, operating under the provisions of provincial legislative acts, are now in existence in the provinces of Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Alberta and British Columbia. The legislation incorporating these associations was inaugurated by The Engineering Institute of Canada. The acts were intended to be uniform in the several provinces, but the model act was amended by each provincial legislature to suit its own ideas, with the result that considerable variations exist. Likewise, the procedure followed in each province in the administration of its act has been developed by the executive in each province very largely without regard to the procedure in the other provinces. The desire to harmonize the provisions and requirements under the several acts, and bring about a unity of purpose and procedure instead of permitting a wider divergence to develop, was the reason for several informal conferences, one result of which was the appointment of this committee whose duty is "to study the problems involved in co-ordinating the activities of The Engineering Institute of Canada and the several associations of professional engineers, looking forward to the ultimate integration of these bodies into one national organization."

In considering any proposal for the merging of The Engineering Institute of Canada and the several provincial associations of professional engineers, it is necessary and proper to consider the welfare of the provincial associations as well as of The Institute. The members of The Institute's committee are in nearly all cases also members of a provincial association, and are interested in the welfare of the one as well as of the other. But they are interested primarily in the welfare of the engineering profession as a whole, and the problem is to work out a solution which will meet that test.

There is still some difference of opinion as to the advantages to the profession of the legislative acts which provide for the registration for licensing of engineers. But since legislation has been enacted in nearly all the provinces, is simplifies our problem to accept it as an accomplished fact, assuming that the provinces which have not already done so will pass such legislation. Considering the problem for the moment from the standpoint of the provincial associations with a separate organization in each province, each following its own procedure with very little regard to the others, would there not be a very material advantage to the engineers of Canada as a whole to have them all brought into some close co-ordination?

The arguments for such a co-ordination may be stated as follows:

(1) Uniformity of requirements for admission and of regulations governing the practice of engineering.

(2) It would facilitate reciprocal arrangements whereby registration in any province would give a right to practise anywhere in the Dominion.

(3) A large membership, comprising all the professional engineers in Canada, working in harmony through one organization, would provide a Dominion-wide medium for expressing the viewpoint of the engineering profession, and exert a strong influence, otherwise unattainable,

(*a*) On legislation affecting—
  (1) The welfare of engineers;
  (2) The safety and welfare of the public where the construction, operation or control of engineering works and public service utilities are governed by legislative enactment.

and (*b*) On public opinion. Greater public recognition and more favourable publicity would result in Canadian engineers becoming better known and being able to compete more successfully with outside engineers.

(4) The educational functions of the technical societies could be co-ordinated with the administration duties of the professional associations to their mutual advantage, resulting in economy of administration and the prevention of overlapping and duplication. The advantages which could be offered to its members by a strong Canadian organization would compare more favourably with those offered by the technical societies of the United States, and would make a stronger appeal to Canadian engineers and lessen the tendency and necessity of their looking outside of Canada for these advantages.

(5) All this should result in the development of a stronger professional consciousness and esprit de corps among engineers comparable to that existing in the other professions.

Having recognized the advantages of having one Dominion-wide body for all professional engineers, it is necessary to consider how it can be brought about. An affiliation of the associations of professional engineers of all the provinces, (assuming that all secure legislative acts), with all the functions I have outlined, would duplicate the activities of The Engineering Institute of Canada. Then why not utilize the machinery already in existence in The Institute, and by co-ordinating its activities with those of the provincial associations accomplish the whole purpose? It would not mean the swallowing up of the provincial associations by The Engineering Institute of Canada, as someone has put it, but rather the reverse would be more nearly true. The majority of the engineers are already members of both. If they were merged, the membership would be identical. The governing body of The Institute—the Council—is elected from and by the local membership. So if the local membership is composed of the professional engineers, and they elect the Council, the Council is likewise controlled by them. There should therefore be nothing to fear on the part of the professional engineers.

Nor need this proposal injure the Canadian Institute of Mining and Metallurgy. Primarily it represents the industry of mining, and there will continue to be a field of usefulness for it to serve, and the two should strengthen rather than weaken each other if proper harmonious relations were established.

At the meeting of the committee on October 5th, the members present from the several provinces presented the following brief statements of the status in their provinces:

Nova Scotia: The Association of Professional Engineers of Nova Scotia has a committee which has had some joint meetings with the members of The Engineering Institute of Canada and this committee is of the opinion that the standard for admission to Associate Membership in The Engineering Institute of Canada should be raised to the level of the association requirements. The council of the association has gone on record as being in favour of the formation of one national body.

F. R. Faulkner.

New Brunswick: The members of your committee resident in New Brunswick have met with representatives of the provincial association. After consideration of the points suggested for discussion it was felt that there existed a provincial feeling in favour of the reduction of the number of engineering organizations. As a result of this it would seem that the members of the association and Institute would welcome a co-ordination of the functions of those bodies. The only serious difficulty seems to be in the matter of collecting and apportioning fees. No machinery for the collection of fees for transmission to The Institute exists at present and the establishment of such would require an amendment to the act. However, as the memberships of the association and The Institute are largely the same, no great difficulty should be experienced in bringing about the required changes.

H. W. McKiel.

Quebec: In the province of Quebec there is practically no difference between the membership of The Engineering Institute of Canada and that of the Corporation of Professional Engineers, i.e., the two lists would be almost identical. The exceptions, generally speaking, would be the few members of the Professional Corporation who have entered the province to do professional work for a short time, and were obliged to take out membership in the Corporation of Professional Engineers and would not usually join The Institute unless they expected to remain here indefinitely. These would be a very small proportion of the total.

In the beginning the organization meeting of the Corporation of Professional Engineers was held at The Institute headquarters and at that time the corporate members of The Engineering Institute of Canada resident in the province automatically became members of the new corporation. Since then the control of the professional corporation has been in the hands of prominent members of The Institute. Furthermore there has been practically no difference in the requirements of qualifications for membership and it is not anticipated by the members of your committee that there would be any difficulty in adopting the same requirements for admission to the Corporation of Professional Engineers of Quebec as for The Institute.

There has never been any friction between The Institute in the Province of Quebec and the Corporation of Professional Engineers nor any overlapping of activities of the two organizations.

In view of the above I am convinced that the engineers in the province of Quebec will be quite in favour of virtual amalgamation between the professional corporations and The Institute as soon as a uniform standard of qualifications for admission is agreed upon.

Geo. R. MacLeod.

Ontario: In Ontario I think the engineers generally are in favour of and ready for consolidation. The process will necessarily be slow but constant pressure should be exerted towards this end. The Engineering Institute of Canada and the Association of Professional Engineers of Ontario should have no difficulty in co-operating in this matter.

A. D. LePan.

Manitoba: In Manitoba The Engineering Institute of Canada and the Association of Professional Engineers of Manitoba are closely interlocked and work in close harmony.

The qualifications required for admission to and registration with the Association of Professional Engineers of Manitoba are virtually the same or very similar to those required of corporate members in The Engineering Institute of Canada.

The one man serves as registrar of the Association of Professional Engineers of Manitoba and as secretary of the Winnipeg Branch of The Engineering Institute of Canada, the only one in Manitoba. The two associations have at present very largely a common membership.

D. L. McLean.

Saskatchewan: While Saskatchewan has no professional engineers' act, it is reported that progress has been made in the sentiment favouring legislation and joining with the other provinces in the co-ordination of all the engineering organizations in the Dominion. Unfortunately neither member of the committee representing Saskatchewan was able to attend our meeting.

S. G. Porter.

Alberta: The Association of Professional Engineers of Alberta has a committee working towards a practical scheme of amalgamation. This committee is willing and ready to co-operate with similar committees of The Engineering Institute of Canada and other provincial associations, and has power to negotiate subject, of course, to final approval by the Association of Professional Engineers of Alberta.

R. S. L. Wilson.

British Columbia: The individual members of the Association of Professional Engineers of British Columbia are favourable to the ultimate joining of The Institute with the Association, and the Association will co-operate with The Institute in any steps toward that end.

Geo. A. Walkem.

In submitting to you the recommendations contained in this report we wish to emphasize the fact that the objects of The Engineering Institute of Canada and of the Associations of Professional Engineers are in entire harmony and in many respects identical. Furthermore that The Engineering Institute was instrumental in bringing the associations into existence and even at the present time the same men who are most active in the one are usually also most active in the other. Our objects and our interests therefore are common. To refresh your memory I quote the objects of The Engineering Institute as stated in the By-laws.

Objects

> Section 1.—The objects of The Institute shall be (a) to develop and maintain high standards in the engineering profession, (b) to facilitate the acquirement and the interchange of professional knowledge among its members, (c) to advance the professional, the social and the economic welfare of its members, (d) to enhance the usefulness of the profession to the public, (e) to collaborate with universities and other educational institutions in the advancement of engineering education, (f) to promote intercourse between engineers and members of allied professions, (g) to co-operate with other technical societies for the advancement of mutual interests, (h) to encourage original research, and the study, development and conservation of the resources of the Dominion.

Now, therefore, in view of the conditions in the various provinces as outlined herein, and of the legal limitations imposed by the British North American Act and by the several provincial acts, and in order to carry out the intention of Council's instructions to attain the "co-ordinating of the activities of The Engineering Institute of Canada and the several associations of professional engineers" and for the advancement of the profession in Canada, we submit the following recommendations:—

(1) That this committee or a similar one be continued.

(2) That at least one member of council in each province be added to the committee to act during his term of office in all cases where council is not already represented.

(3) That this committee be authorized to appoint a small sub-committee whose duty it shall be to approach the provincial associations and in conjunction with them devise a detailed proposal to bring about a co-ordination of the interests and activities of the various professional associations and The Engineering Institute of Canada; and further it is recommended that a sum of $1,800 be appropriated towards a fund to provide for the expense of this work.

(4) That The Engineering Institute of Canada, through The Journal and otherwise, continue to encourage and support the activities of the professional associations and contribute in every reasonable way to their success.

(5) That immediate steps be taken to arrive at an agreement among the professional associations and The Institute for the adoption of standard uniform requirements for admission to membership and that these requirements be rigidly adhered to.

(6) That upon the acceptance of such standard requirements The Institute should adopt the policy of accepting membership in a professional association as sufficient evidence of qualifications for admission to The Engineering Institute of Canada.

(7) That steps be taken to secure the necessary amendments to the By-laws so that membership or registration in a professional association be one of the requirements for admission to corporate membership in The Engineering Institute of Canada for all applicants residing in a province where an engineering professions act is in effect.

Respectfully submitted,

S. G. Porter, M.E.I.C., *Chairman.*

Branch Reports

Border Cities Branch

The President and Council,—

The work of your Branch has been carried out during 1929 by the following committees:

Papers and Entertainment..............A. J. M. Bowman, A.M.E.I.C., chairman, assisted by K. E. Fleming, S.E.I.C., until April, when their term expired. H. J. Coulter, Jr.E.I.C., was then appointed chairman of that committee, with power to add, his term to run until next April.
Publicity...............R. J. Desmarais, A.M.E.I.C.
Membership............Orville Rolfson, A.M.E.I.C.
Nominating............F. H. Kester, M.E.I.C.
Branch News Editor and Assistant-Secretary..Eugene Chorolsky, S.E.I.C.
By-Laws...............Harvey Thorne, M.E.I.C.
Representative on directorate of the Border Chamber of Commerce.A. E. West, A.M.E.I.C.
Welcoming Committee.,.Messrs. Armstrong, Coulter and Thorne.

The followings meeting have been held.

Jan. 11.—Annual meeting and election of officers, which had been adjourned from December 14th, 1928. The business was preceded by an address by Mr. S. A. Thoresen on the **"Detroit-Windsor Tunnel."** Attendance, 20.

Feb. 8.—Mr. R. G. Cone spoke on **"The Construction of the Ambassador Bridge"** and showed moving pictures of the work. Attendance, 37.

Mar. 15.—C. M. Goodrich, M.E.I.C., chief engineer of the Canadian Bridge Co. Limited, spoke on **"Engineering English."** Attendance, 25.

Apr. 12.—Dr. H. M. MacKay, M.E.I.C., Dean of the Faculty of Applied Science of McGill University, spoke on **"The Position and Experience of Engineering Graduates."** Attendance, 38.

May 10.—Mr. Torris Eide, of the Detroit Water Works Department, spoke on the new water supply system in that city. Attendance, 26.

Oct. 25.—We had a visit from the Executive and several out of town members of the Association of Professional Engineers of Ontario. Mr. R. G. Cone again described the bridge. Attendance, 73.

Nov. 15.—Mr. G. T. Bentley, Assistant Superintendent of Manufacture of the Detroit City Gas Co. spoke on, **"The Manufacture and Distribution of Gas."** Attendance, 20.

The average attendance at meetings was 34. This average compares with an average of 31 for 1926; 20 for 1927 and 38 for 1928.

Financial

Following is a summary of our receipts and expenditures up to and including December 13th. There will be one or two small items to come in yet before the end of the year.

FINANCIAL STATEMENT
(1929)

Receipts		
Balance in bank December 29, 1928	$174.55	
H.Q. rebates, balance of 1928	6.00	
	180.55	
H.Q. rebates 1929	217.08	
H.Q. Branch news and advertising	14.00	
Meals at meetings	289.75	
Assistance toward entertaining Professional Engineers of Ontario	86.65	
		$795.17
Expenditures		
Notices	$ 48.49	
Stamps and telegrams	9.42	
Typing	11.00	
Speaker's expenses	43.72	
Meals	353.25	
Cigars	35.00	
Miscellaneous	54.50	
	555.38	
Balance on hand Dec. 31st, 1929	239.79	
		$795.17

Respectfully submitted,

R. C. LESLIE, Jr.E.I.C., *Secretary-Treasurer.*

Calgary Branch

The President and Council,—

On behalf of the Executive Committee we beg to submit the following report of the activities of the Calgary Branch for the calendar year 1929:—

OFFICERS

The officers elected at the annual meeting held on March 9th and the *ex-officio* officers for the Branch year were as follows:—

Chairman	F. J. Roberston, A.M.E.I.C.
Vice-Chairman	W. St.J. Miller, A.M.E.I.C.
Secretary-Treasurer	W. H. Broughton, A.M.E.I.C.
Executive (Elected)	F. M. Steel, M.E.I.C.
	F. J. Heuperman, A.M.E.I.C.
	R. C. Harris, M.E.I.C.
Ex-officio	J. H. Ross, A.M.E.I.C.
	T. Lees, M.E.I.C.
Auditors	A. W. P. Lowrie, A.M.E.I.C.
	C. C. Richards, M.E.I.C.
Branch Editor	H. R. Carscallen, A.M.E.I.C.

MEMBERSHIP

A statement of the membership at the end of 1929 and a comparison with that at the end of 1928, follows:—

Dec. 31st, 1928	Resident	Non-Resident	Total
Members	22	7	29
Associate Members	47	23	70
Juniors	5	1	6
Students	1	2	3
Branch Affiliates	11	..	11
Totals	86	33	119

Dec. 31st, 1929	Resident	Non-Resident	Total
Members	22	8	30
Associate Members	49	18	67
Juniors	3	1	4
Students	5	4	9
Branch Affiliates	12	..	12
Totals	91	31	122

MEETINGS

The executive met ten times during the year and once jointly with the policy committee to draft telegrams which were sent to the Premier, the Minister of Finance, the Hon. Chas. Stewart and the Federal Members representing Calgary, regarding increases of salary for professional Federal Civil Servants.

The committee in charge of arrangements for the annual ball met four times and as a result of their efforts a very successful ball was held at the Palliser hotel on Friday, Nov. 22nd, at which 318 guests and members with their ladies were present. This function is now established as a regular event in the social life of the city and is an excellent publicity feature of the local Branch of The Institute.

Nine general meetings were held which were all announced in the local press, with the result that there were usually a few non-members present; the press generally give us a very fair write-up of our meetings.

Details of the meetings and speakers were as follows:—

Jan. 10.—**"Considerations of Industrial Railway Trackage"** by J. McL. Nicol, A.M.E.I.C., of the engineering department, C.P.R., Calgary.
"Carrier Telegraph Systems" by L. A. B. Hutton, A.M.E.I.C., inspector of telegraphs, C.P.R., Calgary.
"Evaporation as a Factor in Hydrology" by J. A. Spreckley, A.M.E.I.C., hydrologist, D.W.P. and R.S., Calgary.
"Portland Cement Concrete" by K. MacKenzie, Jr.E.I.C., of the Canada Cement Company. Attendance, 36.

Jan. 24.—**"Engineering and Public Service"** by Dr. R. C. Wallace, President of the University of Alberta, Edmonton. Attendance, 43.

Feb. 7.—**"Deep Well Drilling Practices"** by C. W. Dingman, Esq., chairman of the petroleum section of the Canadian Institute of Mining and Metallurgy. Attendance, 55.

Feb. 21.—**"Aerial Topics"** by C. W. Leggatt Esq., B.S.A., M.Sc., President of the Calgary Aero Club.
"Aviation, Review and Prophecies" by W. St.J. Miller, A.M.E.I.C., vice-chairman of the Branch. Attendance, 26.

Mar. 9.—Annual meeting and election of officers. Attendance, 18.

Mar. 9.—Annual dinner. Attendance, 61.

Mar. 27.—**"Hydraulic Regulating Gates"** by F. Newell, M.E.I.C., mechanical engineer, Dominion Bridge Co., Montreal. Attendance, 33.

Nov. 7.—**"The Romance of Map Making"** by M. P. Bridgland, M.E.I.C., of the D.W.P. & R.S., Calgary. Attendance, 36.

Nov. 22.—Annual ball. Attendance, 318.

Dec. 5.—**"The Oil Industry in Alberta"** by B. L. Thorne, M.E.I.C., coal mines branch, D.N.R., C.P.R., Calgary. Attendance, 36.

Dec. 19.—**"Closer Relations with the Professional Associations"** by S. G. Porter, M.E.I.C., chairman of The Institute Committee dealing with this subject.
J. H. Ross, A.M.E.I.C., also gave a resumé of other business done at the Plenary Meeting of Council.
"Static Electricity" by F. N. Rhodes, A.M.E.I.C., in charge of the electrical department, Institute of Technology and Art, Calgary. Attendance, 17.

The average attendance was 36, excluding the annual ball and the annual dinner.

A business meeting to discuss the proposed increase in dues has been arranged for January 9th, 1930.

FINANCIAL STATEMENT

(Year ending December 31st, 1929)

Assets			
Cash in bank		$ 385.41	
Value of bonds, net		1,057.92	
Rebates due as per wire from H.Q.		5.85	$1,449.18
Liabilities			
Cheque outstanding (M. MacGowan)			4.18
			$1,445.00
Net value of assets, Jan. 1st, 1929			1,352.58
Increase in value of assets			$ 92.42
Receipts			
Cash in bank Jan. 1st, 1929		$ 264.68	
Interest on bonds and savings		54.73	
Rebates from H.Q.		252.30	
Rebates due as per wire from H Q.		5.85	
Branch news		13.30	
Branch Affiliates		32.00	
Profit on ball, Nov. 22nd, 1929		45.88	
			$ 668.74
Expenditures			
Expense, ball of 1928		$ 18.30	
Expenses for meetings and speakers		143.20	
Stenographic services		17.28	
Printing, postage and office		102.88	
Cash in bank	$385.41		
Cheque outstanding	4.18		
		$ 381.23	
Rebates due as per wire		5.85	
			387.08
			$ 668.74

Audited and found correct, January, 3rd, 1930.

C. C. RICHARDS, M.E.I.C. }
A. W. P. LOWRIE, A.M.E.I.C. } Auditors.

Respectfully submitted,

F. J. ROBERTSON, *Chairman.*

W. H. BROUGHTON, A.M.E.I.C., *Secretary-Treasurer.*

Cape Breton Branch

The President and Council,—

The Executive Committee of the Cape Breton Branch submits the following report of the Branch activities during the year ending December 31st, 1929:—

Financial Statement

Receipts

Balance in bank	$ 66.15	
Dues collected	10.00	
Rebates from Headquarters	118.26	
Rebate on telegram	3.24	
Receipts annual dinner	106.00	
		$303.65

Expenditures

Telegrams	$ 3.24	
Printing	6.93	
Rent	45.00	
Board of Trade Rooms	2.00	
Wreaths	46.10	
Journal subscriptions	4.00	
Expense annual dinner	130.40	
Stenographer	10.00	
Stenographer	10.00	
Miscellaneous	5.89	
	$263.56	
Balance in bank	40.09	
		$303.65

Papers

Papers read during the year—as follows:—

Jan. 22.—"**Coal Mining in Spitzbergen**" by Louis Frost.
Jan. 24.—"**The St. Lawrence Waterways**" by O. O. Lefebvre, M.E.I.C.
Apr. 22.—"**The Zinc Coating of Steel Wires**" by A. D. Turnbull, S.E.I.C.
July 23.—"**Anaconda Copper Mining Company**" by W. L. Strewe.
Nov. 26.—"**Tendency in Coal Mining Machinery**" by F. W. Gray, M.E.I.C.
Dec. 12.—Annual Dinner—Isle Royale hotel.

Membership is now 39 against 42 for 1928.

New Executive

Chairman........A. L. Hay, M.E.I.C.
S. C. Mifflen, A.M.E.I.C.
C. M. Smyth, A.M.E.I.C.
J. P. Cotter, A.M.E.I.C.
Y. C. Barrington, A.M.E.I.C.
J. A. Fraser, A.M.E.I.C.
E. L. Ganter, A.M.E.I.C.

Respectfully submitted,

M. Dwyer, A.M.E.I.C., *Chairman.*
E. L. Ganter, A.M.E.I.C., *Secretary-Treasurer.*

Edmonton Branch

The President and Council,—

The Executive Committee of the Edmonton Branch begs to submit the following report on the activities of the Branch during the year 1929.

Officers

January to August

Chairman........Vernon Pearson, A.M.E.I.C.
Vice-Chairman........R. W. Ross, A.M.E.I.C.
Secretary-Treasurer........H. R. Webb, Jr.E.I.C.
Committee........R. W. Jones, M.E.I.C.
J. Garrett, A.M.E.I.C.
C. F. Corbett, A.M.E.I.C.
C. R. Crysdale, M.E.I.C.
Ex-officio........A. I. Payne, M.E.I.C.
R. J. Gibb, M.E.I.C.

August to December

Chairman........R. W. Ross, A.M.E.I.C.
Vice-Chairman........J. Garrett, A.M.E.I.C.
Secretary-Treasurer........H. R. Webb, Jr.E.I.C.
Committee........W. H. Greene, M.E.I.C.
A. W. Haddow, A.M.E.I.C.
C. A. Robb, M.E.I.C.
E. Stansfield, M.E.I.C.
Ex-officio........Vernon Pearson, A.M.E.I.C.
R. S. L. Wilson, M.E.I.C.

Meetings

Lectures and papers given before the Branch during the year were as follows:

Jan. 22.—"**Mechanics and Power of Expression**" by the Rev. Thomas Tait.
Feb. 28.—"**The Ghost Water Power Project**" by I. F. Morrison, Professor of Applied Mechanics, University of Alberta, Edmonton, Alberta.
Oct. 30.—Report from Plenary Council Meeting, by R. S. L. Wilson, M.E.I.C., dean, Faculty of Applied Science, University of Edmonton, Alberta.
Nov. 20.—"**The Development of Long Distance Telephony**" by J. D. Baker, deputy minister and general manager, Alberta Government Telephones, Edmonton, Alberta.

Membership

The Branch membership is now as follows:—

	Resident	*Non-resident*
Members	15	2
Associate Members	24	8
Juniors	4	1
Students	13	1
Branch Affiliates	1	..
Total	57	12

Financial Statement

Receipts

Balance on hand January 1, 1929	$143.49	
June 12, rebates from Headquarters	92.25	
Oct. 4, " " "	26.40	
Dec. 23, " " "	20.40	
		$282.54

Expenditures

Expenses, meetings and speakers	$ 20.35	
Printing, postage	14.05	
Miscellaneous, telegrams, etc.	14.03	
Balance on hand, December 31, 1929	234.11	
		$282.54

Respectfully submitted,

R. W. Ross, A.M.E.I.C., *Chairman.*
H. R. Webb, Jr.E.I.C., *Secretary-Treasurer.*

Halifax Branch

The President and Council,—

On behalf of the chairman and Executive Committee of the Halifax Branch I wish to submit the following report on the activities of the Branch for the past year.

Including the annual meeting there have been seven regular meetings of the Branch, and one special meeting in August to meet President Mitchell who came from the Professional Meeting in Moncton for this purpose, and eight meetings of the Executive.

The regular meetings were as follows:—

Jan. 23.—"**St. Lawrence Waterways Project**" by Mr. O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission. Attendance, 45.
Feb. 21.—"**Manufacture of Paper**" by Col. C. H. L. Jones, President of the Mersey Paper Company, Ltd. Attendance, 55.
Mar. 21.—"**Heating of Modern Buildings**" by Mr. F. W. Spencer of the C. A. Dunham Company. Attendance, 23.
Apr. —"**Natural Resources and Reforestation of Nova Scotia**" by Mr. Otto Schierbeck, chief forester, Province of Nova Scotia. Attendance, 35.
Oct. —"**The Submarine**" by Mr. John Patterson. "**Canada, the Land of Opportunity**" by Mr. C. H. Wright, M.E.I.C. Attendance, 150.
Nov. —General business meeting to hear reports from committee on amalgamation of Professional Society and The Institute. Attendance, 28.
Dec. —The annual meeting at the Halifax hotel at which the following officers for the year 1930 were elected:—

Chairman........Professor W. P. Copp, M.E.I.C.
Executive........J. L. Allan, M.E.I.C.
C. St.J. Wilson, A.M.E.I.C.
L. M. Allison, A.M.E.I.C.
J. D. Fraser, S.E.I.C.
W. H. Noonan, A.M.E.I.C.
J. J. Sears, A.M.E.I.C.
G. S. Stairs, M.E.I.C.
W. G. Matheson, M.E.I.C.
H. F. Bennett, A.M.E.I.C.
G. T. Medforth, A.M.E.I.C.
D. S. Wickwire, A.M.E.I.C.
Auditors........F. R. Faulkner, M.E.I.C.
G. W. Burchell.

Branch representative on Nominating Committee: W. A. Winfield, M.E.I.C.

Attendance: 38.

The attendance record is worthy of special attention, there being a total of 336 at six regular meetings or an average of 56 which shows an increased interest in Branch activities and the appreciation of the members to the speakers and the work of the Papers Committee.

The midsummer meeting to greet President Mitchell was very successful as thirty seven members were present at the midday meeting at the Halifax hotel.

Considerable progress was made during the year toward amalgamation with the Professional Society and the efforts put forward by the

Executive and Committee in charge of this work deserve your commendation.

The following is a statement of the finances to date:—

FINANCIAL STATEMENT

Receipts

Cash on hand January 1, 1929	$123.58
Rebates	233.20
Branch news	27.13
Dues—Branch Affiliates	24.00
Bank interest	5.61
	$413.52

Disbursements

Meetings	$ 89.74	
Secretary's office	24.61	
Printing	31.25	
Flowers	18.00	
Mailing list	3.50	
	$167.10	
Balance on hand		$246.42

Audited and found correct:—

F. R. FAULKNER, M.E.I.C.
G. W. BURCHELL.

Respectfully submitted.

HARRY F. BENNETT, A.M.E.I.C., *Chairman.*
R. R. MURRAY, A.M.E.I.C., *Secretary-Treasurer.*

Hamilton Branch

The President and Council,—

The Executive Committee of the Hamilton Branch submits the following report for the year 1929.

The Branch year dates from June 1st so that two Executive Committees acted as follows:—

January to May		*June to December*
W. L. McFaul, M.E.I.C.	Chairman	H. A. Lumsden, M.E.I.C.
J. A. McFarlane, M.E.I.C.	Vice-Chairman	A. H. Munson, A.M.E.I.C.
F. P. Adams, A.M.E.I.C.	Committee	J. B. Carswell, M.E.I.C.
W. D. Black, M.E.I.C.		H. S. Phillips, M.E.I.C.
H. A. Lumsden, M.E.I.C.		F. P. Adams, A.M.E.I.C.
G. R. Marston, A.M.E.I.C.		W. D. Black, M.E.I.C.
W. F. McLaren, M.E.I.C.	Sec.-Treasurer	W. F. McLaren, M.E.I.C.
R. K. Palmer, M.E.I.C.	Councillor	R. K. Palmer, M.E.I.C.
L. W. Gill, M.E.I.C.	Past Chairman	W. L. McFaul, M.E.I.C.
J. R. Dunbar, A.M.E.I.C.	News Editor	J. R. Dunbar, A.M.E.I.C.

The oustanding event of the year was the Annual General and General Professional Meeting held at the Royal Connaught hotel, Feb. 13th, 14th and 15th during the chairmanship of W. L. McFaul, M.E.I.C.

The main committee handling the arrangements was composed of the chairmen of the sub-committees and consisted of the following:—

Chairman	W. D. Black, M.E.I.C.
Entertainment	J. B. Carswell, M.E.I.C.
Papers	L. W. Gill, M.E.I.C.
Reception	R. K. Palmer, M.E.I.C.
Ladies	A. H. Munson, A.M.E.I.C.
Advertising	C. C. Wimperley.
Visits	J. A. McFarlane, M.E.I.C.
Luncheons	J. R. Dunbar, A.M.E.I.C.
Finances	W. L. McFaul, M.E.I.C.
Ladies	Mrs. R. K. Palmer.
Secretary	W. F. McLaren, M.E.I.C.

MEMBERSHIP

	Dec. 31st, 1928			*Dec. 31st, 1929*		
	Resident	*Non-resident*	*Total*	*Resident*	*Non-resident*	*Total*
Members	22	6	28	24	6	30
Assoc. Members	49	11	60	49	10	59
Affiliates	0	0	0	2	0	2
Juniors	8	5	13	9	5	14
Students	31	4	35	36	6	42
Br. Affiliates	27	0	27	23	0	23
Total			163			170

MEETINGS

The following meetings were held:—

Jan. 25.—Welded Structures by the late Prof. Peter Gillespie. Attendance 25.

Feb. 13 to 15.—Annual General and General Professional Meeting. Attendance 450.

Apr. 3.—Research by Dr. H. M. Tory. Attendance 73. Joint Meeting with C.M.A. and Chemists.

Apr. 26.— Vacuum Tube Devices by J. V. Breisky. Attendance 360. Joint Meeting with Toronto branch A.I.E.E.

May 31.—Annual Business Meeting and dinner with address on a **"Trip Through Ireland"** by Rev. G. W. Tebbs.

Sept. 27.—Joint meeting with Niagara Peninsula Branch. Address on **"Institute Affairs from the Branch Viewpoints"** by E. G. Cameron, M.E.I.C. Attendance 35.

Oct. 15.—**"Production Testing of Vacuum Tubes"** by K. S. Weaver and W. S. Jones of the Westinghouse Lamp Co., Bloomfield, N.J. On the invitation of the Toronto branch of the Institute of Radio Engineers.

Oct. 23.— Invited by Niagara Peninsula Branch to inspection trip of Welland ship canal in afternoon and addresses in St. Catharines in evening by F. E. Stearns, M.E.I.C., and A. A. Northrop of Stone & Webster Engineering Corpn.

Nov. 6.—Addresses on **"Machine Tools"** by H. G. Bertram, M.E.I.C. **"Plenary Meeting of Council"** R. K. Palmer, M.E.I.C. **"Coke Ovens of the Steel Co. of Canada"** J. E. Grady, A.M.E.I.C. **"Power Factor"** by J. R. Dunbar, A.M.E.I.C. Attendance 36.

Dec. 5.—**"Engineering Developments in the Army"** by Major Gen. A. G. L. McNaughton, M.E.I.C. Attendance 50.

Dec. 11.—Invited by Ontario Section A.S.M.E. to afternoon and evening meeting at Galt.

FINANCIAL STATEMENT

Receipts

Brought forward	$ 721.11	
Branch Affiliates	66.00	
Journal subscriptions	10.00	
Rebates on fees	251.35	
Branch news	19.63	
Bank interest	35.94	
Annual meeting committee	282.92	
		$1,386.95

Expenses

Printing and postage	$ 71.39	
Lecture expenses	23.25	
Refreshments	26.60	
Flowers (A. M. Jackson)	8.25	
Journal subscriptions	10.00	
Stenographer	50.00	
Annual meeting and dinner	31.50	
Fall opening dinner	30.15	
Philip R. Adams—prize	15.00	
Miscellaneous	10.34	
Balance	1,110.47	
		$1,386.95

Respectfully submitted,

H. A. LUMSDEN, M.E.I.C., *Chairman.*
W. F. McLAREN, M.E.I.C., *Secretary-Treasurer.*

Kingston Branch

The President and Council,—

During the year 1929 the Branch held four meetings.

On February 26th a dinner was held at the Students' Union, Queen's University at which 22 members were present. Unfortunately the speaker scheduled for this occasion was at the last moment prevented from attending.

On March 19th the Branch was addressed by Mr. R. O. Wynne-Roberts, M.E.I.C., of Wynne-Roberts, Son & McLean, on the **East York Sewage Disposal Works.**

On Nov. 15th Mr. A. S. Wall of the Dominion Bridge Company gave a paper on **Structural Steel Welding.**

On Nov. 22nd the President of the E.I.C. visited Kingston and addressed the members of the Branch on **Institute Affairs.**

The average attendance at meetings was twenty-three.

The membership is at present as follows:—

Honorary Member	1
Members	13
Associate Members	14
Junior Members	2
Student Members	40
Total	70

The finances of the Branch are satisfactory and a detailed statement is appended:

FINANCIAL STATEMENT
(1929)

Receipts

Balance last acct	$ 79.83	
June 11,—Rebates	71.70	
" 11,—Branch news	6.45	
Sept. 23,—Rebates	5.35	
" 23,—Branch news	3.16	
Dec. 31,—Rebates	21.90	
" 31,—Branch news	4.87	
" 31,—Bank interest	1.42	
		$194.88

Expenditures

Feb. 8,—Entertainment	$ 2.00	
" 21,—Stationery	3.56	
" 21,—Expenses of Secretary to General Meeting of E.I.C.	13.50	
" 28,—Cards	1.43	
Mar. 21,—Entertainment	8.25	
" 21,—Cards	1.52	
" 26,—Expenses re dinner	13.70	
" 14,—Sundries	12.00	
Nov. 29,—Entertainment	4.00	
Dec. 13,—Postage	.90	
" 31,—Cards	1.37	
" 31,—Honorarium Secretary	50.00	
Bank Balance	82.65	
		$194.88

Respectfully submitted,
L. F. Grant, m.e.i.c., *Secretary-Treasurer.*

Lakehead Branch

The President and Council,—

On behalf of the Executive Committee, I beg to submit the following annual report of the Lakehead Branch of The Engineering Institute of Canada.

Membership

On January 1st, 1929, there were 44 corporate members and 11 non-corporate members and on December 31st, 1929, there were 41 corporate members and 10 non-corporate members, showing a loss of 3 corporate and 1 non-corporate members.

Meetings

Four meetings were held during the year as follows;—

Feb. 12.—A meeting of the Branch was held at the new Technical School, Port Arthur, at 6.30 p.m. The school's domestic science class served a most enjoyable supper in their class room to the members. After the supper a meeting was held in the board room. It was at this meeting that the Branch decided to ask that the Professional Meeting for 1929 be allotted to the Lakehead Branch. After the meeting, Mr. McWilliams, the principal, conducted the members through the new school, a trip which was greatly enjoyed by all.

Apr. 23.—A meeting of the Branch was held at the Garrison Officers' mess, Port Arthur. This was a business meeting, at which matters relative to the Branch were discussed.

May 2.—On this date, our General Secretary, R. J. Durley, m.e.i.c., honoured us with a visit. At noon, Mr. Durley had as his guests at the Royal Edward hotel, Fort William, the officers and members of the Executive Committee of the Branch, to luncheon. After lunch, a general discussion of affairs relative to the holding of the Professional Meeting at the Lakehead took place. In the evening, at the Garrison Officers' mess, a meeting of the Branch was held, at which Mr. Durley again pointed out matters relative to the holding of a Professional Meeting. He also spoke on affairs in general relating to The Engineering Institute.

Oct. 2.—A meeting of the Branch was held at the Garrison Officers' mess, Port Arthur, when matters relative to the interests of the Branch were discussed. At this meeting also, Mr. Brophy, who was going to Montreal to attend the Plenary Meeting of Council, was given the views of the various members on matters which were to come before the Plenary Meeting.

I am sorry to have to report the death of two members of the Branch during the past year, Jos. C. Meader, a.m.e.i.c., of Fort William, a member of the Executive Committee of the Branch and one who took a great deal of interest in the affairs of The Institute at all times, and C. N. Wylde, a.m.e.i.c., of Dryden, Ont.

The following were nominated to represent the Lakehead Branch on the Council of The Institute:

F. Y. Harcourt, m.e.i.c., D. G. Calvert, a.m.e.i.c.

Financial Statement

Revenue

Balance in bank, December 31st, 1928	$241.12	
Rebates on fees	87.45	
Rebates on fees due and not deposited	8.25	
Interest	6.05	
		$342.87

Expenditure

Telegrams	$ 19.73	
Postage	2.00	
Entertainment	64.04	
Travelling expenses to Plenary Meeting	125.00	
Sundries	13.55	
Balance in bank, December 31st, 1929	118.55	
		$342.87

Respectfully submitted,
Geo. P. Brophy, a.m.e.i.c., *Secretary-Treasurer.*

Lethbridge Branch

To the President and Council,—

On behalf of the Executive Committee of the Lethbridge Branch, I have the pleasure of submitting to you the following report showing the progress during the last year.

Since January 1st, the executive has held six meetings all well attended, in addition to thirteen regular and special meetings at which the attendance averaged 34. Very great credit has been due to the Programme Committee for the excellent speakers secured for the regular meetings. It was unfortunate that on the occasion of Mr. Durley's visit, so many of the members were away, but as the date fell during the usual vacation period, the small attendance was naturally accounted for.

A list of the regular meetings with speakers and subjects follows:

Jan. 12.—F. J. Robertson, a.m.e.i.c., gen. supt. Calgary Power Company. Subject: **"Some Features of Power Development in Alberta."**

Jan. 17.—Special meeting, discussion of Institute affairs.

Jan. 26.—Dr. R. C. Wallace, President of Alberta University. Subject: **"Engineering and Public Service."**

Feb. 9.—A. W. Shackleford, Manager, Capitol Theatre, Lethbridge. Subject: **"The Dawn of the Motion Picture up to the Third Era."**

Feb. 23.—H. J. McLean, a.m.e.i.c., Calgary Power Company. W. H. Abbott, a.m.e.i.c., Foundation Co. of Canada. Subject: **Engineering and Construction Features of the Ghost River Power Project, Calgary Power Company."**

Mar. 9.—Annual meeting, general discussion on **"Radio Broadcasting."**

Mar. 23.—Joint meeting with Professional Engineers of Alberta. M. L Wade, gen. supt., East Kootenay Power Company. Subject: **"Some Economic Features of the Power Situation."**

July 16.—Special meeting with Mr. Durley present.

Sept. 21.—Special meeting, discussion of Institute affairs.

Oct. 19.—H. L. Seamans, Entomological Branch, Dept. of Interior. Subject: **"The Effect of Weather on Insects."**

Nov. 2.—B. Jordon, Jeffrey Manufacturing Co., Columbus, Ohio. Subject: **"Coal Cutting Machinery and Conveyors,"** with motion pictures.

Nov. 16.—J. Giegerich, Consolidated Mining & Smelting Co., Kimberley. Subject: **"The Sullivan Mine."**

Nov. 30.—H. B. Banks, Consolidated Mining & Smelting Company, Kimberley. Subject: **"The Kimberley Concentrator."**

Dec. 14.—J. E. Duncan, Geophysicist, Canadian Western Natural Gas Company. Subject: **"Geophysical Methods applied to Foundations."**

The Branch annual meeting was held on March 9th, when the following officers were chosen for the ensuing year:

Chairman	J. B. de Hart, m.e.i.c.
Vice-Chairman	C. S. Clendening, a.m.e.i.c.
Executive	J. T. Watson, a.m.e.i.c.
	R. Livingstone, m.e.i.c.
	P. M. Sauder, m.e.i.c.
Ex-Officio	N. H. Bradley, a.m.e.i.c.
Councillor	G. S. Brown, a.m.e.i.c.
Auditors	C. S. Clendening, a.m.e.i.c.
	W. L. McKenzie, a.m.e.i.c.
Secretary-Treasurer	Wm. Meldrum, a.m.e.i.c.

The membership of the Branch as at December 31st, 1929, is as follows:—

	Resident	*Non-Resident*	*Total*
Members	6	0	6
Associate Members	20	7	27
Junior Members	0	1	1
Student Members	1	0	1
Branch Affiliates	31	0	31
Total	58	8	66

Financial Statement
(As at December 31st, 1929)

Revenue

Bank balance as at Dec. 31st, 1928	$199.41	
Rebates due from Headquarters	5.40	
		$204.81
Rebates received from Headquarters		98.85
Branch news items from Headquarters		32.11
Received on account of telegrams from Headquarters		14.00
Branch Affiliate fees		86.00
Bank interest		6.34
Rebates due from Headquarters as per telegram		1.20
		$443.31

Expenditures

Affiliate Journal fees to Headquarters	$ 26.00	
Printing and stationery	43.27	
Music, complimentary dinners, speakers exs., gratuities	109.00	
Telegrams, postage etc	22.38	
		$200.65

Assets

Bank balance as at December 31st, 1929	$242.46	
Rebates due from H.Q. as per telegram	1.20	
Percentage of members' fees in arrears	37.80	
	281.46	
Less outstanding cheques	1.00	
		$280.46

Liabilities

Accounts due and payable: Journal fees to H.Q...	$ 2.00	
		$ 2.00

We have examined the vouchers, papers and the foregoing statement prepared by the Secretary-Treasurer, and find the same to be a true and correct account of the standing of the Branch.

W. L. McKenzie, A.M.E.I.C.
C. S. Clendening, A.M.E.I.C. } Auditors.

Respectfully submitted,
J. B. de Hart, M.E.I.C., *Chairman.*
Wm. Meldrum, A.M.E.I.C., *Secretary-Treasurer.*

London Branch

The President and Council,—

On behalf of the Executive Committee of the London Branch, we beg to submit the following summary of London Branch activities for the year ending December 31st, 1929:—

At the call of the chairman nine Executive Committee meetings were held. At these meetings plans were made for the seven regular Branch meetings and the annual inspection trip.

The year began with the annual dinner meeting held in the Hotel London. Reports of the past year's progress were read and officers were elected for 1929. The Branch was honoured in the presence of the late Peter Gillespie as speaker of the evening. His choice of subject was **"Canada's Nearest Neighbour"** and his appeal to each of his hearers to foster the most friendly relationship with our neighbours to the south left a very decided impression on those present and demonstrated the kindly character of the speaker. Vocal music brightened the evening.

In order to allow as many members as possible to attend the Annual General Meeting in Hamilton, the regular February meeting of this Branch was cancelled.

For the March meeting Mr. Lesslie R. Thomson's paper on the **"St. Lawrence Problem"** was discussed. The following members of the Branch led the discussion; Messrs. W. M. Veitch, G. H. Chalmers, D. M. Bright, V. A. McKillop and G. E. Martin. At the close of the meeting light refreshments were served.

In April, Mr. W. E. Barker of the Portland Cement Association, gave two lectures before the London Branch on **"The Design and Construction of Concrete Street Pavements."** As in the past these lectures were well attended and proved very instructive.

For the meeting of May 17th, there were two speakers. The Branch was pleased to have a visit from Mr. R. J. Durley who addressed the meeting on Headquarters matters. Mr. Andrew Vogel, of the General Electric Co., Schenectady, spoke on **"Arc Welding in the Fabrication of Structural Steel."** The advantages of welding in certain construction jobs were clearly explained by Mr. Vogel.

The annual inspection trip was taken on October 5th. Members of the Branch with friends motored to Windsor where they were met by members of the Border Cities Branch to be conducted over the new Ambassador bridge and the new Detroit-Windsor tunnel. After dinner at the Prince Edward hotel, Mr. Thoreson gave an illustrated address on the construction of the tunnel. This trip proved to be one of the most instructive trips that the Branch has had.

On November 8th, Prof. R. W. Angus, of the University of Toronto, addressed the meeting on **"Engineering in Europe."** Prof. Angus has had an extended trip on the continent, visiting engineering works of prominence and paying particular attention to hydro-electric power development. His illustrated address brough a great deal of engineering information to his audience.

The London Branch was honoured in the presence, on December 12th, of Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., President of The Institute. After dinner at the Hotel London the President spoke on **"The Engineering Institute and the Progress of Engineering in Canada."** The activities of The Institute were outlined, with special attention being devoted to the work being done to bring about union between The Institute and the various provincial professional associations. Brig.-Gen. Mitchell's comprehensive outline of the engineering work being done in Canada impressed his audience with the vast construction programme that is in progress, the greater part of which is being designed and supervised by members of The Engineering Institute of Canada.

Membership

The membership of the London Branch for 1928 and 1929 was as follows:—

	1928	*1929*
Members	14	15
Associate Members	32	29
Juniors	4	5
Students	10	14
Affiliates	2	2
Branch Affiliates	5	4
	67	69

Financial Statement

(Year ending December 31st, 1929)

Receipts

Balance in bank, January 1st, 1929	$114.11	
Rebate from Headquarters from 1928	2.70	
Rebate from Headquarters for 1929—dues	124.05	
Branch news.	18.05	
Fees from Branch Affiliates	7.50	
From Headquarters for telegrams	3.00	
From dinner, Nov. 21st	12.00	
	$281.41	
Rebates due from Headquarters	2.10	
		$283.51

Expenditures

Notices, printing, and stationery	$ 38.49	
Postage and excise stamps	12.78	
Telephone and telegrams	6.22	
Annual dinner—hotel, cigars, entertainers	27.30	
Refreshments	8.93	
Hotel rooms and railway fares	33.70	
Dinner expenses (other than annual)	52.00	
Janitor, stenographer, elevator	11.00	
Lantern slides	2.25	
Bank balance, December 31st, 1929	86.24	
Cash on hand, December 31st, 1929	2.50	
Rebates due from Headquarters	2.10	
		$283.51

We have examined the above statement prepared by the Secretary-Treasurer and find the same to be a correct and true account of the financial standing of the London Branch.

W. M. Smith,
V. A. McKillop, A.M.E.I.C., } Auditors.

Respectfully submitted,
W. M. Veitch, A.M.E.I.C., *Chairman.*
Frank C. Ball, A.M.E.I.C., *Secretary-Treasurer.*

Moncton Branch

The President and Council,—

On behalf of the Executive Committee we beg to submit the tenth annual report of Moncton Branch.

The Executive Committee held six meetings. There were eight meetings of the Branch held, four of which were supper meetings. The usual mid-winter meeting was held at Sackville for the benefit of the engineering students of Mount Allison University.

During the past summer the Branch had the honour of acting as hosts to a Maritime Professional Meeting. The total registration was 138. Four papers were read, all of timely interest and excellence.

Membership

Our membership at present consists of sixty-three members, as follows:—

	Resident		*Non-Resident*
Members	10	Members	3
Associate Members	22	Associate Members	12
Juniors	3	Juniors	3
Students	2	Students	6
Affiliates	2		
Total	39	Total	24

Officers

The annual meeting of the Branch was held on May 26th, 1929. The following officers were elected for 1929-30:—

Chairman .... M. J. Murphy, A.M.E.I.C.
Vice-Chairman .... L. H. Robinson, M.E.I.C.
Secretary-Treasurer .... V. C. Blackett, A.M.E.I.C.
Executive .... T. L. Landers, M.E.I.C.
J. G. Mackinnon, A.M.E.I.C.
C. S. G. Rogers, A.M.E.I.C.

The members of the Executive Committee in addition to the above are:—

J. R. Freeman, A.M.E.I.C.
G. E. Smith, A.M.E.I.C.
Frank Williams, A.M.E.I.C.
Ex-officio....................F. O. Condon, M.E.I.C.
H. J. Crudge, A.M.E.I.C.
A. S. Gunn, A.M.E.I.C.

FINANCIAL STATEMENT

The financial statement for the year ending December 31st, 1929, is as follows:—

Revenue		
Balance in bank January 1, 1929	$142.22	
Cash on hand January 1, 1929	4.98	
Rebates on dues	105.00	
Branch news	25.04	
Tickets sold for supper meetings	176.00	
Bank interest	3.99	
Headquarters grant, Maritime Professional Meeting	300.00	
Receipts, Maritime Professional Meeting	151.50	
Rebate, Maritime Professional Meeting expenses, chargeable to Headquarters	24.66	
Rebate on telegrams to Members of Parliament	27.28	
City of Moncton	4.00	
Canadian Club of Moncton	6.75	
Rebates due from Headquarters	2.10	
		$973.52
Expenditures		
Expenses of meetings	$182.00	
Expenses, Maritime Professional Meeting	430.86	
Refund to Headquarters, acct. Maritime Professional Meeting	20.64	
Postage	4.00	
Printing and advertising	71.81	
Telegrams and telephones	32.97	
Miscellaneous	33.82	
Balance in bank	191.54	
Cash on hand	3.78	
Rebates due from Headquarters	2.10	
		$973.52

Audited and found correct.
E. T. CAIN, A.M.E.I.C.
R. H. EMMERSON, A.M.E.I.C. } Auditors

Respectfully submitted,
M. J. MURPHY, A.M.E.I.C., *Chairman.*
V. C. BLACKETT, A.M.E.I.C., *Secretary-Treasurer.*

Montreal Branch

The President and Council,—

We have the honour to submit the following report on the activities of the Montreal Branch of The Engineering Institute of Canada for the year 1929.

During the year there were eleven meetings held by the Executive Committee, and these were all well attended. The personnel of the Committee was as follows:—

Chairman..............J. A. McCrory, M.E.I.C., 1929.
Vice-Chairman..........D. C. Tennant, M.E.I.C., 1929.
Past Chairman..........F. C. Laberge, M.E.I.C.
Committee..............R. deL. French, M.E.I.C., 1928-29.
Huet Massue, A.M.E.I.C., 1928-29.
E. A. Ryan, M.E.I.C., 1928-29.
P. E. Jarman, A.M.E.I.C., 1929-30.
J. A. Lalonde, A.M.E.I.C., 1929-30.
Fred Newell, M.E.I.C., 1929-30.

Ex-officio the following members of Council:—
W. C. Adams, M.E.I.C.
F. A. Combe, M.E.I.C.
F. S. Keith, M.E.I.C.
O. O. Lefebvre, M.E.I.C.
G. R. MacLeod, M.E.I.C.
P. B. Motley, M.E.I.C.
P. L. Pratley, M.E.I.C.
F. P. Shearwood, M.E.I.C.
Julian C. Smith, M.E.I.C.

PAPERS AND MEETINGS COMMITTEE

Among the various activities of the Branch, the weekly meetings occupy the position of primary importance. The Committee appointed by this Executive had the arranging of the programme for the season 1929-30 and the personnel was as follows:—

Chairman........................N. L. Morgan, A.M.E.I.C.
Vice-Chairman....................P. E. Jarman, A.M.E.I.C.
Civil Section, Chairman...........L. L. O'Sullivan, A.M.E.I.C.
Electrical Section, Chairman.......A. S. Runciman, A.M.E.I.C.
Vice-Chairman...J. L. Clarke, A.M.E.I.C.
Mechanical Section, Chairman......H. G. Thompson, A.M.E.I.C.
Vice-Chairman.L. H. Birkett, A.M.E.I.C.
Municipal Section, Chairman......A. Cousineau, A.M.E.I.C.
Vice-Chairman..E. Roy, A.M.E.I.C.
Railway Section, Chairman........W. J. McAllister, A.M.E.I.C.
Vice-Chairman....Lt.-Col. F. F. Clarke, A.M.E.I.C.
Student Section, Chairman.........J. H. Haines, S.E.I.C.

A great deal of time and effort is involved in the preparation of these programmes, and in arranging details of the meetings. In addition to a large amount of private time spent in personal effort by the members of the Committee seven meetings were held at which the average attendance was nine.

There were forty-four papers or speakers considered, and from these the programme of twenty-eight papers given below was arranged. Many of the speakers are outstanding in the engineering world, and your Executive feel that their acceptance of invitations to address the Branch indicates the high esteem in which the Branch and The Institute is held. This position can only be maintained by the personal endeavour of each member to attend the meetings and take part in the discussion.

We feel the Papers and Meetings Committee is to be congratulated on the good work in obtaining this programme.

Oct. 3.—**"Carborundum Refractories,"** by Messrs. J. A. King and B. H. Shaw.
" 10.—**"Collection and Utilization of Garbage in European Cities,"** by C. M. Morssen, M.E.I.C.
" 17.—**"Propulsion of Ships by Modern Steam Machinery,"** by Mr. J. Johnson—read by Mr. W. C. Wolfe.
" 24.—**"160,000-k.w. Brown Boveri Turbo-Generator Unit, Installed at Hellgate Power Station, New York,"** by Mr. W. Roth.
" 31.—**"The Organization of Radio Broadcasting in Canada,"** by Dr. A. Frigon, A.M.E.I.C.
Nov. 7.—**"Tie Treatment,"** by G. P. McLaren, A.M.E.I.C., read by Mr. Forbes.
" 14.—**"Mersey River Development,"** by Mr. Blanchet.
"Hydraulic Sluice Gates," by Mr. Williams.
" 21.—**"Radio Interference,"** by H. O. Merriman, A.M.E.I.C.
" 28.—**"Work of the Engineering Standards Association,"** by B. Stuart McKenzie, M.E.I.C.
Dec. 5.—**"Canadian Pacific Railway Terminals,"** by T. Collins.
" 12.—**"Gasoline,"** by F. C. Mechin, A.M.E.I.C.
Jan. 9.—Branch Annual Meeting.
" 16.—**"Process of Zinc Coating Steel Wires,"** by A. D. Turnbull, S.E.I.C.
" 23.—**"Telephone Lines Outside North America,"** by J. L. McQuarrie.
" 30.—**"Scientific Development Leading to Sound Pictures,"** by Mr. Findlay.
Feb. 6.—**"Transformer Load Ratio Control,"** by C. E. Sisson, M.E.I.C.
" 13.—**"Reinforcing Stoney Creek Arch Bridge, British Columbia,"** by P. B. Motley, M.E.I.C.
" 20.—**"The Development of the Cottrell Process of Electrical Precipitation in Canada,"** by P. E. Landolt.
" 27.—**"Construction of the Sun Life Building in Montreal,"** by A. H. Harkness, M.E.I.C.
Mar. 6.—**"Climatic Cycles as Affecting Water Power,"** by A. Streiff.
" 13.—Student Paper.
" 20.—**"Highways of Ontario,"** by E. L. Miles, M.E.I.C.
" 27.—**"Toronto Sewage System,"** by G. Phelps, A.M.E.I.C.
Apr. 3.—**"Hydro-Electric Work in Brazil,"** by A. W. Billings.
" 10.—**"The New Canadian National Shops, Point St. Charles,"** by Mr. Roberts.
" 17.—**"Manufacture and Commercial Uses of Chlorine,"** by J. H. Hubel.
" 24.—**"Hydraulic Fill on Ghost River,"** by W. H. Abbott, A.M.E.I.C.
May 1.—Dr. L. E. Pariseau.

RECEPTION COMMITTEE

The Reception Committee, under the chairmanship of W. McG. Gardner, A.M.E.I.C., has been very active in welcoming to the meetings members and guests and in the other duties assigned to them. The Committee consisted of:—

W. McG. Gardner, A.M.E.I.C., Chairman
J. H. Forbes, A.M.E.I.C.
C. J. LeBlanc, A.M.E.I.C.
H. W. B. Swabey, M.E.I.C.
L. A. Ste. Marie, A.M.E.I.C..

The Committee reports that the average attendance at the weekly meetings was 94 which is somewhat above the average for previous years. However, the Executive feels that the attendance, being less than ten per cent of the total membership of the Branch, is not what it should be and indicates that a large number of the members do not realize the value to themselves and to the Branch of attendance at the meetings. Refreshments were provided at four of the meetings and served by the Reception Committee.

MEMBERSHIP

Although the total membership of The Institute has fallen during the past year, we are glad to be able to report an increase of 24 corporate and 14 non-corporate members, or a total of 38.

It is with the deepest regret that we have to record the loss by death of the following six members:—

A. W. K. Massey, A.M.E.I.C., Designing Engineer, Canadian Vickers Ltd.
H. S. Quigley, Affil.E.I.C., Manager, Canadian Airways Ltd.
Albert Dawes, M.E.I.C., Structural Engineer, Canadian Vickers Ltd.
A. W. Robinson, M.E.I.C., Consulting Engineer, Melbourne, Que.
R. W. T. Robb, A.M.E.I.C., District Manager, Robb Engineering Works, Ltd.
L. T. G. Boisseau, A.M.E.I.C., Engineer, Technical Service, City of Montreal.

Financial Statement

Ordinary Revenue		
Branch news	$ 58.96	
Affiliate dues	98.00	
Rebates from H.Q.	1,789.80	
Interest and discount	25.19	
		$1,971.95
Extraordinary Revenue		
Balance on hand, January 1st, 1930	816.76	
		$ 816.76
		$2,788.71
Expenditures		
Post card notices	$ 673.65	
Miscellaneous printing	56.40	
Stationery and stamps	19.96	
Secretary's honorarium	300.00	
Clerical assistance	120.00	
Telephone	64.35	
Movies, slides, etc.	90.48	
Miscellaneous	186.25	
		$1,511.09
Balance at December 31st, 1929		1,277.62
		$2,788.71

Publicity Committee

H. B. Montizambert, A.M.E.I.C., was appointed Chairman of this Committee at the beginning of the year and served until early in the fall, when he accepted a position which necessitated his leaving Montreal, and he tendered his resignation. The duties of the Publicity Committee, consisting of editing the Branch News and supervising reports of the meetings and other publicity work in the press, require a great deal of time and thought which Mr. Montizambert devoted faithfully to the work.

Summer Excursion

The Branch is indebted to the Montreal Island Power Company for their kindness in extending an invitation to visit the power development on the Riviere des Prairies. This invitation was accepted and on September 4th, a party of 150 members was conducted over the plant by guides supplied by the Power Company. Construction work on the development had reached a very interesting phase, one of the units having been completed and three others being in various stages of erection.

The Executive Committee in addition to routine work such as appointment of sub-committees, consideration of various matters of policy, and recommendations on application for admission and transfer, had a number of problems to consider notably those giving contact to other organizations. We were called upon to give support in the work of the following committees, and were represented on them by the members named.

Montreal Terminals Committee....O. O. Lefebvre, M.E.I.C. and J. A. McCrory, M.E.I.C.
Smoke Abatement Committee of the Citizens Association..........F. A. Combe, M.E.I.C.
City Improvement League.........R. deL. French, M.E.I.C.
Placement Bureau Committee, Board of Trade..............N. E. D. Sheppard, A.M.E.I.C.
Metropolitan Town Planning Board.R. deL. French, M.E.I.C.

Respectfully submitted,

J. A. McCrory, M.E.I.C., *Chairman.*
C. K. McLeod, A.M.E.I.C., *Secretary-Treasurer.*

Niagara Peninsula Branch

The President and Council,—

The Executive of the Niagara Peninsula Branch present herein the report of another successful year.

Meetings were well attended and a keen interest was shown in Institute affairs.

The attendance at thirteen executive meetings averaged 12, or 75 per cent. Failures to attend were almost invariably due to absence from the district, or similar good reasons.

The meetings have all been reported in the Journal. They are summarized hereunder:—

Jan. 15.—Discussion on Institute Affairs. Guest speakers—E. F. Sterne, President Association of Professional Engineers of Ontario, T. R. Loudon, M.E.I.C., Member of Council. Attendance, 38.

Feb. 16.—Luncheon to the President and party from the Annual Meeting. Attendance, 50.

Mar. 13.—Trip over the steam plant of the Buffalo General Electric Company, followed by joint meeting with the Buffalo Engineering Societies. Speaker:—A. A. Northrup, of the Stone and Webster Corporation—**"The Conowingo Power Development."** Attendance E.I.C., 48.

Apr. 17.—Discussion of Institute publications, followed by A. J. Grant, M.E.I.C., Vice-President E.I.C., **"Reminiscences of an Engineer's Holidays in Europe."** Attendance, 60.

May 9.—Electoral Meeting. Attendance, 30.

May 16.—Annual Meeting. Speaker:—F. I. Ker, A.M.E.I.C., **"Some Political Phases of the St. Lawrence Waterways Question."** Attendance, 230.

Oct. 23.—Joint outing and meeting with Buffalo Engineering Societies. Trip over Welland ship canal; dinner meeting at St. Catharines; Speakers:—F. E. Sterns, M.E.I.C., **"Some Engineering Features of the Welland Ship Canal."** A. A. Northrup, of the Stone and Webster Engineering Corporation. **"Power."** Attendance, 114.

Nov. 12, 13 and 14.—Short course in the design of concrete mixes. Speaker:—J. W. Kelly, of the Portland Cement Association. Registration, 130.

Membership

	At the end of year 1928	*At the end of year 1929*	*Loss*	*Gain*
Members	19	20	..	1
Associate Members	71	70	1	..
Juniors	17	17	..	..
Students	24	24	..	..
Branch Affiliates	19	20	..	1
Total	150	151	1	2

Financial Statement

(*January 1st, 1929 to December 31st, 1929*)

Receipts		
Balance on hand Jan. 1st, 1929	$ 357.01	
Rebates	253.20	
Branch news	41.21	
Proceeds meetings	924.00	
Branch Affiliates fees	100.00	
Bank interest	7.98	
Sale of Journals	.75	
		$1,684.15
Expenditures		
Telephone	$ 19.70	
Telegrams, exchange, express, incidentals	11.83	
Expenses—meetings	1,128.87	
Printing and stationery	63.54	
Stamps and post cards	45.00	
Journal subscriptions, Branch Affiliates	42.00	
Secretary's honorarium	100.00	
Balance on hand	262.71	
Rebates and Branch news in transit	10.50	
		$1,684.15

Respectfully submitted.

E. G. Cameron, A.M.E.I.C., *Chairman.*
R. W. Downie, A.M.E.I.C., *Secretary-Treasurer.*

Ottawa Branch

The President and Council,—

On behalf of the Managing Committee of the Ottawa Branch we beg to submit the following report for the calendar year 1929.

During the year the Managing Committee held nine meetings. In addition the Branch held six evening meetings, thirteen luncheon meetings and three tours of inspection. One luncheon was a joint meeting with the Ottawa branch of Queen's University Alumni Association and one was a joint meeting with the Ottawa Branch of the University of Toronto Alumni Federation. On the 5th, 6th and 7th of November a short course of lectures on the **"Design and Control of Concrete Mixtures"** by J. W. Kelly was given in co-operation with the Society of Chemical Industry, the Architects Club of Ottawa and the Canadian Construction Association.

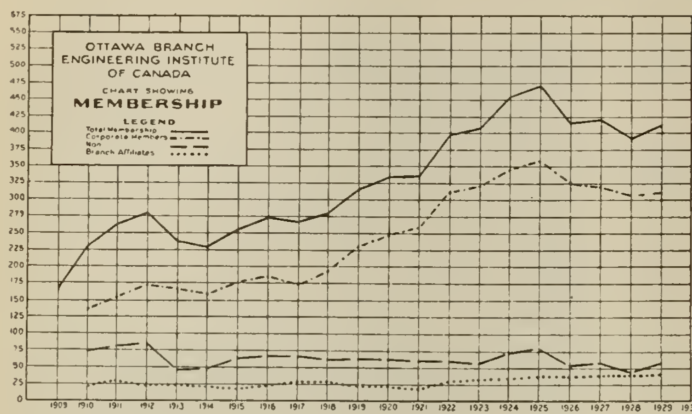
The balance sheets show a very successful year financially, our assets having increased by $163.74 so that our working capital is now $2,308.82.

It is with deep regret that we report the loss, through death, of one Member, E. V. Johnson, and one Branch Affiliate, William Clark.

Proceedings and Publicity

During the year thirteen luncheons, four tours of inspection and six evening meetings were held as follows:—

Jan. 10.—Annual Meeting—Daffodil Tea Rooms.



Jan. 17.—**"The St. Lawrence Waterways in History"** by Prof. Duncan McArthur; joint luncheon meeting with the Ottawa branch of Queen's University Alumni Association at the Chateau Laurier.

Feb. 14.—**"Patent Law and Its Application to Engineering"** by Russell Smart, K.C., B.A., M.E., luncheon meeting at Chateau Laurier.

Feb. 28.—Inspection tour of laboratory and equipment of the Forest Products Laboratory, Dept. of Interior, Ottawa.

Mar. 7.—General discussion of Branch affairs—Address by R. J. Durley, M.E.I.C., General Secretary of the E.I.C.—evening meeting at the University Club.

Mar. 14.—**"Some Impressions of Australia and New Zealand"** by D. Roy Cameron, B.Sc.F., M.E.I.C.; luncheon meeting at Chateau Laurier.

Mar. 28.—**"The Engineer from a Layman's Point of View"** by Dr. M. J. Maloney, M.P.; luncheon meeting at Chateau Laurier.

Apr. 4.—Inspection tour to No. 1 depot, Civil Government Air Operations, Victoria Island, Ottawa.

Apr. 11.—**"Lake St. John District and Its Water Power"** by J. E. A. Dubuc, M.P.; luncheon meeting at Chateau Laurier.

Apr. 25.—**"Transportation and the Upbuilding of Canada"** by Simon J. McLean, LL.B.; luncheon meeting at Chateau Laurier.

May 13.—**"Engineering Education"** by Lt.-Col. E. J. Schmidlin, M.C., M.E.I.C.; luncheon meeting at Chateau Laurier.

June 8.—Inspection tour of plant and logging operations of the Singer Mf'g., Co., Thurso, Quebec.

Oct. 1.—**"The Control and Distribution of Production"** by Major Clifford Hugh Douglas, R.A.F. (Res.), M.E., Mech.E., M.I.E.E.; luncheon meeting at Chateau Laurier.

Oct. 17.—**"Acoustic Sounding and Radio-Acoustic Position Determination"** by Commander N. H. Heck, United States Coast and Geodetic Survey; luncheon meeting at Chateau Laurier.

Oct. 24.—Inspection tour—Publication and Preparation of Maps and Reports, Geological Survey of Canada, Dept. of Mines.

Oct. 31.—**"The Beauharnois Power Scheme"** by R. O. Sweezy, B.Sc., M.E.I.C., M.C.I.M.M.; luncheon meeting at Chateau Laurier.

Oct. 31.—**"Designing Concrete for Durability"** by J. F. Hough, C.E.; evening lecture at the Victoria Memorial Museum.

Nov. 5, 6 and 7.—**"Design and Control of Concrete Mixtures"**—short course of lectures by J. W. Kelly of the Portland Cement Association; this course of lectures was given in co-operation with the Society of Chemical Industry, the Architects' Club of Ottawa and the Canadian Construction Association.

Nov. 14.—**"Ottawa Water Supply"** by Dr. George C. Nasmith, C.M.G., D.Sc.; joint luncheon meeting with the Ottawa branch of the University of Toronto Alumni Federation at the Chateau Laurier.

Nov. 28.—**"Ontario Association of Professional Engineers"** by E. T. Sterne, B.Sc.; luncheon meeting at the Chateau Laurier.

Dec. 12.—**"The Navy as a Public Force"** by Commander R. L. Edwards, R.N.; luncheon meeting at the Chateau Laurier.

Dec. 16.—**"Recent Engineering Developments in the British Army"** by Major Gen. A. G. L. McNaughton, C.M.G., D.S.O., M.Sc., LL.D., M.E.I.C.; illustrated evening lecture at the Victoria Memorial Museum.

The average attendance at the luncheons was 102, the largest being at the luncheon address by Professor McArthur when 240 were present. Six evening meetings were held, five of which dealt with technical subjects, but the luncheons appear to be more popular as a means of bringing the members together.

Due to the construction of the new wing of the Chateau Laurier and the alterations to existing structure the Branch was unable to secure accommodation for the annual ball and the event was consequently postponed.

Membership

Although several members were lost during the year through resignations, transfers, death, etc., a number of new members were added so that the total membership shows a net increase of 21 for the year. The membership of the Branch from 1909 to date is shown graphically on the accompanying chart.

The following table shows in detail the comparative figures of the Branch membership for the years 1927, 1928 and 1929:—

	1927	*1928*	*1929*
Honorary Members	1	1	1
Members	110	107	108
Associate Members	212	199	204
Affiliates of Institute	8	7	7
Juniors	28	23	24
Students	22	14	27
Branch Affiliates	41	40	41
Total	422	391	412

Rooms and Library

The Branch library is still situated on the third floor of the Stephen building, where it is open to consultation by members under the same conditions as have previously prevailed.

The library has not been used to any great extent recently as there are other technical libraries in the city much more extensive and up-to-date, but the collection has been kept in good order and available for use.

Journal Advertising

Commissions due for advertising in The Journal during 1929 amount to $130.50, which is equivalent to the rebates from 65 associate members.

Finances

The attached statements of assets and liabilities and of receipts and expenditures show that the Branch closed the year with a balance of $848.20 in the bank, $8.12 cash on hand, and $1,000.00 in Victory Bonds, a total balance of $1,856.32. In addition to this balance the Branch has assets of $41.00 in rebates due from Headquarters, $130.50 in commissions due for advertising in The Journal, and $281.00 in refunds due, furniture, stationery, etc., making a total of $2,308.82, an increase of $163.74 over the assets for 1928. The accompanying chart shows the financial standing of the Branch from 1910 to date.

The income for the past two years was:—for 1928—$879.07 and for 1929—$864.67; the expenditure for 1928—$568.61 and for 1929—$940.03. The annual income from Victory Bonds is $52.50.

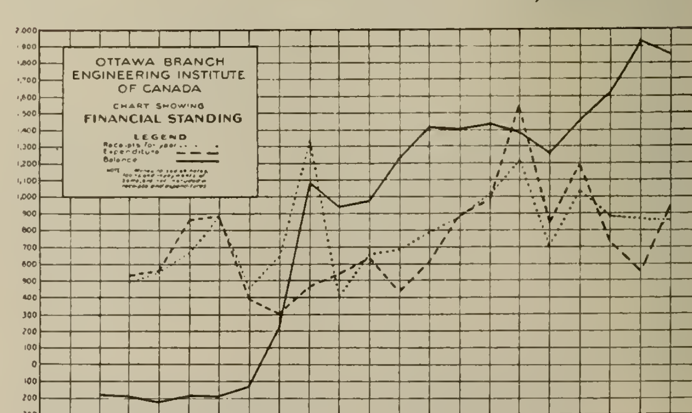
Officers for 1930

The annual meeting of the Branch will be held in Ottawa on January 9th, when the officers and members of the Managing Committee for the year 1930 will be elected.

Financial Statement
(Year ending December 31st, 1929)

Receipts

Balance in bank Jan. 1, 1929	$ 915.22
Cash on hand Jan. 1, 1929	16.46
Interest on Victory bonds	52.50
Bank interest	24.94
Rebates from Headquarters, Dec. 1928	11.40
" " " Jan. to April, 1929	457.60
" " " May to July, 1929	73.60
" " " Sept. to Nov. 1929	59.20
" " " Branch news, Jan. to March, 1929	16.07
" " " May to July, 1929	16.97
Forward	$1,643.96



Forward	1643.96	
Rebates from Headquarters, Nov. to Dec. 1929	12.39	
Branch affiliate fees and subscriptions to E.I.C. Journal	140.00	
Proceeds from sale of luncheon tickets	802.00	
Refund from Headquarters, re editorials	120.00	
		$2,718.35

Expenditures

Chateau Laurier, luncheons, etc	$1,200.75	
Daffodil Tea Rooms	35.50	
University Club	23.00	
Rogers Ltd.—catering	115.00	
Printing, stationery, etc	29.39	
Advertising	21.20	
Insurance	3.40	
Subscription to "Engineering Journal"	6.00	
Subscription to "Engineering News-Record"	5.00	
Board of Trade membership fee	15.00	
R. B. Farrell, for editorials	200.00	
Petty cash, postage, etc	163.66	
Sundries, entertainments, etc	44.13	
Balance in bank, Dec. 31, 1929	848.20	
Cash on hand, Dec. 31, 1929	8.12	
		$2,718.35

Assets and Liabilities
(Year ending December 31, 1929)

Assets

Furniture (Cost $200.00)	$ 80.00	
Stationery and equipment	20.00	
Library:		
Book cases (Cost $105.00)	75.00	
Bound magazines (nominal)	1.00	
Books	25.00	
Rebates due from Headquarters on 1929 fees	41.00	
Rebates due from Headquarters for advertising 1929	130.50	
Refund due from Headquarters re editorials	80.00	
Victory bonds, due November 1, 1934	500.00	
" " " October 15, 1943	500.00	
Cash in bank	848.20	
Cash on hand	8.12	
		$2,308.82

Liabilities

Surplus	$2,308.82	
		$2,308.82

Audited and found correct,
L. H. Cole, M.E.I.C.

Respectfully submitted,
F. H. Peters, M.E.I.C., *Chairman.*
F. C. C. Lynch, A.M.E.I.C., *Secretary-Treasurer.*

Peterborough Branch

The President and Council,—

On behalf of the executive of the Peterborough Branch, we take pleasure in submitting the following report covering the various activities of the Branch during the year 1929.

Meetings and Papers

Jan. 10.—Ladies Night. Travel talk by F. L. Roy.
Jan. 24.—**"Recent Mining Developments in Northern Manitoba,"** by Dr. Charles Camsell, M.E.I.C, Deputy Minister of Mines, Dept. of Mines, Ottawa.
Feb. 14.—Student night, **"Stave Falls, Power Development,"** by F. G. A. Tarr, S.E.I.C.; **"Fabricated Steel Construction for large Generators"** by M. V. Powell, Jr.E.I.C.; **"Labrador"** by B. H. Zwicker, S.E.I.C.
Mar. 14.—**"Manufacture of Bakelite or Synthetic Resins"** by W. A. Campbell, Bakelite Co. of Canada.
Mar. 28.—**"Electrical Insulations"** by W. P. Dobson, M.E.I.C., chief testing engineer, H.E.P.C. of Ontario.
Apr. 11.—**"Gatineau-Toronto Transmission Line,"** by A. E. Davidson, transmission engineer, H.E.P.C. of Ontario.
Apr. 25.—**"Telephotography"** by Mr. W. C. Dancy, transmission engineer, Bell Telephone Co. of Canada.
May 9.—Annual meeting.
Sept. 21.—Annual picnic.
Nov. 7.—**"Automatic Screw Machines and Their Importance and Use in Industry Today"** by W. W. Appleton, Brown and Sharpe Tool Company.
Nov. 12.—Annual dinner.
Dec. 12.—**"Recent Developments in Hydraulic Turbines"** by H. S. Van Patter, A.M.E.I.C., hydraulic engineer, Dominion Engineering Works.

Membership

The following is our present standing:—

Members	20
Associate Members	31
Juniors	20
Students	30
Affiliates and Branch Affiliates	25
Total	126

This is a net gain of 9 per cent during the year.

The Student and Junior Section continues to be the most active section of the Branch. They were responsible for one meeting as listed above. They were in charge of all arrangements for the very successful annual picnic at Clear lake, also supplied the entertainment for the annual dinner of the Branch.

An event of importance to the Branch and the community of Peterborough was the erection by the Branch of a tablet on the lift lock at Peterborough to the memory of the late R. B. Rogers, M.E.I.C., who was resident engineer during the construction of the Trent Valley canal.

The following were the members elected to the Executive Committee on May 9th, 1929.

Chairman.....R. C. Flitton, A.M.E.I.C.
Secretary.....S. O. Shields, Jr.E.I.C.
Treasurer.....A. B. Gates, A.M.E.I.C.
A. L. Killaly, A.M.E.I.C.
B. Ottewell, A.M.E.I.C.
W. E. Ross, A.M.E.I.C.
E. R. Shirley, A.M.E.I.C.
H. R. Sills, Jr.E.I.C.
Ex-Officio.....R. L. Dobbin, A.M.E.I.C., Councillor.
W. M. Cruthers, A.M.E.I.C., Past Chairman.

Financial Statement
(For year ending December 31st, 1929)

Receipts

Bal. in bank Jan. 1st, 1929	$ 33.62	
Rebates on fees	149.25	
Journal news	39.62	
Affiliate fees	36.00	
Annual dinner receipts	156.00	
Rogers Memorial subscription	109.40	
Bal. from outing	17.10	
Civic grant—Old Home Week	75.00	
Bank interest	.74	
		$616.73

Expenditures

Rent	$ 55.00	
Printing	43.74	
Meetings speakers	32.90	
Flowers	20.00	
Annual dinner	139.40	
Rogers Memorial	145.43	
Old Home Week arch	105.80	
Insurance m.p. machine	7.20	
Secretarial expense	4.62	
Affiliate Journal subscriptions	18.00	
Bal. in bank	44.64	
		$616.73

Respectfully submitted,
Stanley O. Shields, Jr.E.I.C., *Secretary.*
A. B. Gates, A.M.E.I.C., *Treasurer.*

Quebec Branch

The President and Council,—

The council of the Quebec Branch has the honour of submitting the following report for the year 1929:—

Membership

	Resident	Non-Resident	Total
Honorary Members	1	..	1
Members	17	..	17
Associate Members	60	9	69
Juniors	11	5	16
Students	11	3	14
Affiliates	2	..	2
	102	17	119

Annual Meeting

The annual meeting of the Branch was held on June 26th, 1929, under the chairmanship of A. B. Normandin, A.M.E.I.C., president of the Branch; the following officers have been elected for the year 1929-30:—

Honorary President, for life	A. R. Décary, D.A.Sc., M.E.I.C.
President	A. B. Normandin, A.M.E.I.C.
Vice-President	S. L. de Carteret, M.E.I.C.
Secretary-Treasurer	Philippe Méthé, A.M.E.I.C.
Councillors	Alex. Larivière, A.M.E.I.C.
	L. C. Dupuis, A.M.E.I.C.
	F. T. J. King, M.E.I.C.
	Hector Cimon, A.M.E.I.C.
Ex-officio	W. G. Mitchell, M.E.I.C.

MEETINGS

The council of the Quebec Branch held its meetings regularly during the year 1929.

All questions submitted by the Council of The Institute were studied, discussed and transacted.

Our Branch followed with interest the deliberations of The Institute and devoted its full energy to all matters aiming to the protection and promotion of the interests of The Institute and its members.

Our special committee followed closely, studied carefully, and made as complete reports as possible on all applications for membership referred to our Branch, and the necessary recommendations were made to the Council of The Institute.

ADDRESSES

The following addresses were delivered at our various luncheons and evening meetings:

Jan. 28.—**"The North Shore of the St. Lawrence River"** by Mr. Edgar Rochette, M.P.P. for the county of Charlevoix-Saguenay.

Feb. 15.—**"Canada's Natural Resources"** by Major G. G. Ommanney, chief of development service, C.P.R.

Mar. 18.—**"Quebec Mines"** by Hon. J. E. Perrault, Minister of Colonization, Mines and Fisheries for the Province of Quebec.

"The Press Through the Ages," by Mr. Henri Gagnon, managing director of "Le Soleil" of Quebec.

Apr. 8.—**"The Evolution of Modern Locomotives"** by C. E. Brooks, Esq., chief of motive power, C.N.R.

Apr. 22.—**"High Pressure in Steam Boilers"** by C. M. McKergow, M.E.I.C., professor of mechanical engineering at McGill University.

Apr. 19.—General meeting, to discuss proposed amendments to the rules and regulations of The Institute.

Oct. 28.—Welcome to Brig. Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., President of The Institute, and Mr. R. J. Durley, M.E.I.C., Secretary.

FINANCIAL STATEMENT

Revenue		
Cash in bank, Jan. 1st, 1929	$265.47	
Interests on deposit	5.84	
Rebates from Headquarters	247.20	
		$518.51
Expenditures		
Printing, stamps, telephones etc	$ 62.50	
Meetings	130.16	
Gratuity to the secretary	100.00	
	$292.66	
Cash in bank, Jan. 1st, 1930	$225.85	
		$518.51

Respectfully submitted,

A. B. NORMANDIN, A.M.E.I.C., *President.*

PHILIPPE METHE, A.M.E.I.C., *Secretary-Treasurer.*

Quebec Branch

Au Président et au Conseil,—

Le conseil de la Section de Québec a l'honneur de vous soumettre son rapport annuel pour l'année 1929, comme suit:—

ROLE DES MEMBRES

	Résidents	*Non-résidents*	*Total*
Membres honoraires	1	..	1
Membres	17	..	17
Membres associés	60	9	69
Membres Juniors	11	5	16
Membres étudiants	11	3	14
Membres affiliés	2	..	2
	102	17	119

ASSEMBLEE ANNUELLE

L'assemblée annuelle de la Section de Québec eut lieu le 26 juin 1929, sous la présidence de monsieur A. B. Normandin, président de la Section; les officiers dont les noms suivent ont été élus pour 1929-30:—

Président honoraire à vie	A. R. Décary, D.A.Sc., M.E.I.C.
Président	A. B. Normandin, A.M.E.I.C.
Vice-Président	S. L. de Carteret, M.E.I.C.
Secrétaire-trésorier	Philippe Méthé, A.M.E.I.C.
Conseillers	Alex. Larivière, A.M.E.I.C.
	L. C. Dupuis, A.M.E.I.C.
	T. J. F. King, M.E.I.C.
	Hector Cimon, A.M.E.I.C.
Ex-officio	W. G. Mitchell, M.E.I.C.

ASSEMBLEES

Le Conseil de la Section de Québec a tenu ses assemblées régulièrement pendant l'année 1929.

Toutes les questions soumises par le Conseil de l'Institut ont été étudiées et expédiées.

Notre Section a suivi avec intérêt les travaux de l'Institut et a prêté son plein concours à toutes les questions ayant pour but de protéger et promouvoir les intérêts de l'Institut et de ses membres.

Notre comité spécial s'est efforcé, après étude, de faire un rapport aussi complet que possible sur toute demande d'admission à lui référée, et les recommandations nécessaires ont été faites au Conseil général de l'Institut qui a bien voulu en tenir compte.

CAUSERIES

Les causeries suivantes furent données à nos différentes réunions:—

"La Côte Nord," par M. Edgar Rochette, avocat, député de Charlevoix-Saguenay.

"Les Ressources Naturelles du Canada," par le Major G. G. Ommanney, chef du Service de Développement au Pacifique Canadien.

"Les Mines de Québec," par l'Hon. J. E. Perrault, Ministre de la Colonisation, des Mines et des Pêcheries de la Province de Québec.

"La Liberté de La Presse à Travers les Ages," par M. Henri Gagnon, Directeur-gérant du Soleil de Québec.

"L'Evolution des Locomotive Modernes," par M. C. E. Brooks, Ingénieur en chef du département de la force motrice, Chemins de fer Nationaux.

"L'Emploi des Hautes Pressions dans les Chaudières à Vapeur," par M. Chs. M. McKergow, professeur de mécanique, Université McGill.

Assemblée générale, le 19 avril, pour discuter certains amendements proposés aux règlements de l'Institut.

Bienvenue au Brig. Gén. C. H. Mitchell, Président de l'Institut, et à M. R. J. Durley, secrétaire général, le 28 octobre 1929.

ETAT FINANCIER POUR L'ANNEE 1929

Revenus		
Solde en banque au 1er janvier 1929	$265.47	
Intérêts sur dépôt	5.84	
Remises du Bureau chef	247.20	
		$518.51
Dépenses		
Impression, timbres-postes, téléphones, etc	$ 62.50	
Réunions	130.16	
Gratification au secrétaire	100.00	
	$292.66	
Solde en banque au 1er janvier 1920	$225.85	
		$518.51

A. B. NORMANDIN, A.M.E.I.C., *Président.*

PHILIPPE METHE, A.M.E.I.C., *Secrétaire-trésorier.*

Saint John Branch

The President and Council,

On behalf of the Executive Committee we beg to submit the following report concerning the activities of the Saint John Branch.

The Executive Committee met eight times during the past year, and the Branch nine times. The members also made an inspection of the brush plant of T. S. Simms & Co.

The meetings were well attended, not only by members of the Branch but also by the public in general who are at all times welcomed. Continuing the policy adopted some years ago, the members made their annual trip to the University of New Brunswick on April 12th last. This meeting affords the members resident in the Fredericton district an opportunity of listening to our papers and also taking part in the discussions.

We have to comment again on the absence of unemployment among engineers in this district during the past year. We have co-operated with the Civil Service Commission by notifying our membership of positions in which they might be interested.

Last year this Branch adopted the policy of serving light refreshments after the meetings. This seemed to meet with the approval of the membership and certainly increased the attendance. This year, however, we have had to change our meeting place and as a consequence are not yet in a position to furnish refreshments.

Membership

A statement of membership as at December 31st, 1929, is as follows:—

	Resident	Non-Resident	Total
Members	13	7	20
Associate Members	26	17	43
Juniors	3	4	7
Students	3	12	15
Affiliates	1	..	1
	46	40	86

The total at the end of 1928 was 78, making a gain of 8.

Papers

Jan. 17.—A paper on **"Automatic Telephone"** by William Brebner, an engineer of the Northern Electric Co., Montreal.

Jan. 20.—Inspection of the brush plant of T. S. Simms & Co., Ltd., Fairville.

Jan. 28.—Dinner meeting at the Admiral Beatty hotel held with the N.B. Association of Professional Engineers. The speaker on this occasion was O. O. Lefebvre, D.Sc., M.E.I.C. whose subject was **"Some Engineering Aspects of the Saint Lawrence Waterways."**

Feb. 21.——**"Highway Bridges of New Brunswick,"** C. A. McVey, New Brunswick Department of Public Works, Fredericton, N.B.

Mar. 21.—**"The Rayon Industry,"** Adam Cameron, D.Sc., University of New Brunswick, Fredericton, N.B.

Apr. 12.—Joint meeting with the U. N. B. Engineering Society at Fredericton.

Paper on **"Lightning and Its Effects"** by G. A. Vandervoort, A.M.E.I.C.

Paper by K. S. LeBaron on the **"Manufacture of Bleached Sulphite Pulp at the Nashwaak Plant."**

Paper on **"The Rise of the Technical Societies"** by W. J. Johnston, A.M.E.I.C.

Slides of Newfoundland bridges by A. R. Crookshanks, M.E.I.C.

May 2.—Annual meeting.

This took the form of a dinner after which reports of Committees were submitted.

Oct. 21.—**"Metals and their Alloys,"** by James S. Hoyt, plant manager, T. McAvity & Sons, Ltd., Saint John, N.B.

Nov. 21.—**"The Grand Falls-Dalhousie, Transmission Line,"** R. A. Lawther, Saint John River Power Co., Dalhousie.

Dec. 12.—**"The N. B. Power Co. New Plant,"** by J. D. Garey, A.M.E.I.C., chief engineer, Saint John, N.B.

The new meeting place of the Saint John Branch is in the Board of Trade rooms, 162 Prince William street.

Financial Statement

(Year Ending December 31st, 1928)

Receipts

Balance in bank December 31st, 1929	$171.12	
Rebates from Headquarters	195.82	
		$366.94

Expenditures

Expenses of Secretary (including notices of meeting, postage, etc.)	42.53	
Entertainment	14.10	
Hall and meeting	18.50	
Printing	35.61	
Stenography	15.00	
Balance in bank December 31st, 1929	241.20	
		$366.94

Assets

Balance in bank December 31st, 1929	$241.20	
Rebates due from Headquarters	3.30	
		$244.50

Liabilities

Outstanding accounts	$ 11.70	
Surplus at December 31st, 1929	232.80	
		$244.50

Respectfully submitted,

E. A. Thomas, M.E.I.C., *Chairman.*

E. J. Owens, A.M.E.I.C., *Secretary-Treasurer.*

St. Maurice Valley Branch

Au Président et au Conseil:

Le conseil de la Section a l'honneur de vous soumettre son rapport annuel pour les opérations de la Section de la Vallée du St-Maurice, pour 1929.

Cette section comprend les ingénieurs de Trois-Rivières, Grand'-Mère, Shawinigan Falls et Cap de la Madeleine. Durant l'année, il y eut deux assemblées, la première fut à Grand'Mère le 4 de mai 1929. Elle coincida avec l'ouverture du nouveau pont suspendu, qui relie Grand'Mère avec St-Georges de Champlain. Une conférence fut alors donnée par le Dr. B. Steinman, M. P. L. Pratley et autres sur les avantages et les développements anticipés de la région dus à la construction du nouveau pont.

La deuxième assemblée eut lieu au Chateau de Blois, Trois-Rivières le 2 novembre 1929. La Branche avait l'honneur de recevoir le Général C. H. Mitchell, président de l'Engineering Institute. Après l'expédition des affaires de routine, la Branche a pris un dîner en l'honneur de son hôte distingué.

Le même bureau de direction a été gardé en force pour 1930, et comprend M. Ellwood Wilson, président, MM. Henri Dessaulles, A. A. Wickenden et Bruno Grandmont, conseillers, et R. Morrissette comme secrétaire.

La Branche a acquitté tous ses comptes pour l'année 1929 et a une balance à son crédit de $66.13.

Le tout humblement soumis.

Ellwood Wilson, M.E.I.C., *Président.*

Romeo Morrissette, A.M.E.I.C., *Secrétaire.*

Saguenay Branch

The President and Council,—

On behalf of the Executive Committee, we submit the following report covering the activities of the Saguenay Branch during the year 1929:

Membership

On December 31st, 1929, the membership of the Branch was as follows:—

Members	7
Associate Members	26
Juniors	6
Students	7
	46

Financial Statement

(As at December 31st, 1929)

Receipts

Balance on hand—December 31st, 1928	$250.65	
Rebates from Headquarters	121.43	
Interest	2.07	
		$374.15

Expenditures

Printing, postage, stationery, etc	$ 27.95	
Postal box	2.00	
Telephone and telegrams	7.75	
Expense of meetings	88.20	
Express charges	2.95	
	$128.85	
Balance on Hand	245.30	
		$374.15

On May 28th, O. O. Lefebvre, D.Sc., M.E.I.C., addressed a meeting of the Saguenay Branch held in Kenogami, on the subject of **"The St. Lawrence Waterways,"** which proved most interesting.

The general meeting of the Branch was held in Riverbend on June 21st, 1929. The following officers were elected:

Chairman	R. E. Parks, A.M.E.I.C.
Vice-Chairman	S. J. Fisher, M.E.I.C.
Secretary-Treasurer	M. R. Lanctot, Jr.E.I.C.
Executive Committee	H. R. Wake, A.M.E.I.C.
	G. E. LaMothe, A.M.E.I.C.
	J. A. Knight, A.M.E.I.C.
	G. O. Vogan, A.M.E.I.C.

After the business part of the annual meeting the members were the guests of Price Brothers and Company at luncheon, and later visited the surrounding industrial establishments.

General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., President of The Institute, visited the district on August 23rd. On the evening of that day a meeting was held in Arvida at which General Mitchell gave a short talk on things of interest to The Institute.

On November 7th there was a meeting of the Branch held in Arvida. A paper by Mr. I. E. Burks on **"Concrete Work"** was read and proved to be very interesting to all.

Respectfully submitted,

R. E. Parks, A.M.E.I.C., *Chairman.*

M. R. Lanctot, Jr.E.I.C., *Secretary-Treasurer.*

Saskatchewan Branch

The President and Council,—

On behalf of the Branch Executive we beg to submit the following report concerning the activities of the Saskatchewan Branch for the calendar year 1929.

Membership

The membership of the Branch shows an increase of nine over last year, with the usual fluctuations due to transfers, etc.

The present membership of the Branch is:

	Branch Residents	Branch Non-Residents	Total
Members	13	3	16
Associate Members	57	20	77
Juniors	4	6	10
Students	4	7	11
Affiliates	1	1	2
Branch Affiliates	7	0	7
Total	86	37	123

EXECUTIVE COMMITTEE

The present Executive was elected on March 22nd at the Branch annual meeting and with those continuing in office is as follows:—

Chairman .... H. R. Mackenzie, A.M.E.I.C., Regina, Sask.
Vice-Chairman .... W. G. Worcester, M.E.I.C., Saskatoon, Sask.
Sec.-Treas. .... R. W. E. Loucks, A.M.E.I.C., Regina, Sask.
Executive (2 years)...D. W. Houston, A.M.E.I.C., Regina, Sask.
A. P. Linton, A.M.E.I.C., Regina, Sask.
P. C. Perry, A.M.E.I.C., Regina, Sask.
(1 year)....J. M. Campbell, A.M.E.I.C., Moose Jaw, Sask.
J. W. D. Farrell, A.M.E.I.C., Regina, Sask.
Stewart Young, A.M.E.I.C., Regina, Sask.
A. M. Macgillivray, A.M.E.I.C., Saskatoon, Sask. (Past Chairman.)
D. A. R. McCannel, A.M.E.I.C., Regina, Sask. (Councillor.)
Auditors .... W. H. Hastings, A.M.E.I.C., Regina, Sask.
D. D. Low, Jr.E.I.C., Regina, Sask.

COMMITTEES

Chairmen of the standing committees are:

Papers and Library...Stewart Young, A.M.E.I.C., Regina, Sask.
Legislation .... P. C. Perry, A.M.E.I.C., Regina, Sask.
Nominating .... H. S. Carpenter, M.E.I.C., Regina, Sask.
Attendance .... D. C. M. Davies, A.M.E.I.C., Regina, Sask.
H. A. Jones, S.E.I.C., Regina, Sask.
Publicity .... R. W. E. Loucks, A.M.E.I.C., Regina, Sask.
Meetings .... C. D. Lill, Br.AFFIL., Regina, Sask.

The Saskatchewan Branch representative on the Nominating Committee of The Institute is H. R. Mackenzie, A.M.E.I.C., Regina, Sask.

MEETINGS

The Executive held seven meetings for the transaction of Branch affairs. There were five regular meetings of the Branch and two special meetings. Mr. R. J. Durley, M.E.I.C., General Secretary of The Institute, met the members of the Branch at a special meeting in July. The Branch meetings in all cases were preceded by a dinner. The attendance and general interest in the meetings has been satisfactory.

Much interest at present centres around the Engineers Bill which is expected to be introduced in the Provincial Legislature early in the year, particularly in view of the fact that legislation incorporating the engineers is now in force in almost all other Provinces of the Dominion. This Branch has endeavoured and will endeavour to encourage and guide this effort to a satisfactory conclusion.

PROGRAMME

The programme for the year was as follows:—

Jan. 25.—Debate—**"Resolved that in Engineering Projects the Contract System is Preferable to Day Labour."**
Speakers for affirmative:
Messrs. W. W. Perrie, A.M.E.I.C.
W. R. Allen, A.M.E.I.C.
T. S. McKechnie.
Speakers for negative:
Messrs. C. H. Biddell, A.M.E.I.C.
D. D. Low, Jr.E.I.C.
Harry Jones, S.E.I.C.
Judges—R. N. Blackburn, M.E.I.C.
H. S. Carpenter, M.E.I.C.

Feb. 22.—**"Industrial Relations"** by P. C. Perry, A.M.E.I.C., division engineer, C.N.R., Regina, Sask.

Mar. 22.—"Twelfth Annual Meeting" reports of committees, election of officers, banquet, toast list and other entertainment.
Address by C. J. Mackenzie, M.E.I.C., Dean of the Faculty of Engineering, University of Saskatchewan, on **"The Future of Urban Centres in Saskatchewan and Some Problems Arising Therefrom."**

May 3.—Complimentary dinner to and short talks from R. O. Wynne-Roberts, M.E.I.C., of Toronto, Ont. and Nicholas Hill, Jr., of New York, N.Y.

July 8.—Informal address by R. J. Durley, M.E.I.C., General Secretary of The Institute, on Institute Affairs.

Nov. 22.—Report on Plenary Meeting of Council by D. A. R. McCannel, A.M.E.I.C., City Commissioner, City of Regina. Report on Legislation for incorporation of Engineers in Saskatchewan by P. C. Perry, A.M.E.I.C., division engineer, C.N.R., Regina, Sask.

Dec. 18.—**"The Einstein Theory"** by R. N. Blackburn, M.E.I.C., chief mechanical supt., Department of Public Works, Regina, Sask.

SCHOLARSHIP

The annual scholarship of $50.00 offered by the Branch to the most deserving student in the graduating class in Engineering at the University of Saskatchewan, was awarded to Mr. B. P. Scull.

FINANCIAL STATEMENT

Revenue

Balance from 1928	$241.65	
Headquarters rebates	280.05	
Branch dues	33.00	
Sundries, Branch news, etc	36.98	
		$591.68

Expenditure

Meetings	$ 31.70	
Stationery, notices, etc	37.76	
Scholarship	50.00	
Honorarium	130.00	
Sundries	15.90	
Cash in bank	308.92	
Cash on hand	17.40	
		$591.68

Respectfully submitted,
H. R. MACKENZIE, A.M.E.I.C., *Chairman.*
R. W. E. LOUCKS, A.M.E.I.C., *Secretary-Treasurer.*

Sault Ste. Marie Branch

The President and Council,

There were four regular meetings and two special meetings held during the year, with an average attendance of twenty-two. Both in number of meetings and attendance we are below our 1928 figures.

The papers and meetings that were arranged for by the Papers Committee were much appreciated by all. The committee this year found it very difficult to obtain speakers and the incoming executive will be well advised to make every effort to meet this difficulty in 1930.

The meetings held and the papers given were as follows:—

Feb. 22.—An inspection trip through the plant of the Soo Falls Brewery. Enough said, much enjoyed by all.

Mar. 25.—**"The St. Lawrence Waterway"** by Prof. G. A. Cornish of the Department of Science of the Ontario College of Education of Toronto.

Apr. 27.—A visit to the engineering department of the Sault Ste. Marie Michigan ship canal. Mr. Edmonds outlined methods he used in metering the St. Mary's rapids.

May 31.—**"Industrial Relations"** or **"Human Engineering"** by Mr. Douglas Chant of the Abitibi Power and Paper Company.

Aug. 29.—Special luncheon at the Country Club in honour of R. J. Durley, M.E.I.C., the General Secretary.

Sept. 22.—A round table discussion by the members on the **"Organization of The Institute."**

	Branch Resident	Branch District	Total
Members	9	16	25
Associate Members	15	37	52
Juniors	2	12	14
Students	0	18	18
Affiliates	2	1	3
Branch Affiliates	16	0	16
			128

This is a decrease of ten members from last year. The incoming membership committee for 1930 should get busy and wipe out this decrease as locally there are several engineers not members.

FINANCIAL STATEMENT

Receipts

Balance from 1929	$131.34	
Income from H.Q. rebates	183.75	
Income from H.Q. advertising	30.00	
Income from H.Q. Branch news	10.93	
Affiliate fees	27.00	
Journal subscriptions	12.00	
Meetings, dinners and entertainments	30.75	
Rebate from H.Q. telegrams	18.92	
		$444.69

Expenditures

Postage and stationery	$ 15.00	
Printing and advertising	29.20	
Gratuities and donations	10.00	
Stenographer	25.00	
Telegrams	20.50	
Deposit in savings account	100.00	
Meetings, dinners and entertainments	73.25	
Journal subscriptions	16.15	
Sundries	.15	
		$289.25
Balance in current account		155.44
Balance in savings account		216.33
Total balance		$371.77

Outstanding Affiliate fees $38.00.

Respectfully submitted,
J. H. JENKINSON, A.M.E.I.C., *Chairman.*
A. H. RUSSELL, A.M.E.I.C., *Secretary-Treasurer.*

Toronto Branch

The President and Council,—

The Executive Committee of the Toronto Branch respectfully submits the following report for the calendar year 1929:—

The Executive Committee holding office during this period are as follows, the present members being elected at the annual meeting of the Branch on April 4th, 1929.

EXECUTIVE COMMITTEE

January to April, 1929		*April to December, 1929*
L. W. Wynne-Roberts, A.M.E.I.C.	Chairman	T. Taylor, M.E.I.C.
T. Taylor, M.E.I.C.	Vice-Chair	J. J. Traill, M.E.I.C.
J. J. Spence, A.M.E.I.C.	Sec.-Treas.	J. J. Spence, A.M.E.I.C.
J. J. Traill, M.E.I.C.	Executive	G. H. Davis, M.E.I.C.
G. H. Davis, M.E.I.C.		A. B. Crealock, A.M.E.I.C.
A. B. Crealock, A.M.E.I.C.		H. N. Mason, A.M.E.I.C.
J. W. Falkner, A.M.E.I.C.		*C. S. L. Hertzberg, M.E.I.C.
C. S. L. Hertzberg, M.E.I.C.		*J. R. Cockburn, M.E.I.C.
H. N. Mason, A.M.E.I.C.		*C. B. Hamilton, M.E.I.C.
T. R. Louden, M.E.I.C.	*Ex-officio*	T. R. Louden, M.E.I.C.
J. M. Oxley, M.E.I.C.		J. G. R. Wainwright, A.M.E.I.C.
J. G. R. Wainwright, A.M.E.I.C.		L. W. Wynne-Roberts, A.M.E.I.C.
W. B. Dunbar, A.M.E.I.C.		R. B. Young, M.E.I.C.

*Elected for a period of two years.

STANDING COMMITTEES

The following standing committees, with the chairman of each, were appointed by the Executive at a meeting on April 25th, 1929.

January to April, 1929		*April to December, 1929*
L. W. Wynne-Roberts, A.M.E.I.C.	Papers	T. Taylor, M.E.I.C.
T. Taylor, M.E.I.C.	Finance	J. J. Traill, M.E.I.C.
J. J. Traill, M.E.I.C.	Publicity	C. S. L. Hertzberg, M.E.I.C.
C. S. L. Hertzberg, M.E.I.C.	Membership	H. N. Mason, A.M.E.I.C.
J. W. Falkner, A.M.E.I.C.	Meetings	G. H. Davis, M.E.I.C.
A. B. Crealock, A.M.E.I.C.	Library	J. R. Cockburn, M.E.I.C.
W. B. Dunbar, A.M.E.I.C.	Student Relations	W. B. Dunbar, A.M.E.I.C.
H. N. Mason, A.M.E.I.C.	Branch Editor	A. B. Crealock, A.M.E.I.C.

The Executive Committee of this Branch held nine meetings during the year for the transaction of Branch business, and thirteen general meetings.

In addition to this, a dinner was tendered to the President of The Institute, Brig. Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., by the Toronto Branch. This event took place in the Engineers' Club on December 4th, and was attended by some seventy-eight members.

This Branch still maintains the policy of welcoming out-of-town speakers at informal dinners held previous to the meetings.

The various meetings for the year 1929 were as follows:—

Jan. 3.—"**Development of Hydro-Electric Power on the Gatineau River**" by Major Jas. H. Brace, M.E.I.C., of the Fraser-Brace Engineering Company, Limited.

Jan. 15, 16 and 17.—Three-day short course on "**Design and Control of Concrete Mixtures**" by R. S. Phillips of the Portland Cement Association of Chicago.
Attendance 240, 240 and 230.

Jan. 25.—"**Ontario Research Foundation and its Objects.**" Speakers—Sir Joseph Flavelle, Chairman of Foundation, and Dr. Speakman, Director.

Feb. 7.—"**The Construction of the North Toronto Sewerage System**" by Geo. Phelps, A.M.E.I.C., sewer engineer, City of Toronto.

Feb. 21.—"**The Motor Ship**" by J. L. Busfield, M.E.I.C., of Montreal.

Mar. 7.—"**The Welland Ship Canal and its Relation to the St. Lawrence Project**" by A. J. Grant, M.E.I.C., engineer-in-charge Welland ship canal.

Mar. 21.—"**General Erection Methods on Steel Construction**" by Jas. Robertson, A.M.E.I.C., erection engineer, Dominion Bridge Co. Limited, Montreal.

Apr. 4.—Annual meeting of the Branch.

Oct. 24.—"**The Story of Iron and Steel**" by film kindly loaned by United States Steel Products Company, through the courtesy of Mr. F. Brunke.

Nov. 7.—"**Engineering in Europe**" by Prof. R. W. Angus, M.E.I.C., Faculty of Applied Science, University of Toronto.

Nov. 21.—"**Planning and Development Act of Ontario and its Operation in Toronto**" by Tracy D. leMay, city surveyor, City of Toronto.

Dec. 5.—"**Toronto Waterworks**" by Wm. Gore, M.E.I.C., of Gore, Nasmith and Storrie, consulting engineers, Toronto.

Dec. 19.—"**Inspection**" by Robert R. Deans, Vice-President of Canadian Inspection & Testing Company.

MEMBERSHIP

The membership as listed at December 31st, 1929 is as follows:—

	Residents	*Non-residents*	*Total*
Members	127	4	131
Associate Members	255	13	268
Juniors	56	3	59
Students	65	4	69
Affiliates	5	..	5
Branch Affiliates	2	..	2
Total 1929	510	24	534
Total 1928	530	25	555
	−20	−1 net loss	−21

The falling off in the membership from the previous year is partially due to a number of names being dropped by Headquarters and to several resignations and deaths.

We regret the loss by death of E. A. Wallberg, Prof. Peter Gillespie, Jas. Hyslop and Edmund Wragge.

FINANCIAL STATEMENT

(For calendar year 1929)

Revenue		
Bank balance at Jan. 1, 1929	$1,140.66	
Rebates and Branch news	735.33	
Fees Branch Affiliates	20.00	
Receipts on dinner accounts (Hart House and Engineers' Club)	146.70	
Bank interest	12.60	
Rebate H.M. customs (film)	350.00	
		$2,405.29
Expenditures		
Advertising and printing	$ 228.53	
Room rental	88.00	
Flowers	55.00	
Stenographer	38.16	
Chairman's expenses	23.00	
Librarian's expenses	25.00	
Secretary honorarium and expenses	133.50	
Deposit's, H.M. customs (films)	350.00	
Affiliate Journal fees	4.00	
Engineers Club (dinner account)	146.35	
		$1,091.54
Bank balance at December 31st, 1929	$1,332.54	
Less outstanding cheques S-36, S-41	18.79	
		$1,313.75
		$2,405.29

Respectfully submitted,

THOS. TAYLOR, M.E.I.C., *Chairman.*

J. J. SPENCE, A.M.E.I.C., *Secretary-Treasurer.*

Vancouver Branch

The President and Council,—

I beg to report upon the affairs of the Vancouver Branch for the year 1929 as follows:—

MEETINGS

Jan. 16.—J. B. Alexander on "**Structural Timber.**"

Feb. 4.—Frank P. McKebban, Esq. on "**The Arc Welding of Steel Buildings.**"

Feb. 20.—Student Section night. Four student papers presented.

Mar. 21.—W. H. Powell, M.E.I.C. on "**The Development of Mountain Lake Reservoirs.**"

Apr. 3.—F. Newell, M.E.I.C. on "**Hydraulic Regulating Gates.**"

Apr. 11.—Luncheon meeting. Brig. Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C. addressed the Branch.

July 31.—R. J. Durley, M.E.I.C., on "**Institute Affairs.**"

Oct. 30.—Vancouver Engineering Works. Inspection trip to see manufacture of new arc-welded steel water-pipe.

Dec. 18.—Annual meeting.

EXECUTIVE COMMITTEE

The Executive Committee held nine regular meetings during the year, the business of the Branch being transacted by it. General meetings were confined to a speaker and his subject, with the exception of the annual meeting.

GENERAL REVIEW OF 1929 ACTIVITIES

Walter Moberly Memorial Prize

The fifth award of the prize, consisting of technical books to the value of $25.00 was made on May 21st, to Clifford E. Lord for his essay on "The Physiography of the Coast Range of British Columbia and South-Eastern Alaska."

Library

The question of the library is one that must be faced very soon. The cost to the Branch is $100.00 a year against which should be credited the use of the University Club for Branch meetings, making the net cost somewhere in the neighbourhood of $50.00 per annum. As the members make very little use of the library, the above sum is a dead loss to the Branch.

As a result, the Executive are working with the association of Professional Engineers in an endeavour to establish a proper engineering library that will be of use to the members of the profession in the city. Some progress has been made but much remains to be done before this ideal can be realized.

Co-operation with Association of Professional Engineers

The Executive have met with the Council of the Association to discuss mutual problems, particularly with regard to the extension of the licensing principle. The resolution passed at the last Plenary Meeting of Council, pledging the support of The Institute toward obtaining uniform licensing acts in the various provinces, where such do not exist, is due in some measure to the work of these joint meetings.

PAPERS

The papers delivered before the Branch this year have been of high standard, two of them being printed in full in the Journal. Attention should be drawn to the fact that it is becoming increasingly difficult to persuade members to contribute papers.

FINANCIAL STATEMENT

(December 12, 1928 to December 18, 1929)

Receipts

Bank balance as at December 12, 1928	$ 61.00	
Cash in hand	2.50	
Rebates from Headquarters (August 1928 to August 1929)	378.75	
Branch news	12.89	
Branch news (Student Section)	17.37	
Library rent (Association of Professional Engineers)	50.00	
Rent for Women's building (A.I.E.E.)	12.50	
Rebates on telegrams from Headquarters	28.75	
		$563.76

Disbursements

Office Expenses:		
Secretary's expenses	$ 14.45	
Postage and stationery	18.77	
Telegrams	39.81	
Rent	75.00	
		$148.03
Meetings:		
Notices and ballots	$ 66.55	
Rent—Women's building	25.00	
		$ 91.55
Student Section:		
By cheque	$ 13.42	
By cash	5.00	
		$ 18.42
Stenographer		$ 15.00
Honorarium—secretary (1928)		$ 50.00
Library:		
Rent	$100.00	
Installment to Headquarters	50.00	
		$150.00
Balance:		
Bank balance	$ 81.07	
Cash in hand	9.69	
		$ 90.76
		$563.76

LIBRARY CAPITAL ACCOUNT

(December 18, 1928)

	Dr.	Cr.
To loan from Headquarters	$300.00	....
By installment repaid 1927	....	$ 25.00
" " " 1928	....	100.00
" " " 1929	....	50.00
Balance debit	....	125.00
	$300.00	$300.00

WALTER MOBERLEY MEMORIAL FUND

(December 12, 1928 to December 18, 1929)

Receipts

Bank Balance, December 12, 1928	$ 59.00	
City of Vancouver bond interest 1929	25.00	
Dominion of Canada bond interest 1929	5.00	
Bank interest	2.19	
		$ 91.19

Disbursements

Bursar, University of B.C.	$ 25.00	
Bank balance, December 28, 1929	66.19	
		$ 91.19

MEMBERSHIP

Branch Residents	Dec. 14, 1927	Dec. 12, 1928	Dec. 18 1929
Members	59	58	59
Associate Members	85	77	79
Juniors	10	11	14
Students	44	61	76
Affiliates	0	2	2
	198	209	230
Branch Non-Resident			
Members	17	16	17
Associate Members	37	40	46
Juniors	5	8	9
Students	7	17	19
Affiliates	0	0	0
	66	81	91

STUDENT SECTION

The Student Section of the Branch is a very vigorous and growing youngster. Those of the members who heard the papers delivered at the Student night on February 20th, 1929, realized that the calibre of those papers was exceedingly high.

The Section has held weekly noon-hour meetings throughout the University year, to hear engineers of all branches describe their work and difficulties.

ELECTION

Sixty-five ballots were returned out of a total of 158 mailed, which is about the average.

Respectfully submitted,
A. D. CREER, *Chairman.*
JOHN OLIVER, S.E.I.C., *Secretary-Treasurer.*

Victoria Branch

MEMBERSHIP

The changes notices in our Branch membership during the year are:—Three Members, four Associate Members and two Students have left us, while two Associate Members have come to the Branch territory. In the Branch non-resident membership three Associate Members have left and we have two new Students and one new Affiliate Member. The numerical standing being as follows;—

	Branch Residents	*Branch Non-Residents*
Members	20	1
Associate Members	22	3
Juniors	1	..
Students	4	2
Affiliates	2	..

Total Branch membership is 55.

The Branch Executive Committee for the year has been as follows:—

Chairman .... F. G. Aldous, A.M.E.I.C.
Vice-Chairman .... H. F. Bourne, A.M.E.I.C.
Secretary-Treasurer .... K. M. Chadwick, M.E.I.C.
Executive Committee .... A. L. Carruthers, M.E.I.C.
L. W. Toms, A.M.E.I.C.
F. C. Green, M.E.I.C.
O. W. Smith, M.E.I.C.
Ex-officio .... R. F. Davy, A.M.E.I.C., Councillor and Past-Chairman.

The Executive Committee held four meetings during the year at which Branch business was transacted.

The convenors of committees were:—

Papers Committee .... F. L. Macpherson, M.E.I.C.
Social Committee .... F. C. Green, M.E.I.C.
Town Planning .... H. F. Bourne, A.M.E.I.C.
Publicity Committee .... J. N. Anderson, A.M.E.I.C.
Library Committee .... F. W. Knewstubb, A.M.E.I.C.

The whole Executive Committee acted as Legislative, Credentials and Attendance committees.

In the latter part of May the secretary instructed by the Executive Committee, sent several night letters to the Ministers at Ottawa urging increase of salaries to the Civil Service employees as recommended by the Royal Commission.

The Branch has been fortunate in having som excellent lectures, visits and luncheons, a list of which follows. Reports of these have already been published in the Branch News in the Journal.

"Wooden Pipes," by J. B. Holdcroft, A.M.E.I.C., of Vancouver.

Jan. 21-22.—Two joint meetings with Vancouver Island Prospectors Association. **"Workings of the B.C. Mineral Act,"** by F. C. Green, M.E.I.C., and **"Opportunities of the Prospector in Northern British Columbia,"** by Dr. Forest Kerr.

"Electric Welding of Steel Buildings and Bridges," by F. P. McKibben of the General Electric Company, Black Gap, Pa.

Feb. 22.—"**Education of the Engineer,**" by E. A. Wheatley, A.M.E.I.C.

Mar. 20.—"**Structural Timber,**" by J. B. Alexander, timber mechanics supervisor of the Forest Products Laboratory, Vancouver.

Apr. 13.—Visit of President of The Institute, Brig.-General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C. Inspection of New Dry Dock under J. P. Forde; luncheon at Spencers Dining rooms with short address by the President.

Apr. 25.—Through courtesy of Lincoln Electric Company of Cleveland moving pictures were shown by Mr. C. L. Harrison, of the electrically welded construction of the Upper Carnegie building, Chicago.
Visit of General Secretary R. J. Durley, M.E.I.C. Luncheon and address to members.

Oct. 23.—Through courtesy of J. P. Forde, M.E.I.C., members visited the Dry Dock.

Nov. 13.—Nominations for new officers for the coming year. R. F. Davy's report of the Plenary Meeting of Council in Montreal.

FINANCIAL STATEMENT
(From December 1st, 1928, to November 30th, 1929)

Receipts

Balance in hand December 1st, 1928		$117.08
Branch dues for 1928 (3)	$ 9.00	
Branch dues for 1929 (23)	69.00	
Rebates from H.Q.	127.05	
Branch news	24.47	
Refund from H.Q. on night letters	36.25	
Key of room sold	.50	
		$266.27
		$383.35

Expenses

Rent of 25 Brown building, 12 mos. at $12.50	$150.00	
Honorarium (Secretary)	50.00	
Cross and Co. rent of lecture room	10.50	
Pemberton and Son rent of lecture room	5.00	
Electric light, 12 mos. at 75c	9.00	
Magazines	13.85	
Wreath	3.50	
Bill heads	5.61	
Insurance on books	4.10	
Night letters to Ottawa	36.25	
Hollins—notices of meetings	16.00	
Expenses of lunches	1.90	
Stamps for the year	7.16	
Miscellaneous	1.35	
		$314.22
Balance in Royal Bank	$ 68.12	
Balance in cash	1.01	
		69.13
		$383.35

Audited and found correct,
F. L. MACPHERSON, M.E.I.C. }
E. G. MARRIOTT, A.M.E.I.C. } Auditors.

Respectfully submitted,
H. F. BOURNE, A.M.E.I.C., *Chairman.*
K. M. CHADWICK, M.E.I.C., *Secretary-Treasurer.*

Winnipeg Branch

The President and Council,—

The following report for the year ending December 31st, 1929, of the Winnipeg Branch, is respectfully submitted.

The membership at the end of the year stood as follows:—

	Resident	*Non-Resident*	*Total*
Members	42	3	45
Associate Members	99	27	126
Juniors	22	2	24
Students	47	3	50
Affiliates	6	0	6
Branch Affiliates	12	0	12
	228	35	263

There were eleven regular meetings held as tabulated below:—

Jan. 10.—Dale J. Graham, "**Street Car and Bus Transportation.**" Attendance, 35.

Jan. 24.—C. H. Attwood, F. H. Martin, J. W. Sanger, "**Winnipeg River, Seven Sisters and Slave Falls.**" Attendance, 74.

Feb. 7.—W. Sanford Evans, "**Manitoba Interests with Respect to Transportation Routes to the North.**" Attendance, 38.

Feb. 21.—J. Gilchrist, "**Specifications and Testing of Steel.**" Attendance, 46.

Mar. 21.—F. Newell, "**Sluice Gates.**" Attendance, 59.

Apr. 25.—N. M. Hall, "**Construction and Operation of Water Tube Boilers.**" Attendance, 54.

Aug. 13.—Prof. Smith, "**Thirty-five Years of Ventures in High Voltages.**" Attendance, 69.

Sept. 26.—J. F. Cunningham, "**Heat Treatment of Steel.**" Attendance, 23.

Oct. 24.—Paul C. Nanton, "**The Respective Merits of Stocks and Bonds as Investments.**" Attendance, 44.

Nov. 28.—W. E. Barker, "**Design and Construction of Concrete Pavements.**" Attendance, 59.

Dec. 12.—A. A. McCoubrey, "**Early Western Railway Surveys.**" Attendance, 37.

On Wednesday, April 17th, the officers and members of the Branch were fortunate in having as a luncheon guest, President Brigadier-General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C.

Twice during the season the Executive Committee was honoured by a visit from General Secretary R. J. Durley, M.E.I.C.

It must be reported with regret that the Chairman of the Branch, F. H. Martin, has been so seriously ill, that an extended visit to the south has become necessary for his recovery.

FINANCIAL STATEMENT

Receipts

Bank balance December 31st, 1928	$543.05	
Rebates from Headquarters	442.59	
Dues net	282.50	
Journal subscriptions	18.00	
Bond interest	27.50	
Bank interest	7.83	
Refund from annual supper-dance	13.55	
		$1,335.02

Expenditures

Secretary's Honorarium	$300.00	
Printing	221.21	
Student prizes	80.00	
Refreshments at Branch meetings	43.37	
Petty cash	15.00	
Journal subscriptions	18.00	
Supper-dance	200.00	
Contribution Town Planning Institute of Canada	50.00	
Telegrams	14.40	
Bank exchange	.90	
		$ 942.88
		$ 392.14
Bank balance December 31st, 1929	$396.83	
Less outstanding cheque S 191	4.69	
		$ 392.14

Item rebates under receipts includes revenue from Branch news, cash on hand, advice by wire from Headquarters.

Rebates December $36.25
Advertising 18.00

Respectfully submitted,

E. W. M. JAMES, A.M.E.I.C., *Secretary-Treasurer.*

THE

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Second World Power Conference

The attention of all members of The Institute is drawn to the Second World Power Conference Meeting in Berlin, June 16th-25th, 1930, at which engineers, economists, statesmen and others from practically all countries of the world will gather to discuss, from every aspect, problems associated with the development of power.

The Canadian Executive Committee of the World Power Conference has been fortunate in arranging for the presentation at the Berlin Meeting of seven papers comprehensively covering the power situation in the Dominion, by such authors as Dr. F. A. Gaby, M.E.I.C., chief engineer, Hydro-Electric Power Commission of Ontario, Dr. T. H. Hogg, M.E.I.C., chief hydraulic engineer, Hydro-Electric Power Commission, Dr. Julian C. Smith, M.E.I.C., vice-president and general manager, Shawinigan Water and Power Company, and Professor C. V. Christie, M.E.I.C., McGill University, Dr. O. O. Lefebvre, M.E.I.C., chief engineer, Quebec Streams Commission, J. T. Johnston, M.E.I.C., director, Dominion Water Power and Reclamation Service, G. Gordon Gale, M.E.I.C., vice-president and general manager, Gatineau Power Company, and B. F. Haanel, M.E.I.C., chief engineer, Division of Fuels and Fuel Testing, Department of Mines, Ottawa. This assures that Canada will be substantially represented in the programme and the effort of the Executive Committee is being supported by an Honorary Committee of Dominion wide influence in power matters, under the Honorary Chairmanship of the Honourable Charles Stewart, Minister of the Interior.

It remains to support the Canadian effort by sending a strong delegation to Berlin and with the interest already manifest, there is every indication that many from this country will seize this rare opportunity to meet and discuss with the power authorities of other countries problems which are of common interest.

Membership in the Second World Power Conference is obtained by paying a fee of ten dollars to the German National Committee and membership forms are to be secured by addressing N. Marr, M.E.I.C., acting secretary, Canadian National Committee, 81 Metcalfe street, Ottawa. Prompt action in filling out and forwarding these membership forms to the German National Committee is urged upon those intending to go in order that the German Committee may have an opportunity of making proper provision for accommodation, etc.

Fiftieth Anniversary Celebration of the A.S.M.E.

The fiftieth anniversary celebration of the American Society of Mechanical Engineers will take place on April 5th to 9th, 1930, in New York, Hoboken, and Washington; an extensive programme will make it an event of international significance interpreting the social and economic influence of engineering on civilization.

The proceedings will commence on Saturday, April 5th, with the unveiling of a memorial tablet in the Engineering Societies Building, New York City, followed in the afternoon by a pageant at the Stevens Institute of Technology, Hoboken, N.J., featuring engineering progress. On Sunday the 6th, a special commemorative service will be held at the Cathedral of St. John the Divine, and the delegates will leave for Washington, where, on Monday, the 7th, a welcoming assembly will be held in the National Council Chamber, United States Chamber of Commerce Building, at which addresses will be made by the delegates from the various countries represented and by representatives of the other American engineering societies. In the afternoon monographs covering the humanistic aspects of engineering will be presented by representatives of all the principal industrial countries of the world. There will be a convocation for the conferring of honours, and the day will close with the fiftieth anniversary formal dinner of the Society.

On the concluding day of the gathering, Wednesday, April 9th, excursions have been arranged to the Bureau of Standards, the United States Navy Yard, and the various government buildings, and places of interest in and around Washington.

A cordial invitation to attend this anniversary has been extended to members of The Engineering Institute of Canada, and preliminary registration blanks can be obtained from the General Secretary of The Institute at Headquarters.

Progress in Steam Research

The rapid development of the last few years in the use of steam at high pressures and high superheat has greatly changed our outlook on the problems of steam power generation. Progress as regards knowledge of combustion engineering problems has been remarkable, and marked advance has been made in the difficult task of obtaining reliable data as to the physical properties of steam at the high temperatures and pressures which are now either in actual use or are contemplated in installations under design.

The determination of these properties has been the object of prolonged scientific research. One hundred and fifty years ago, when the steam engine was being developed by Watt, the search for the true properties of steam began, and the accuracy of the measurements of the pressure, temperature and total heat of steam made by Regnault and other early experimenters in the early nineteenth century was such that until quite recently, within their limited range, they afforded a sufficient basis for calculations. Since that time, however, quite different conditions have arisen, and to-day steam plants are in operation with working temperatures up to 1,000° F. and working pressures approaching 1,000 lbs. per square inch. Experimental work dealing with the properties of steam under these conditions is much more arduous and expensive than in the days of Rankine. It involves complications and difficulties with which the early physicists were not faced. Its necessity, however, has become increasingly evident, since it was found, some ten years ago, that available tables of the thermal properties of steam were not reliable in those higher regions; further, there was no international agreement on such figures as had been obtained. Investigators were at work, however, in many countries, and after much had been done independently, principally in England, the United States and Germany, an International Steam Table Conference was held in London last year, at which the work of such men as Callendar, Mollier, Jakob, Keyes and Osborne was discussed, with a view to the preparation of a set of international steam tables. As as result of the examination by this conference of all available figures, a network of selected values was agreed upon for the saturated and superheated regions of the steam table, taking temperatures up to 350° C. (about 650° F.) for saturated steam, and pressures up to 250 atmospheres, or say, 3,600 lbs. per square inch, for superheated steam. It is interesting to note that the conference decided upon the use of the International scale of temperature, and the unit of heat employed was the kilo-calorie, defined as the heat value of an international kilowatt-hour divided by 860. The selection of this unit avoids the difficulty caused in the case of the British Thermal Unit by its dependence on the value of gravity and the specific heat of water.

The conference assigned tolerances, or measures of uncertainty, to the various quantities, such as specific volume and total heat, at each selected point, and it was agreed to regard as international any steam table which, at each of the test points selected, differs from the selected value by an amount less than the assigned tolerance. The report of this conference* marks a notable advance, for it provides a method of handling the results of the work of many independent investigators on an international basis, and furnishes at the same time a foundation for further extended research.

*See "Engineering," Dec. 6th, 1929, pp. 751-752; also "Mechanical Engineering," Feb., 1930, pp. 120-141.

The Forty-Fourth Annual General and General Professional Meeting

Convened at Headquarters, Montreal, Montreal, January 23rd, 1930 and adjourned to the Chateau Laurier, Ottawa, Ontario, February 12th, 1930.

Annual General Meeting at Institute Headquarters

The Forty-fourth Annual General Meeting of The Institute was held at Headquarters on Thursday, January twenty-third, nineteen hundred and thirty, at eight o'clock p.m., with Councillor O. O. Lefebvre, D.Sc., M.E.I.C., in the chair.

The Secretary having read the notice convening the meeting, the minutes of the Forty-third Annual General Meeting were submitted, and on the motion of J. H. Hunter, M.E.I.C., seconded by F. P. Shearwood, M.E.I.C., were taken as read and confirmed.

Appointment of Scrutineers

On the motion of J. T. Farmer, M.E.I.C., seconded by J. D. Alder, M.E.I.C., Messrs. J. A. Burnett, M.E.I.C., and J. L. M. Tait, A.M.E.I.C., were appointed scrutineers to report the result of the Officers' Ballot.

Appointment of Auditors

On the motion of J. G. Caron, A.M.E.I.C., seconded by C. K. McLeod, A.M.E.I.C., Messrs. Riddell, Stead, Graham and Hutchison were appointed auditors for the ensuing year.

There being no other formal business it was resolved, on the motion of P. B. Motley, M.E.I.C., seconded by H. G. Thompson, A.M.E.I.C., that the meeting do adjourn to reconvene on Wednesday, the twelfth day of February, nineteen hundred and thirty, at ten o'clock a.m. at the Chateau Laurier, Ottawa, Ontario.

Adjourned General and General Professional Meeting at the Chateau Laurier, Ottawa

The adjourned meeting was convened at ten o'clock a.m. on February 12th, 1930, President C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., in the chair. The Secretary having read the messages of regret received from members and invited guests, the membership of the Nominating Committee appointed to nominate officers of The Institute for 1931 was announced as follows:—

Nominating Committee 1930

Chairman: A. Duperron, M.E.I.C.

Branch	*Representative*
Halifax Branch	W. A. Winfield, M.E.I.C.
Cape Breton Branch	J. R. Morrison, A.M.E.I.C.
Saint John Branch	J. L. Feeney, A.M.E.I.C.
Moncton Branch	T. L. S. Landers, M.E.I.C.
Saguenay Branch	N. D. Paine, A.M.E.I.C.
Quebec Branch	Philippe Méthé, A.M.E.I.C.
St. Maurice Valley Branch	A. A. Wickenden, A.M.E.I.C.
Montreal Branch	H. G. Thompson, A.M.E.I.C.
Ottawa Branch	D. W. McLachlan, M.E.I.C.
Peterborough Branch	W. M. Cruthers, A.M.E.I.C.
Kingston Branch	D. S. Ellis, A.M.E.I.C.
Toronto Branch	G. A. McCarthy, M.E.I.C
Hamilton Branch	H. S. Philips, M.E.I.C.
London Branch	F. C. Ball, A.M.E.I.C.
Niagara Peninsula Branch	C. G. Moon, A.M.E.I.C.
Border Cities Branch	F. H. Kester, M.E.I.C.
Sault Ste. Marie Branch	J. L. Lang, M.E.I.C.
Lakehead Branch	F. C. Graham, A.M.E.I.C.
Winnipeg Branch	J. W. Sanger, A.M.E.I.C.
Saskatchewan Branch	H. R. MacKenzie, A.M.E.I.C.
Lethbridge Branch	N. H. Bradley, A.M.E.I.C.
Edmonton Branch	R. S. L. Wilson, M.E.I.C.
Calgary Branch	F. M. Steel, M.E.I.C.
Vancouver Branch	W. B. Greig, A.M.E.I.C.
Victoria Branch	F. L. Macpherson, M.E.I.C.

A letter was presented from the Hon. Charles Stewart, Minister of the Interior, dated February 4th, 1930, and drawing attention to the fact that the second plenary meeting of the World Power Conference will be held in

Berlin from June 16th to 25th, 1930, and that a number of papers by representative Canadian engineers have been arranged for. The letter further requested the support of The Engineering Institute of Canada in making the Canadian effort effective and invited the President of The Institute to act upon the Canadian Honorary World Power Conference Committee. The Minister of the Interior also asked that the invitation to participate in the Berlin Conference should be brought to the attention of members of The Institute, with the object of encouraging the attendance of as many as possible as official delegates. The President stated that the Hon. Mr. Stewart had been assured of the co-operation of The Institute in any way possible, and that the matter would come up for consideration at an early meeting of Council.

Presentation of Medals and Prizes

In regard to the prizes and medals of The Institute, the President announced that for the year 1928-1929, it had not been considered advisable to make any award of the Sir John Kennedy Medal, and that the committees judging the competitions for the Past-Presidents' Prize, the Gzowski Medal and the Leonard Medal had been unable to recommend any award. The President then called upon A. S. Wall, M.E.I.C., to whom the Plummer Medal had been awarded for his paper on "Arc Welding in Structural Fabrication," and the medal was handed to Mr. Wall. The President next presented the Phelps Johnson Prize to E. Gray-Donald, Jr.E.I.C., for his paper on "Distribution Transformers" and the John Galbraith Prize to Morley V. Powell for his paper on "Fabricated Steel Construction for Large Electric Generators." It was announced that the examiners had been unable to make any award for the Ernest Marceau, H. N. Ruttan and Martin Murphy Prizes.

Reports of Council and Committees

The President requested the Secretary to outline the principal features of the Report of Council, which was accordingly done, this report being printed on page 179 of this issue of the Journal.

Report of the Finance Committee

G. R. MacLeod, M.E.I.C., the chairman of the Finance Committee, then discussed the principal features of the Finance Committee's report and the financial statement.

Report of the Committee on Engineering Education

The President remarked that Fraser S. Keith, M.E.I.C., the chairman of the committee on Engineering Education, who was unfortunately unable to be present, had hoped that there would be discussion on the recommendations of that committee, and he asked the Secretary to read the report containing them. In regard to these recommendations, E. M. Proctor, M.E.I.C., drew attention to the committee's fourth recommendation, that immediate steps be taken to confer with university heads with a view to adopting a six-year course for engineers. This course Mr. Proctor thought inadvisable, if it contemplated a six-year college course, although he believed that two years of practical experience at the end of a four-year course would be a satisfactory arrangement. He then moved that suggestion number four be referred back to the committee, and his motion, being seconded by J. B. Carswell, M.E.I.C., was carried unanimously. Discussion followed, in which A. F. Baird, M.E.I.C., commented on the fifth recommendation, namely that the universities be urged to give consideration to the inclusion of public speaking and literature in the curricula of their engineering courses. He felt that if the whole of the college training of an engineer had to be covered in four years, it would be impossible to give additional time to such a subject, and was doubtful whether it would be desirable to adopt this recommendation, though he would not press this point to a motion. Messrs. J. W. Whyte, M.E.I.C., George R. MacLeod, M.E.I.C., O. O. Lefebvre, M.E.I.C. and J. A. McCrory, M.E.I.C., took part in further discussion on this report.

Report of the Committee on Publicity

The report of the Committee on Publicity, of which Mr. Keith was also chairman, was next given consideration. In Mr. Keith's absence, it was presented by W. C. Adams, M.E.I.C., who pointed out that the benefits arising from well-managed publicity had been illustrated by the very successful activities of the Ottawa Branch in connection with the present meeting. Mr. Adams drew attention to the fact that the various recommendations of the Committee on Publicity were difficult if not impossible to carry out in the present state of the finances of The Institute, and the discussion was continued by F. P. Shearwood, M.E.I.C., and others.

The President suggested that in view of the amount of business before the meeting it would perhaps be desirable to take together those reports upon which comparatively little comment would be expected. Among these he would name the reports of the Library and House Committee, the Board of Examiners and Education and the Service Bureau Committee. The reports were, however, open for discussion. There being no further comment, W. G. Mitchell, M.E.I.C., moved that the following reports be received and adopted: the Reports of Council, Finance Committee, Library and House Committee, Legislation Committee, Board of Examiners and Education, Service Bureau Committee, Canadian National Committee of the International Electrotechnical Commission, Committee on International Co-operation, the report of The Institute's members on the Main Committee of the Canadian Engineering Standards Association, and those of the Honour Roll and War Trophies Committee and the Committee on Publicity. This motion was seconded by George R. MacLeod, M.E.I.C., and being put was carried unanimously.

Report of the Committee on the Relations of The Institute with the Provincial Associations of Professional Engineers

On the suggestion of S. G. Porter, M.E.I.C., the chairman of the committee, the Secretary outlined the leading features of its report, and stated its final conclusions, after which Mr. Porter, in a striking address, gave his views on the present situation. He remarked that if the scheme proposed by his committee were carried to its conclusion, with the support of the associations, the election of the Council of The Engineering Institute of Canada would be in the hands of men who would all be members of one or other of the provincial organizations, The Institute thus becoming a co-ordinating body. Mr. Porter then commented on the seven recommendations of his committee, and said that in his opinion a system similar to that outlined by his committee afforded the only way in which the engineering profession in Canada could reach real consolidation and solidarity. The profession would then form one Dominion-wide body of engineers and would attain a position which would give it a strength and influence which it had never yet possessed in Canada. If there were a Dominion-wide organization, embracing all the engineers in Canada, into which only those would be admitted who had received proper education and training, engineering could properly take its place along with the other professions. The public would then be able to rest assured that when an engineer belonged to this Dominion-wide body and was also registered in his province as being able to practise engineering, he must have received proper training and experience; this would give the engineer a definite standing, with a resulting increase in the confidence felt by the public in the engineering profession. Such a development would take time, but by deciding on a common high standard and living up to it, the whole body of engineers would be in a position far superior to that held to-day. Further, such action would do much to discourage the practice of going outside of Canada to get engineering work done, and the engineering profession would be more favourably known to the Canadian people and to the industries and governments of Canada. Mr. Porter believed that upon an analysis of the problem it would be found to be one which could be solved if we had the will to solve it, and he hoped that his committee's report would convince the meeting that this was the case.

The President pointed out that the report had already been received and adopted by the 1929 Plenary Meeting of Council, after prolonged discussion, but that Council properly felt reluctant to embark on a policy of this kind until it had been endorsed by the Annual Meeting. He would ask Mr. Porter to move the reception and adoption of this report so that the opinion of the meeting might be taken. It was accordingly moved by S. G. Porter, M.E.I.C., seconded by George R. MacLeod, M.E.I.C., that the report of the Committee on the Relations of The Institute with Provincial Associations of Professional Engineers be received and adopted.

The discussion was opened by P. B. Motley, M.E.I.C., who stated that in his opinion the Provincial Associations were now in somewhat the same position as the Canadian provinces at the time of Confederation, and the policy advocated by Mr. Porter's committee, if put in effect, would have the same beneficial results as Confederation had for the Dominion. He thought that the benefits of such a policy had been strikingly shown by the progress made by the Canadian National Railways since the various roads constituting that organization had been brought together and consolidated. He hoped that the committee's report would be endorsed and that the committee would be placed in a position to continue and develop its work.

He was followed by J. L. Busfield, M.E.I.C., who was unable to agree with Mr. Porter or Mr. Motley, and considered that the policy recommended in the committee's report was undesirable from the point of view of The Institute. He felt that the distinction between the real purposes of the Professional Associations and those of The Engineering Institute of Canada had not been sufficiently emphasized. While he was himself quite in accord with the committee's sixth recommendation, he could not approve of the seventh, feeling that if membership or registration in a Professional Association were made a requirement for admission to corporate membership in The Institute, this would exclude from The Institute hundreds of men who ought to be members, having regard to the fact that one of the principal objects of The Institute is educational. If recommendation number seven were acted upon, The Institute would practically be handed over to the Professional Associations, and he would deprecate putting The Engineering Institute of Canada under the control of any group of associations with such diversified constitutions and powers. If the action contemplated in the seventh suggestion were to be postponed until the associations had themselves attained uniformity, this would involve a long period of waiting, and to his mind the possibility of standardizing the various provincial acts was very remote. The provincial legislatures, in passing these acts, had done so for the purpose of protecting the public, not for the protection of the engineers, and he felt that the difficulty of obtaining uniformity in provincial legislation was almost insuperable. He further believed that even if the provincial associations were co-ordinated so as to form a coherent body, the objects and purposes of that body would certainly not be identical with those of The Engineering Institute of Canada, and he did not see that The Institute could function as such an organization. Mr. Busfield pointed out that two policies appeared open to The Institute at the present time, on the one hand that of confederation with the Professional Associations, a course which was admittedly beset with great difficulties, and on the other hand there was the course of independent growth which he considered far safer and more promising, as it would permit The Institute to develop along its own lines independently of the provincial associations.

After expressing appreciation of the great amount of work accomplished by Mr. Porter and his committee, P. L. Pratley, M.E.I.C. observed that the committee's report had not convinced him that the objects of The Institute were "in many respects identical" with those of the Professional Associations. In his opinion educational effort and legislative functions should be divorced. He felt that the committee, before making a proposal for co-ordination, integration or confederation, should have studied the various duties of the associations on one hand and The Institute on the other to see whether such action would be possible. Mr. Pratley pointed out that at the time when the professional associations were formed there was a natural desire to protect the engineer, and this was, in fact, the motive which prompted the action then taken. The provincial legislatures, however, would not accept that point of view, being concerned with the protection of the public, and this had led to many changes in the provincial acts. He believed that the work of the committee should be the study of co-ordination of the associations rather than endeavouring to combine The Institute with these various bodies. If the differences in the functions of the associations and of The Institute were clearly realized, it would be seen that there must necessarily be a difference in the qualifications for membership. Mr. Pratley was quite opposed to the fifth recommendation of the committee, contemplating the adoption of uniform requirements and qualifications for admission as between the associations and The Institute. He though it quite right that there should be a standard requirement for all the associations for registration purposes, but did not think that The Institute should adopt the same requirements or necessarily have the same membership as the associations. Many hundreds of men interested in the engineering profession and employed in the technical offices of large corporations should have a place in The Institute, which could offer them educational advantages and the information and experience of senior members. These men in the offices of large companies had no intention of practising engineering as a profession, and did not need licenses to practise, since they carried on their engineering work under the guidance of those who were in responsible positions. In his opinion there was no need for many of these junior members to belong to any professional association, but they certainly should belong to The Institute. Accordingly, he thought it would be wrong on the part of The Institute to exclude them from its membership simply because of the special requirements for membership which might properly be insisted upon by the associations. Mr. Pratley felt that the committee's report had failed to distinguish clearly between the functions of the various organizations and had come to the wrong conclusion as to the necessity for uniform requirements for admission.

H. N. Mason, A.M.E.I.C., believed that although some of the professional associations were operating under acts which gave them but little power, it was wrong to continue to divorce The Institute from the professional associations. The Institute must co-operate with such associations so that engineers throughout the country could co-ordinate their efforts.

D. W. McLachlan, M.E.I.C., continued the discussion, and was of the opinion that The Institute should accept the membership of those belonging to professional associations, but he saw no reason why there should not be a large number of additional members belonging to The Institute and not belonging to any association.

E. M. Proctor, M.E.I.C., drew attention to the suggestion in recommendation number seven that membership or registration in a professional association be a requirement for admission to The Institute, and enquired whether if this were put into effect difficulties would not arise in regard to engineers from the United States, Great Britain and elsewhere who desired to join The Institute. He hoped that the professional associations would aid in defraying the cost of the further investigations contemplated by Mr. Porter's committee.

C. G. Moon, A.M.E.I.C,, did not think that amalgamation with the provincial associations would be a good thing for The Engineering Institute, and held that The Institute should go on its way as an educative body, taking in every man who was sincere in his desire to become an engineer and follow the engineering profession. This might involve a slight lowering of The Institute's present requirements for admission, but he believed that it would be in the true interests of the engineers of the country and of The Engineering Institute of Canada.

G. E. Bell, M.E.I.C., referred to the very large proportion of the membership of The Institute which consisted of employees of contracting manufacturing corporations, and pointed out that while these men were not interested in the question of registration for private practice, they were interested in belonging to a technical organization whose function was educational, and consisted in the exchange of professional experience and information. He thought that The Institute had a great deal to gain from the membership of such men, and feared that if the scheme contemplated by Mr. Porter's committee went into effect, a large number of them would resign from The Institute and possibly join other organizations.

A. F. Baird, M.E.I.C., fully endorsed the report of Mr. Porter's committee and believed that it would have the support and approval of the professional associations in New Brunswick and Nova Scotia. Professor Baird could assure those who doubted whether the associations really protected the public that in New Brunswick, where they had a rather strict act, several cases had occurred where the association had proved its value in this respect, and he would point out that effective acts existed in other provinces also. The discussion was continued by A. F. Macallum, M.E.I.C., J. B. Carswell, M.E.I.C., F. H. Peters, M.E.I.C., B. S. McKenzie, M.E.I.C., and A. J. Grant, M.E.I.C.

J. L. Busfield, M.E.I.C., believed that sufficient differences of opinion had been expressed during the discussion to justify further consideration of the report, and he therefore moved as an amendment to the main motion that this meeting approve of the principle of The Engineering Institute of Canada helping the provincial associations of professional engineers to standardize their requirements, and co-ordinate their activities, but that we do not commit ourselves to definite action of combining with them until such time as it has been found possible to co-ordinate the professional associations.

J. P. Hodgson, M.E.I.C., read a telegram which he had received from the registrar of the Association of Professional Engineers of the Province of British Columbia urging The Institute to encourage all its members to comply both in spirit and letter with the engineering acts of the various provinces since this course would aid the movement for confederation.

Colonel H. J. Lamb, M.E.I.C., remarked that when the movement for closer relations between The Engineering Institute of Canada and the Provincial Associations was initiated, he was president of the Ontario Association, and at that time was impressed with the great difficulties attending the carrying out of such a scheme. Since that time, having served as a member of Mr. Porter's committee, he had entirely changed his mind and now believed that it would be in the interests of the engineering profession throughout the Dominion if the movement were successful. He was sure that The Institute would prosper and be better able to help engineers throughout the country if such relationship could be brought about. Colonel Lamb was strongly in favour of standardizing the requirements for admission to the professional associations and particularly those as regards admission by examination. He hoped that the meeting would give its support to the movement by approving the report of Mr. Porter's committee.

After further discussion, the President pointed out that Mr. Busfield's amendment had not been seconded, and Mr. Pratley, in seconding it, remarked that while the majority seemed quite ready to help in furthering some form of co-operation between the various provincial associations, he believed there were quite a number who would hesitate in committing The Institute to the adoption of the fifth recommendation in the report. He felt that Mr. Porter's committee was to be commended, it had done a great deal of admirable work and should continue that work in the direction of persuading if possible the professional associations to get together and standardize their own attitude. He thought The Institute should await some such action on the part of the associations before committing itself to the approval of uniform regulations for admission.

Harold S. Johnson, M.E.I.C., observed that there were many members of the Association in Nova Scotia who were not members of The Engineering Institute of Canada and were not likely to become members. The present meeting was of course a general meeting of The Engineering Institute of Canada but could not be considered as being fully representative, as it could not bring expressions of opinion from each of The Institute's Branches. He did not think that a vote of this meeting could, therefore, be regarded as expressing the views of the whole membership.

The President pointed out that Mr. Porter's committee comprised representatives from all parts of the country, and that its report had been considered and approved by a Plenary Meeting of Council, at which Councillors from almost all the Branches were present. He believed that the Council had been satisfied that the Branches were generally in favour of the proposals. Council had, however, been reluctant, notwithstanding this general approval, to embark upon the proposal until it had been formally endorsed by the Annual General Meeting.

Mr. Busfield enquired whether it was the intention to put immediately into effect the suggestion in the seventh recommendation that amendments to The Institute's By-laws should be secured so that membership or registration in a professional association be one of the requirements for admission to corporate membership in The Engineering Institute of Canada. The President replied that it was not the intention to take immediate action in this respect; Mr. Busfield then said that in such a case he would be willing, with the permission of his seconder, to withdraw his amendment. The President remarked that as recommendation number seven would not come into effect until numbers five and six had become operative, the necessity for Mr. Busfield's amendment was not so apparent. On Mr. Pratley's agreement, the amendment was then withdrawn.

After further discussion, the main motion was put and carried, one member dissenting.

Report of the Committee on Policy

Dr. O. O. Lefebvre, M.E.I.C., in presenting the report of the Committee on Policy, explained that this report was not a final one, since some of the subjects dealt with depended upon the action taken by the membership in connection with the proposed amendments to By-laws which were shortly to be voted upon. His committee had reported at The Plenary Meeting of Council, previous to which the Branches had been consulted by questionnaire, and replies from them had been used in connection with the discussion at the Plenary Meeting, the results of which had been available in preparing this report now submitted. The question of the publications of The Institute, which was among those referred to the Committee on Policy, was being dealt with by a special committee and would form the subject of another report later on.

Mr. Lefebvre outlined the recommendations of his committee and moved the reception and adoption of the report; the motion being seconded by Mr. J. A. McCrory, was carried unanimously.

Special Committee on the Publications of The Institute

The President stated that this committee, which was appointed at the Plenary Meeting of Council in October 1929, had not completed its work, and no report had yet been received from it, but he would ask the chairman to make a statement regarding the information obtained and the conclusions arrived at. W. C. Adams, M.E.I.C., accordingly stated that his committee had made a progress report at the meeting of Council on February 4th, and their enquiries were still proceeding, but he desired to place before the annual meeting such information as had already been obtained. He felt that the work of his committee would have to be continued, and thought that some discussion might now take place which would be of assistance in this further work. A record of the information obtained by his Committee and a questionnaire had been sent to each of the Branches of The Institute, but at the time of speaking replies had been received from only about half the Branches. On the receipt of the remaining replies he hoped that his committee, or some other committee to be appointed by Council to continue its work, would shortly be able to present definite recommendations.

The Secretary read a letter dated February 11th, 1930, addressed to the Council, and received from Councillor C. H. Scheman, M.E.I.C., in which the views of the Niagara Peninsula Branch regarding the publications of The Institute were set out in some detail. After some discussion Dr. Lefebvre moved that the progress report of Mr. Adams' committee and the communication from the Niagara Peninsula Branch dated February 11th, be received, and the incoming Council be instructed by this meeting to continue the committee. The motion being seconded by C. G. Moon, A.M.E.I.C., was put and carried unanimously.

Proposals for Amendments to By-Laws

In connection with the amendments to the By-laws proposed by Council, the President remarked that these were brought up for discussion in accordance with Section 75 of the By-laws, previous to their submission to the membership for decision by letter ballot. He asked G. R. MacLeod, M.E.I.C., to make a statement with regard to the proposed amendments.

G. R. MacLeod, M.E.I.C., pointed out that the principal proposal (that to amend Section 34) involved an increase in the annual fees of members, and was a repetition of the proposal which failed to carry in 1929. He called attention to the memorandum on this subject which had been sent to all corporate members and urged that the additional funds asked for were required for vital services required by The Institute. On the motion of Hew M. Scott, M.E.I.C., seconded by T. Taylor, M.E.I.C., it was unanimously resolved that this meeting go on record as endorsing the memorandum regarding the increase of fees issued by Council, dated January 31st, 1930, and forwarded to all corporate members.

Dr. Lefebvre drew attention to the fact that when the amendment proposed to Section 34 goes out to ballot, it would be very desirable for it to be accompanied by a statement of the reasons advanced in its support, and from further discussion it appeared to be the unanimous opinion of the meeting that a statement of the reasons in favour of the proposed increase should be drawn up with the approval of Council, and issued with the ballot.

In regard to the amendment to Section 75 dealing with a proposed change in the procedure at the Annual Meeting regarding proposals to introduce new By-laws or to amend or repeal existing By-laws, Mr. Busfield was of the opinion that the change now suggested by Council would not prove satisfactory in actual practice, as if it were adopted the procedure would practically revert to the conditions obtaining in 1926, when the Annual General Meeting could do nothing except discuss any changes in the By-laws proposed by Council or by twenty corporate members. The present proposal, however, added the complication that after discussion by the Annual General Meeting the proposals would have to go back either to the Council or to twenty corporate members. He thought that some method should be worked out by which the Annual Meeting would have the definite power to modify such proposals, the difficulty as to voting on so many propositions being taken care of by proper direction from the chair.

Dr. Lefebvre remarked that at the Annual Meeting of 1929 a number of modifications had been proposed to one of Council's amendments, and these had all to go out to ballot; as a result the proposal of Council and all of the modifications thereto suggested by the Annual Meeting failed to carry, because the vote was so split that no one item could secure the necessary 66 per cent majority. Further discussion on this point was then postponed on the suggestion of the President, until Council's proposals respecting Sections 13 and 37 had been dealt with. On the motion of Dr. Lefebvre, seconded by Mr. G. R. MacLeod, it was unanimously resolved that this meeting endorse Council's amendment to Section 13. On the motion of Dr. Lefebvre, seconded by Mr. Hew M. Scott, it was unanimously resolved that Council's proposal with regard to Section 37 should have the endorsement of the meeting.

Discussion having been resumed on the proposed amendment to Section 75, the President stated that in view of the differences of opinion disclosed with respect to this matter, he would appoint a committee in accordance with the provision of Section 75, to prepare reasons for and against the proposal, such reasons to be sent out with the ballot papers. He nominated for this purpose Dr. Lefebvre and Mr. MacLeod to state reasons in favour of the proposal, and Mr. Busfield and Mr. Shearwood to state reasons against the proposal.

Reports of the Branches

The President having pointed out that it was not customary to read these reports in full, enquired if any members present desired to make any remarks regarding them. No comment being made, it was unanimously resolved, on the motion of Major L. R. Grant, M.E.I.C.

seconded by E. M. Proctor, M.E.I.C., that the reports of the Branches as submitted in printed form be taken as read and received.

President's Retiring Address

The President next gave his retiring address, which is printed *in extenso* on pages 219-226 of this number of The Engineering Journal.

On the conclusion of General Mitchell's address, Dr. Lefebvre moved a hearty vote of thanks to the retiring President for his interesting and valuable address, and this proposal was at once carried by acclamation.

Election of Officers

The report of the scrutineers appointed to canvass the Officers' Ballot for 1930 having been read by the Secretary, the following officers were declared elected:

President	A. J. Grant, M.E.I.C.
Vice-Presidents:	
Zone B	T. R. Loudon, M.E.I.C.
Zone C	W. G. Mitchell, M.E.I.C.
Zone D	F. R. Faulkner, M.E.I.C.
Councillors:	
Victoria Branch	F. M. Preston, A.M.E.I.C
Vancouver Branch	A. K. Robertson, M.E.I.C.
Calgary Branch	T. Lees, M.E.I.C.
Edmonton Branch	E. Stansfield, M.E.I.C.
Lethbridge Branch	G. N. Houston, M.E.I.C.
Saskatchewan Branch	D. A. R. McCannel, A.M.E.I.C.
Winnipeg Branch	C. H. Attwood, A.M.E.I.C.
Lakehead Branch	F. Y. Harcourt, M.E.I.C.
Sault Ste. Marie Branch	A. E. Pickering, M.E.I.C.
Border Cities Branch	L. McG. Allan, A.M.E.I.C.
Niagara Peninsula Branch	C. H. Scheman, M.E.I.C.
London Branch	W. P. Near, M.E.I.C.
Hamilton Branch	E. H. Darling, M.E.I.C.
Toronto Branch	L. W. Wynne-Roberts, A.M.E.I.C.
Kingston Branch	W. L. Malcolm, M.E.I.C.
Peterborough Branch	R. L. Dobbin, M.E.I.C.
Ottawa Branch	J. E. N. Cauchon, A.M.E.I.C.
Montreal Branch	J. L. Busfield, M.E.I.C.
	J. A. McCrory, M.E.I.C.
St. Maurice Valley Branch	B. Grandmont, A.M.E.I.C.
Quebec Branch	J. M. H. Cimon, A.M.E.I.C.
Saguenay Branch	H. R. Wake, A.M.E.I.C.
Moncton Branch	V. St.C. Blackett, A.M.E.I.C.
St. John Branch	E. A. Thomas, A.M.E.I.C.
Cape Breton Branch	S. C. Mifflen, A.M.E.I.C.
Halifax Branch	H. F. Bennett, A.M.E.I.C.

The Secretary reported with regret the decease of one of the gentlemen thus elected to the Council, Mr. E. A. Thomas, of the Saint John Branch, whose sudden death occurred subsequent to the issue of the ballot papers to the membership; it was pointed out that in such a case the By-laws provide that the Council shall fill the vacancy by selecting from a list of nominees furnished by the Branch concerned. The Secretary was instructed to take the necessary action.

Induction of Newly-Elected President

On relinquishing the presidency, General Mitchell requested the new President, Mr. A. J. Grant, M.E.I.C., to assume office. Mr. Grant was escorted to the platform by Dr. O. O. Lefebvre, M.E.I.C., and Dr. A. R. Decary, M.E.I.C., and on taking the chair expressed to the meeting and to the members of The Institute his very great appreciation of the honour conferred upon him.

President Grant remarked that one of the most important duties confronting this year's Council and those of several years to come would be that of continuing the work so well begun by Mr. Porter and his committee toward bringing about a confederation of the provincial associations and The Engineering Institute of Canada.

He considered the idea of the confederation of the provincial associations and the Engineering Institute a matter of paramount importance, and trusted that the members of The Institute would do all in their power to encourage the development of a sentiment favourable to this result.

Mr. Grant pointed out the responsibilities of Branch Executive Committees in connection with the affairs of The Institute. The Council was largely dependent upon the suggestions and criticisms from Branch Executive Committees in dealing with any questions regarding the policy of The Institute.

He regarded it as a most happy circumstance that his installation as President of The Institute should take place in the city of Ottawa where many of his early years were spent. He desired to express to the officers and members of the Ottawa Branch his appreciation of the success which had attended their onerous work in connection with the Annual Meeting.

Mr. S. G. Porter desired to have the honour of making the first motion under Mr. Grant's presidency, and remarked that the retiring President and retiring members of Council had most effectively served The Institute and had devoted a great deal of time and energy to its affairs. He therefore moved that the thanks and appreciation of The Institute be expressed to General Mitchell, the retiring President, and to the retiring members of Council for their valuable work on behalf of The Institute during the past year. The motion was seconded by Mr. G. R. MacLeod and carried unanimously.

On the motion of Mr. W. C. Adams, seconded by Mr. Busfield, it was unanimously resolved that the thanks of the meeting be conveyed to the scrutineers for their services in preparing the report on the ballots for the election of officers, and that the ballot papers be destroyed.

R. K. Palmer, M.E.I.C., remarked that as coming from the city where the Annual General Meeting of 1929 was held, he was able to appreciate the very great amount of work involved and the consideration which had to be given to multifarious details in connection with an Annual Meeting, and he therefore desired to move a hearty vote of thanks to the Ottawa Branch in recognition of their hospitality and activity in connection with the Forty-fourth Annual General and General Professional Meeting of The Institute in Ottawa. The motion, being seconded by J. B. Carswell, M.E.I.C., was unanimously carried.

There being no further business, the Annual General Meeting then terminated.

Luncheon

On the first day of the meeting, on Wednesday, February twelfth, a luncheon was given in the Ball Room of the Chateau Laurier, at which John McLeish, M.E.I.C., Chairman of the Ottawa Branch, presided. Mr. McLeish expressed the pleasure of the Ottawa Branch in having the Annual Meeting in that city, and was followed by Mayor Frank H. Plant, who welcomed the visiting members and ladies. G. J. Desbarats, M.E.I.C., Deputy Minister of National Defence, delivered a felicitous address in French in which he referred to the presence side by side in Canada of the two races. The next speaker was Sir Henry Thornton, M.E.I.C., who discussed the factors that have contributed towards the upbuilding of Canada, touching on the romantic history of France, and sketching England's development from the days of Queen Elizabeth. He felt that it should be a matter of pride to Canada that such a large proportion of French-speaking people in this country were Canadians. Dealing with the engineering profession, Sir Henry declared that the first requisite of an engineer was imagination, and there was no calling in which greater loyalty and fidelity to tradition had been exhibited.

Ladies' Tea

During the afternoon a visit was arranged for the ladies to the Memorial Chamber and the Peace Tower, and this was followed by a ladies' tea.

Smoking Concert

In the evening a very successful smoking concert was held in the Jasper Tearoom, various items of the programme being broadcast over CNRO. Meanwhile the ladies were entertained at bridge in the Quebec Suite.

First Technical Session

On Thursday, February thirteenth, the technical sessions began, the papers presented being as follows: In the Assembly Hall, under the chairmanship of O. O. Lefebvre, M.E.I.C.,

"Rigid Air Ships," by Group Captain E. W. Stedman, M.E.I.C., Chief of the Aeronautical Engineering Division, Royal Canadian Air Force, Department of National Defence, Ottawa.

"The Engineers' Work in Surveying and Mapping," by F. H. Peters, M.E.I.C., Surveyor General, Department of the Interior, Ottawa.

In Salons B and C, under the chairmanship of J. L. Busfield, M.E.I.C.

"Development of Radio in Canada," by A. N. Fraser, A.M.E.I.C., Chief Engineer, Radio Branch, Department of Marine and Fisheries, Ottawa.

"Recent Developments in Mechanical Transport Vehicles with Particular Reference to Multi-Wheeled Cross-Country Commercial Types," by Captain N. G. Duckett.

"Radio Communication as an Aid to Aviation in Canada," by Major W. A. Steel, A.M.E.I.C., Radio Engineer, Royal Canadian Corps of Signals, Department of National Defence, Ottawa.

Visit to Rideau Hall

During these sessions Her Excellency Viscountess Willingdon graciously received the visiting ladies at Rideau Hall.

Luncheon

At the luncheon on Thursday, under the chairmanship of Mr. McLeish, the principal speaker was Dr. H. M. Tory, President, National Research Council, who spoke on the contribution of the National Research Laboratories to Canadian industrial life. Dr. Tory's address was of peculiar interest in view of the present developments in the organization and construction of the laboratories of the Research Council, some phases of which were dealt with in the technical papers.

Second Technical Session

At the technical sessions in the afternoon the papers presented were as follows: In the Assembly Hall, under the chairmanship of R. L. Dobbin, M.E.I.C.,

"Aerial Surveys as Applied to Engineering," by A. M. Narraway, M.E.I.C., Chief Aerial Surveys Engineer, Surveys Bureau, Department of the Interior, Ottawa.

In Salons B and C, under the chairmanship of Major L. F. Grant, M.E.I.C.,

"Aeronautical Laboratories of the National Research Council of Canada," by J. H. Parkin, M.E.I.C., Chief of the Aeronautical Research Division, National Research Council of Canada, Ottawa.

Mechanical Transport Demonstration

Arrangements had been made through the kindness of the Department of National Defence to hold an interesting demonstration at Rockliffe during the afternoon. A number of various types of six-wheeled vehicles were shown working across country in snow. These trials were largely attended and served to illustrate the paper presented on Thursday morning by Captain Duckett. During the event the ladies were entertained at tea at the Chelsea Club.

Reception and Engineers' Ball

In the evening a reception and dance took place in the Ball Room of the Chateau Laurier, to which Their Excellencies the Governor-General and Viscountess Willingdon gave their distinguished patronage. On the arrival of Their Excellencies, Lord Willingdon, as an Honorary Member of The Institute, accepted an Institute badge, which was presented by President A. J. Grant, and the gift was accompanied by a bouquet of roses for Lady Willingdon. The Ball was admittedly a great success, and attracted a gathering of nearly eight hundred.

Third Technical Session

On Friday, February fourteenth, the papers presented in the Assembly Hall, under the chairmanship of Dr. H. T. Hogg, M.E.I.C., were as follows:

"Fabrication and Erection of the Superstructure of the Montreal South Shore Bridge," by Major LeRoy Wilson, M.E.I.C., Vice-President in Charge of Operations, Dominion Bridge Company, Montreal.

"The St. Hubert Airship Mooring Tower," by R. deB. Corriveau, M.E.I.C., Assistant Chief Engineer, Department of Public Works, Canada, Ottawa.

Visit to Paugan Falls

Many of the members and visitors accepted the hospitality of the Gatineau Power Company and visited Paugan Falls, a special train leaving at twelve noon, on which luncheon was served. The inspection of this very interesting power development was timed so as to permit the visitors' return to Ottawa in time for dinner.

Visit to Department of Mines Laboratories

Many of those who were unable to visit Paugan took part in a visit to the Fuel Research Laboratory and the Ore Dressing and Metallurgical Laboratories of the Department of Mines, Ottawa, the whole afternoon thus being given up to technical visits.

Annual Dinner

The closing function of the meeting was the Annual Dinner of The Institute, held in the Ball Room on the evening of the fourteenth, at which President Grant occupied the chair. The speakers included the Hon. Charles A. Dunning, Minister of Finance; the Hon. Charles Stewart, Minister of the Interior; the Hon. T. A. Crerar, Minister of Railways and Canals; Mr. Norman R. Fisher, President of the Canadian Institute of Mining and Metallurgy; Mr. P. E. Nobbs, President of the Royal Architectural Institute of Canada, and Mr. G. R. Mickle, President of the Association of Professional Engineers of Ontario.

Mr. Dunning, with many happy touches, said that for the first time for many years he was head of a department of the Government which had no engineers on its roster. He paid particular tribute to the President, Mr. A. J. Grant, and referred to the many associations he had had with members of the engineering profession, particularly while Minister of Railways and Canals. Mr. Stewart's address indicated a robust faith in the future of Canada, and referred to the wonderful development of the north country. Mr. Crerar pointed out that while engineers had already played a great part in the development of the country, yet as Canada continued its growth quite as great, if not greater, engineering problems would have to be faced in the future. Mr. Fisher, Professor Nobbs and Mr. Mickle brought the greetings of the organizations they represented.

Everyone attending this Forty-fourth Annual Meeting felt that its success was due to the untiring efforts of the Ottawa Branch, and that the previous Ottawa meetings had, if possible, been surpassed.

Alexander Joseph Grant, M.E.I.C.

President of The Engineering Institute of Canada

The approaching opening of the Welland ship canal, giving the great freight carriers of the upper lakes access to Lake Ontario, will be a notable event in the history of transportation in North America. This canal, with its terminal harbours and flight locks, is an outstanding engineering achievement, and it is peculiarly fitting that The Engineering Institute of Canada should choose this year, as its President, the man upon whom the responsibility has rested for the successful completion of this great work.

Alexander Joseph Grant, M.E.I.C.

The highest office in the gift of The Institute has been conferred upon one of its eminent members, Alexander Joseph Grant, the engineer in charge of the construction of the Welland ship canal, and a man of ripe experience and mature judgment. Mr. Grant, long connected with the Niagara Peninsula Branch, has already served The Institute as vice-president, and has now been chosen to direct its destinies as President for 1930.

Mr. Grant was born in Scotland on May 10th, 1863, at Dufftown, Banffshire, and came to Canada in 1872. He was educated at the University of Ottawa and St. Mary's College, Montreal.

His professional career began in 1880 on a survey party under H. D. Lumsden, for the Canadian Pacific Railway, west of Winnipeg. In 1883 he worked on the Baie des Chaleurs Railway, and in July 1886 he entered the outside service of the Department of Railways and Canals by joining the engineering staff of the Cape Breton Railway, under Hiram Donkin, M.E.I.C., where he was assistant engineer on the construction of the railway from 1887 to 1891. In the latter year he was transferred to the engineering staff of the Soulanges canal under Thomas Monro, remaining as an assistant engineer until the completion of the canal in January 1903, when he was appointed to the position of engineer in charge of the Port Colborne improvements. Here he remained until April 1906, when he was promoted by the department to the position of superintending engineer of the Trent canal.

During his tenure of this appointment, the construction of the Ontario-Rice Lake Division of the waterway was carried out, and the surveys and plans made for the Severn River Division of the canal. The works for improving the navigation of the Severn river were begun under his supervision, but, owing to war conditions, were suspended in 1916-17.

On January 1st, 1919, Mr. Grant was transferred to his present position as engineer in charge of the construction of the Welland ship canal, which project is now nearing completion.

Mr. Grant joined The Institute before its change of name, having been elected an Associate Member on October 8th, 1891, and a Member on November 21st, 1901.

His well-deserved professional reputation rests on a solid basis, and he is an example of the excellent type of engineer in the service of the Dominion Government. Frequently such men as Mr. Grant are not well-known to the general public, but it is to their professional capacity that the sound design and substantial construction of our great public works are so largely due.

Address of the Retiring President

Brig.-General Charles Hamilton Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C.

Delivered before the Forty-fourth Annual General Meeting of The Engineering Institute of Canada, Ottawa, Ontario, February 12th, 1930

Gentlemen:—

It is with interest that we have listened to the Reports of Council and of the various Committees, during this day's business session, and I am sure that you will all realize that the members of your Council and of these committees have put into their work of the year much of their time and effort to guide the affairs of The Institute through this period. I wish personally to thank the members of these most important bodies for their generous assistance to The Institute, and especially do I desire to express my deep appreciation of the untiring and able efforts of the chairmen of these committees.

I desire also to record my sincere thanks to the Secretary for his able and constant assistance to me during my term of office as President and to assure you that his helpful efforts in this respect have been distinctly reflected by the office staff in their loyal support.

To the officers and members of the twenty-five Branches of The Institute, spread across the Continent, I offer my congratulations on the progress they have reported and I wish for them continued successful years for the future.

The Engineering Institute, as the national foundation of the engineering profession, upon which has been erected the technical structure of Canada's development, is more than ever recognized throughout the country. Its solidity, its quality, its broad extent are all reflected in the type, ability and wide interests of its members.

The wisdom of the founders and of their successors in office throughout the various periods of The Institute's history, is now amply manifested in the wide outlook of its membership comprising as it does, professional men engaged in all the principal spheres of engineering. In this respect our Canadian organization is, with one exception, unique in the national engineering societies of the world.

As a nation-wide organization, with its membership approaching five thousand of all classes, it is so geographically distributed from coast to coast as truly to represent all those regions of the Dominion where engineering activities are being carried on.

It is with no small degree of pride in our profession that we survey the broad scope of the service which is being given to the country in the development of its resources. We receive with gratification the generous assurances of our fellow-citizens discribing how indispensable the engineer is to this young country and how his versatility is called upon to contend with the many varied problems which are peculiar to Canada.

With this sense of pride but with one of humility, we can pardonably record the work which has been done and is today being done by the engineers of Canada, and it is with this view that I now offer to you my retiring address on the subject of "The Extent and Quality of Canadian Engineering."

The Extent and Quality of Canadian Engineering

Once again we are assembled in the Annual Meeting of The Engineering Institute to consider our progress during the past year and to endeavour to foresee the future. This Forty-fourth Annual Meeting marks a distinct stage in the history of the organization and indeed this year provides an index to the unprecedented progress of engineering in Canada.

It may be a platitude to draw attention to the advances and diversities which have made their appearance in recent years, especially since the war. If, however, we wish to look at the engineering profession and to visualize the kaleidoscopic readjustments made necessary by modern invention, application, and practice—even only in the period of the past five years—we will do well to think about these successive advances and their significance.

In considering the diversity of engineering, we can well reflect upon this progression in Canada during the past few years, embracing as it has:—agriculture, now passing into the mechanized age; aviation, in the air business of the nation; railway transportation in its newest motive power and its march to the far north; water transportation on the Great Lakes; our great harbours, with their grain elevators; the disclosures of our mineral resources in the northern portions of the country; the developments of paper manufacture from our forest resources; our metallurgical and chemical industries; structural engineering in the construction of huge buildings; unprecedented development of water power, both in efficiency and quantity, and its electrical and mechanical application to the thousand and one industries for providing new commodities only made possible by having available ample power.

As we look back to the history of engineering in Canada the past forty or fifty years, we now can see how some of the problems, apparently similar in their beginnings, have come to their present day magnitude and complexity through the natural growth of the country and the efforts of its citizens to take advantage of the rapid advances of science and invention.

This Annual Meeting of The Institute in the capital city of Ottawa this year brings to our thought a historical reminiscence bearing on our engineering development, which, at this juncture in our history, it may be well to record.

Seventy years ago there was incorporated under the laws of Upper Canada what appears to be the first engineering organization in Canada. It was called the "Association of Provincial Land Surveyors and Institute of Civil Engineers of Canada." Its first General Meeting was held in Ottawa on Wednesday, the 10th of October, 1860. The composition of this organization was largely land surveyors, but there were also numerous civil engineers and architects. One item of business at this meeting was the establishment of an "Engineers' committee to form a Board of Examiners for admission of candidates."

The inaugural address of the president of that first meeting is of much interest as indicating the progress of engineering in the country as at that time and as anticipating the trend for the future. The first railways had just been constructed up into Ontario (the old Grand Trunk). Extensions of roads and railways and the opening up of new country appeared to be in the mind of everyone. Expressions such as the following are to be found in this president's address:—"Road engineering, applicable to new countries, therefore, would be one of the most useful subjects the Association could take up" and "It is to be borne in mind that by far the larger part not only of Lower Canada, but also of Upper Canada, is still unknown and unexplored." Speaking of the upper portion of the Ottawa, he says "The best representatives of it in the most recent maps published prove, as exploration advances, to be quite visionary."

The address goes on to say "It is but lately, comparatively, that we had any engineering works in progress to observe; and latterly, it has justly been the pride of Canada to boast of having constructed some of the most extensive and stupendous works" (including the Victoria bridge at Montreal and railway suspension bridge at Niagara). A plea is then made for papers and descriptions of engineering works, bearing in mind that among the objects of the Institute are "the advancement of the interests of the members—the attainment of a higher degree of efficiency in the theory and practice—and the promotion of objects affecting the public interest." Among the suggestions put forward with regard to contributions are "Essays by experienced members on the adaption of engineering to the peculiarities of our climate, on the effects of extreme cold on structures and the action of ice in its formation and departure." How very similar this train of thought is to the one we nowadays are still pursuing in The Engineering Institute of our time! Such subjects were first principles to our engineering forefathers of those days and naturally enough are still basic with us.

This early address foresees the extraordinary position that engineering is destined to take in the development of the new country of Canada for he makes the bold statement that "It is singularly remarkable that a profession—a branch of scientific art that dates its separate existence as such from about thirty years ago—seems likely to govern the future destiny of the race more than any other pursuit of man." That too can be repeated today with similar assurance and is even more applicable today than it appeared seventy years ago.

The president's address of that day anticipated also the great development of Canada in the succeeding years by reason of the extension of railways:—"Commerce will take its course directly over continents, as formerly it did over the ocean that divided them. Interior regions before inaccessible to immigration and commerce will, ere long, be laid open to enterprise, and to none of them will the advantages of railway communication be of more importance than to our vast prairie lands on the Red river and the Saskatchewan." He seemed to have some information about the coal of Alberta for he considered that this "would powerfully contribute to render the opening of a railway by that route to the Pacific a practical reality" and he then proceeded to say, as they at that time said in England, that "men and manufactures will follow coal; and the site of future great cities and the concentrations of industrial population, are to be found where it prevails."

All these things were said in 1860, seventy years ago, by a forward-looking engineer. Could he have foreseen what succeeding decades would produce, would he, in the main, have altered his views? He obviously could foresee the march of development by the railway building of the sixties. Everyone at that time was foreseeing the Confederation of the provinces to form the Dominion. But the succeeding decades were not so easy to anticipate. So many questions of statecraft, of national ambitions, and of administration were involved with the practical problems of engineering and the material development of the country, that anyone in those days would have been courageous if he attempted to foretell the course of the young Dominion. If he had, he would have fallen far short in his estimates, as it has now turned out, for we have progressed and developed very much faster than the boldest could then have dreamed.

Who could have foreseen the networks of railways that sprung up in eastern Canada in the seventies? The Intercolonial Railway, the "bargain" of Confederation, and the enlarged Welland Canal and the St. Lawrence Canals were the answers to the transportation demands of the provinces. The movement westward had begun.

Now that we look back on the very busy eighties, it seems so reasonable that in those years the great national highway of the Canadian Pacific Railway should have come into being and entered into our national life. It seems now, to the present generation, only a matter of history that its first trainload of wheat eastward came out in December, 1885, and its first passenger train westward crossed to the Pacific in June, 1886, in five days, nineteen hours. It may seem only history that the deep water terminus at Halifax was completed in 1860 and that the great drydock there, then the largest on the continent (601 feet long, 102 feet wide), was opened in 1889. It may now only be history that the first sailing ship from the Orient with cargo consigned to the Canadian Pacific Railway arrived at Vancouver (Port Moody) with tea in July, 1886. But this is the history which was the very start of our national commerce, of our Empire trade. It was in this decade that The Engineering Institute was founded as the Canadian Society of Civil Engineers, following all this national activity.

In the nineties, the railways and the opening up of the west, brought our immigration, our beginnings of large agriculture and grain milling and our first copper mining in British Columbia, the first shipment being eight carloads to England in 1897. This decade brought the greater development of municipal engineering and saw the general introduction of electric lighting and electric railways.

It was in the first decade of the new century, however, that our engineering and the development of our national resources broadened out and began to acquire the diversity that has more recently become so distinctive in our national progress. It was in this period that our water powers began to be developed on a large scale as hydro-electric power, the most notable ones being the great Niagara developments, then the largest in the world. The steel and the pulp and paper industries acquired a distinct importance, and engineering was applied on a large scale to lumbering. The discovery of silver in northern Ontario gave the real start to its remarkable mining development, and together with the copper and nickel mining already in progress, turned the attention of mining engineers to eastern Canada. Agriculture in the west made large advances and was assisted by the irrigation projects which introduced irrigation engineering.

The second decade of the century will always be remembered by its two-fold character in our national development. The first period marked a notable prosperity in all directions, and the latter half engaged all our energies in carrying on the Great War. In both these periods there were extensive, even remarkable advances in the diversity and quality of our engineering. The early portion of the decade saw widespread application of electric power to industry by means of transmission from the many power plants which had sprung up. This activity brought on an extensive diversity in mechanical and electrical engineering. Gold discoveries in northern Ontario gave a further impetus to mining. The inception and construction of the Transcontinental and Grand Trunk Pacific Railways, and the great expansion of the Canadian Northern System again put the country into an extraordinary period of railway building, even feverish in its competition, providing as they did the second and the third transcontinental routes to the Pacific and opening up fresh agricultural regions further north.

The war period in the last half of the decade produced a distinct effect on the extent and character of our engineering. Not only were hundreds of our engineers at the front engaged in a great diversity of technical activities, thus gaining valuable and wide experience, but those who remained to fight the war at home were plunged into all manner of industrial problems and undertakings to provide those munitions and war supplies for which Canada became notable. This war period was, so far as Canadian professional engineers were concerned, a distinctive one of railway, municipal, mechanical, electrical, road, dock, and mining engineering of such wide diversity and location in the different war theatres that they came back to civil life rich in new engineering experience and organizing ability.

The third decade, that which has just now ended, has been by far the most remarkable in engineering that this country has yet experienced. To appraise the value of all that engineers have contributed to the country's development during the past ten years would be out of the question, but it is recognized on every hand as being a very large factor in the material progress of the country.

There are many notable hydro-electric undertakings which were constructed and brought into operation during this ten-year period, mainly the following:—The Queenston plant at Niagara Falls of the Hydro-Electric Power Commission of Ontario with its output of 550,000 h.p., the largest single plant in the world, which, with other plants, brings the total of the Commission's capacity up to its recent peak output of 1,200,000 h.p. The Duke-Price plant on the Saguenay river, Quebec, with over 500,000 h.p. The newer plants of the Shawinigan Water and Power Company in Quebec which, with its plants previously built, bring its total capacity up to 625,000 h.p. and with other recently acquired sources, bring its available power to over 800,000 h.p. Three new plants on the Gatineau river, Quebec, aggregating 430,000 h.p. Plants in the Maritime Provinces built by the Provincial Governments and the paper industry aggregating 120,000 h.p. New plants for the paper and mining industries in northern Ontario aggregating over 200,000 h.p. New plants on the Winnipeg river comprising those of the Winnipeg Electric Company and extensions to the city plant which aggregate 225,000 h.p. since 1920. The new plants of the British Columbia Electric Company mainly for transmission to Vancouver and the West Kootenay Company, which aggregate nearly 200,000 h.p., with several very large additions at present under construction. With all of these there have been constructed long transmission lines, the most notable of which are the Ontario Commission's line from Gatineau to Toronto, 260 miles, at 220,000 volts, and that of the Shawinigan Company from the Saguenay to Quebec, 136 miles, at 165,000 volts.

Bridge engineering has, during the past decade, been quite marked, not only in steel but in reinforced concrete. In the larger cities many new structures have been built which formed a part of the remarkable municipal expansion which took place in this period. Throughout the various provinces, especially in the east, the road construction programmes have included hundreds of steel and reinforced concrete highway bridges.

Highway construction itself has run into many thousands of miles of new work in all the provinces of the Dominion, a large portion of which has been of concrete type. There are now many trunk motor highways in Quebec and Ontario and various ones in the western provinces, while a through transcontinental highway is all but completed.

Building construction too, during this decade and especially in the past few years, has formed a large part of the expansion and progress of prosperity. It has been notable in its recent yearly increases at rates from 10 to 22 per cent in value in all types of large buildings and in all provinces from stores and industrial types to schools, churches, hospitals, banks, and public buildings. The value of the yearly construction has trebled in ten years until last year it was almost 600 million dollars. This has demanded the attention of a large proportion of the engineering profession in conjunction with the architects.

In communication engineering there have been very great strides during the past ten years. In the telephone field by the rapid adoption of the automatic apparatus and the expansion and extension of the systems, a new generation of telephone engineers has come into being. This is even more marked in the wireless and radio which, since the war, has become so much a part of our daily life as to be now inseparable from it. The demand for radio engineers seems to be increasing by geometric progression.

What is to be said with regard to the increasing establishment of industries and manufactories which have grown up with all this activity during the period, can only be indicated. The enumeration of those basic industries of food, flour milling, steel, wood, and textile products; those which comprise agricultural, mechanical, hydraulic, electrical, and other machinery; those of railway equipment and automobiles; of cement, glass and clay industries and those of the rubber, paint, sugar, beverage and other chemical industries, only partly visualize the many fields in Canada into which the engineers of this decade have entered.

In all this great national activity, the engineering in the civil services of the Dominion and the provinces has greatly expanded in volume and diversity, its importance in the national development and to the various regions and communities being served, has been very much greater than in earlier days and the abilities displayed have been so remarkable as to bring praise from all quarters of the world. Into this have entered the engineering services of railways, canals, river improvement, harbours, docks, public buildings, highways reclamation, topographical and geological surveys, water power, aviation and wireless communication.

This picture of the past decade, and indeed of the preceding decades, would not be complete without the inclusion of engineering education in its relation to the many activities of the country and to the quality of the engineering ability which has entered into them. Thirty years ago there were but two universities in Canada which provided regular courses for an engineering education: Toronto and McGill, and two engineering schools: The Royal Military College and Ecole Polytechnique. There are now ten, mostly provincial universities, providing courses in from three to eight of the main branches of the profession. During the past six years these universities have been producing between 400 and 600 engineers yearly in various branches. A few years ago, following the war, there was an excess of engineers and for a while a dearth of employment. Now there is a reversal, a marked shortage of engineers to supply the large demand that has developed by reason of this activity. It is gratifying to add that recently these engineers and university graduates are practically all being employed in our own country and many are returning who had formerly left.

Neither would the picture be complete without including the very valuable research agencies that have been established by the universities and the governments. The National Research Council at Ottawa and the Ontario Research Foundation at Toronto are performing most valuable services in co-ordination with these activities of national development.

From the earlier times, when there were only three or four classes of engineer, we have now emerged with a diversity of engineering which counts the branches of the profession in many times the number. These have been developed by our growing requirements and by advancing civilization and discovery. They have had their influences of course from Britain and from the United States but at the most these outside influences have assisted us only in so far as adapting practice elsewhere to our own peculiar

Canadian requirements. After all, that is the spirit of engineering and indeed of all scientific practice the world over. It is international but it becomes national practice by its employment under peculiarly national conditions.

It took some time after the war for us to reconstruct and change to peace conditions. To absorb our energies in civil occupation and to properly distribute them in the different fields of engineering caused some dislocation and many readjustments. However, when the new conditions were met and the readjustments accomplished, the progress of the country was marked and as the years followed each other with their fresh advances in all engineering fields, we realized the great diversity and the high quality of Canadian engineering.

The past decade has seen the acquisition by the government and the reconstruction and consolidation of the two newer transcontinental railway systems into the Canadian National, of which, as a nation, we are justly proud, now with its 23,000 miles of operated system. This period has seen great advances in railway organization and operation and in new equipment adapted to our Canadian conditions, by both of our great systems. The ten-fold increase in the use of the automobile has brought about yearly programmes of new road construction which have demanded contributions from many engineering fields in civil, mechanical, and electrical work.

In water transportation and all the engineering which attends it, there has been remarkable activity. Within the decade our overseas shipping capacity has been more than doubled on both oceans and the expenditures by the Government on harbour works for it have run into tens of millions. On the Great Lakes progress has also been marked by a three-fold increase in tonnage passing through our existing canal systems, now eight million tons per annum. This period has marked the construction of the New Welland Ship Canal, the greatest in the world with the exception of the Panama. With its depth of 27 feet and locks 860 feet long, 80 feet wide with 30 feet depth of water on the sills it becomes the measure of what the new St. Lawrence and Great Lakes navigation system will ultimately provide for ocean shipping to penetrate to the heart of the country.

Again our agricultural industry has claimed its position as first of our industries by more than doubling the crop yield in the decade, the maximum for wheat being 560 million bushels in 1928. The significant feature of this, however, lies in the rapid change that has come over the industry in these later years by the processes of mechanization, due to the adaptations of motor equipment. This has been rapidly replacing man and animal labour, especially on western farms. That this is so is evidenced by the absence of the harvesters' excursions which were an almost national summer event in the two previous decades but which, in the past two seasons, have been discontinued. This really means the entry of the mechanical engineer into this industry in a new and a very large way.

In the development of our forest resources, the past decade has provided what has already been called "the miracle of paper." It has indeed been a miracle in its rapid development, in its magnitude as an industry, in its distribution among five of our provinces, and in its widespread demand on the engineering profession. It is now our second greatest industry, not only in extent, but in value in our exports. This has brought prominently into the Canadian industrial field the chemical engineer in co-operation with nearly all other branches of engineering.

Mining, during the decade, has taken an entirely fresh hold on the activities of the country. The gold, silver, copper, and nickel mining of northern Ontario has trebled in this period and production has reached a value of well over a hundred millions. Ontario is now producing a third of the output of the Dominion, British Columbia has attained a quarter of the whole and Quebec, Manitoba and Saskatchewan have come actively into production of copper, silver, and zinc. The great oil fields of Alberta are also new since the war. The coal mines of Nova Scotia and British Columbia have greatly increased their output and Alberta coal has, during the decade, come into the national picture. The discovery, within recent months, of large deposits of coal of the lignite type in northern Ontario, may quite change the fuel balance of the country where formerly we had coal only at the two coasts. Iron mining, too, has been revived by encouragement of the means of treating our vast quantities of low grade ore. The fact is that, within the past few years, we are just coming to realize the significance and the possibilities of the great pre-Cambrian shield which lies across Canada from Labrador to Saskatchewan and which, up to the present, has been explored in any depth only at a few localities:—Rouyn in Quebec; Cobalt, Kirkland, Porcupine, Sudbury, and Michipicoten in Ontario; Northern Manitoba and Flin Flon in Saskatchewan.

Metallurgical industries have fast followed the mining during the decade and now, added to the older copper and nickel plants in British Columbia and Ontario, new ones in Quebec and Saskatchewan have been quickly coming into operation. These, with the expansion of our steel industries, have created a distinct demand for Canadian metallurgical engineers.

The development of commercial air transportation during the past four years has been very marked. It is naturally another outcome of the war whereby we have the advantage of many trained airmen. There are certain geographical, economic, and climatic features that are peculiar to Canada with reference to air transportation. In some of these respects Canada has already been leading all countries as in forest patrol, mapping, prospecting for minerals and exploration in the far north. In the organization of commercial flying routes, ground organization, airports and the industries attendant on aviation, the engineering profession is having a large part in an entirely new field.

The past decade has been most remarkable in the development of our water power. There had been notable construction in the two previous periods but upon the conclusion of the war, Canada entered into large programmes of development in all parts of the country from Nova Scotia and New Brunswick to British Columbia. The activity has been maintained throughout the whole period and now at the end of the past year it is announced by the Water Power Branch of the Dominion Government that, whereas the total installation in Canada in 1920 was 2,460,000 h.p., there is today 5,720,000 h.p., or an increase of 125 per cent in ten years. There is in Canada today 0.6 installed horse power per capita, which places this country in second place in the world, Norway still being first. Of these totals Quebec has increased in the 10 years by about 1,650,000 h.p., bringing its total to nearly 2,600,000 h.p.; Ontario has increased about 830,000 h.p. to a total of nearly 2,000,000 h.p.; and British Columbia about 300,000 h.p. to a total of 600,000 h.p.

That the quality of the engineering necessary to have accomplished these things is of the highest, there can be no question. That our heavy transcontinental passenger trains can now cross Canada in the dead of winter, making the 2,900 miles in less than four days and arrive on the minute, is certainly an achievement. That our huge Niagara and Quebec hydro-electric power plants can continue absolutely reliable operation producing hundreds of thousands of horse power continually, year in and year out, with interruptions, if any, measured only in seconds, is another achievement. That our steel mills can produce the largest and best railway rails and our locomotive works the heaviest and fastest engines in America, are matters of pride. That we can build such a stupendous public work of such high quality as the New Welland Canal, is an outstanding achievement of Canadian engineering ability. That our great Quebec bridge takes its place with the greatest in the world, is a further proof of quality and Canadian ability. That our manufactories can now produce the largest hydraulic turbines and electric generators, are accomplishments that have attracted universal attention. That our harvesting operations, our grain elevators, our nickel and our paper production are unique in the world, display a combination of the highest qualities of Canadian engineering and business ability.

The enumeration of the varied activities during these decades and especially of those of the one just closed, while giving us some picture of the great strides which the country has been making, does not quite get us up to date—to this year of 1930.

In order to bring this survey closer home, both geographically and in point of time, and to place on record more in detail on this occasion the remarkable engineering activities which are actually in progress in Canada today, it may be useful to review or tabulate them proceeding from coast to coast. This review of all branches of engineering covers the more important works which have been under construction in 1929 or on which construction is proceeding in 1930.

Engineering Activities in Canada 1929-1930

Halifax, N.S.—New grain elevator recently completed, now doubling capacity.
Additional docks under construction.

Sydney, N.S.—Production of 127 lb. steel railway rails 39 ft. long, heaviest yet rolled, on severe specification. A second order now going through.

Liverpool, N.S. — Three new N.S. Government hydro power plants on Mersey river; 20,000 h.p. just completed and installation continuing.
New paper mill of Mersey Company completed and commenced operation in 1929, 250-ton mill.

Saint John, N.B.—Two new docks each 1,250 ft. for ocean ships. Harbour improvements to cost 5 million proceeding. Bridge under construction over harbour. New grain elevator 2,500,000 bushel capacity.

Grand Falls, N.B.—New power plant completed 1929 for 40,000 h.p. 20,000 more now being installed.

Dalhousie, N.B. — New paper mill being constructed by Can. Int. Paper Co., also a pulp mill near Chatham.

Moncton, N.B.—Oil fields being developed; a new area, producing heavy fuel and lubricating oils.

Anticosti Island—Wood pulp supply on large scale under development supplying four paper companies in Eastern Canada.

Gaspe, Que. — Highway around peninsula completed summer of 1929. Railway being reconstructed by Canadian National Railways.
Minerals and oil being discovered.

Chicoutimi—New harbour works and channel Saguenay river under construction; 20 ft. depth at low tide.

Arvida, Que. — Power plant at Chute-à-Caron under construction for American Aluminum Co. Arvida plant (Second largest aluminum plant in world). Power development 250,000 h.p. initial, 750,000 ultimate.

Isle Maligne, Que.—The Duke-Price power plant on the Saguenay river fully completed in 1929 with 500,000 h.p.
Transmission line Shawinigan Power Co. from this plant to Quebec, 136 miles completed 1929.

Murray Bay, Que. — New Manoir Richelieu hotel completed June, 1929, replacing old one burned September, 1928. Winter construction in reinforced concrete accomplished in 9 months under wooden housing heated for zero weather.

Quebec—Remainder of 5,000 ft. docking wall completed for harbour 1929.
Harbour shed 1,700 ft. long and 14 miles tracks for 1930 with 3 new grain elevators each 2 million bushels following.
Roadway constructed over Quebec bridge for motor vehicles.

St. Maurice River — Storage dam for power under construction on Mattawin (tributary) for 33 billion cu. ft. to be operated by Quebec Streams Commission.
Shawinigan Power Co. added 43,000 h.p. unit (No. 8) in 1929 and is adding two 25,000 h.p. units at Grand Mere and one of 30,000 h.p. at La Gabelle plant in 1930. This company also expects to commence in 1930 construction of a new plant on the Upper St. Maurice above La Tuque, with initial power of 200,000 h.p. and transmission 150 miles to Montreal.

Three Rivers, Que.—Improvements to port facilities now contracted for (3 million).

Montreal—New harbour works and extension on a three-years programme; includes 1,000 ft. in 1929.
City street extension and subways completed.
New city main sewer completed.
High level "South Shore" bridge over harbour joined up in July, 1929, and completed in 1930.
Canadian National Railways Terminals project started; programme involving several years and 50 million cost.
Particular activity in manufacture of hydraulic and paper mill machinery. (Dom. Eng.)
Large orders continuing for bridge construction. (Dom. Bridge.)
Power Plant, Montreal Island Power Co. on Riviere des Prairies placed 72,000 h.p. into operation autumn 1929, installation continuing to 120,000 h.p. (Feature in this is adjustable propeller turbine blades for heads 18 to 26 ft.)
Building construction completed 1929:—
Royal Bank Head Office.
Bell Telephone Head Office.
Dominion (Office) Building.
Sun Life Co. (still continuing.)
Montreal University buildings (starting.)

Quebec Province — Extensive highway construction continuing.

Gatineau River, Que.—Three power plants stlil continuing installation. Fourth units, 24,000 and 34,000 h.p. to Farmers and Chelsea plants respectively and a 25,000 h.p. unit to Bryson plant all in 1929. Paugan Falls plant to be added to in 1930. This company is supplying 180,000 h.p. to Ontario Hydro, 150,000 of which is over the 220,000 volt line, 260 miles to Toronto. A new 110,000 transmission line completed 1929 to Hawkesbury.
Storage dam Cabonga completed providing capacity 45 billion cu. ft.

Lievre River, Que.—High Falls power plant under construction; 60,000 h.p. expected to be completed in 1930, ultimate 120,000 h.p.
A new (second) paper mill near Buckingham under construction and expected to go into operation in 1930.
A storage reservoir 25 billion cu. ft. under construction.

Ottawa River — Chats Falls power; preliminary construction started. Initial 100,000 h.p., ultimate 200,000 (under interprovincial plan).
Carillon power project; prospects of early commencement of 200,000 h.p. development by Ontario Hydro and Quebec interest jointly.

Ottawa — City waterworks extension, under construction, including filtration system.
Chateau Laurier extension completed 1929.
Government departmental block completing 1930.
City Planning Commission's operations continuing on a large scale.

Beauharnois, Que. — Hydro - electric power project commenced on St. Lawrence river. 500,000 h.p. by means of 15-mile canal Lake St. Francis to Lake St. Louis. First power expected in 1932. Half of this contracted for transmission to Ontario Hydro Commission.

Prescott, Ont. — Dominion Government grain elevator under construction; 5,400,000 bushel capacity.

Kingston, Ont.—New grain elevator under construction; 2,500,000 bushel capacity, ultimate 5,000,000.
Harbour extension works and new docks.
New series of locomotives ("6100" class) built for Canadian National Railways, largest and fastest on continent, 70 miles per hour for heaviest passenger trains.
Similarly new heavy locomotives now under construction for Canadian Pacific Railway; "5900" class, oil-burning, for mountains.
Construction completed and trial run made August, 1929, of new oil-electric locomotive for Canadian National Railways heavy trains—"the newest thing." (All the foregoing by Can. Loco. Co.)

Peterborough, Ont. — Particular activity manufacturing electrical and mechanical equipment for power and ndustries. (Can. Gen. Elec. and Wm. Hamilton.)

Toronto — Viaduct construction for railways at front completing after 5 years work. First trains into new station on high level, January, 1930.
Harbour development still continuing deepening to 24 ft. and new docks.
Waterworks construction; duplicate system of intake, pump house, mains and reservoir (cost 14 million).
New bridges, street extensions and reconstruction contemplated under city planning for 1930.
The Ontario Hydro Commission is constructing a second main transmission line from the Gatineau, 260 miles to Toronto, at 220,000 volts.
The Commission completed about 1,000 miles of new rural transmission lines in western Ontario in 1929 and expects to construct about 1,400 in 1930.
Building construction completed 1929:—
Royal York Hotel (Canadian Pacific Railway; cost 16 million, completed in 21 months).
Star building.
Canada Permanent.
General Hospital extensions.
Building construction continuing 1930:—
Bank of Commerce Head Office (32 floors).
Eaton's new store.
Federal building (Custom House).
Canada Life building.

Niagara Falls—Additional unit Queenston plant Ontario Hydro, 55,000 h.p. (the 10th).
A second main transmission line to St. Thomas is under construction at 110,000 volts.

Welland Canal — New Ship Canal nearing completion after 10 years' active construction since war. Costing about 116 millions. Expected to open July, 1930 for through traffic. Locks 860 ft. long, 80 ft. wide with 30 ft. depth water on sills. (Reaches 25 and 27 ft. depth.)

Hamilton—New docks Can. Steamship Co.
Street railway extensions (about 2 million).
Special activity manufacturing electrical equipment for power and industries (Westinghouse).

London, Ont.—Reconstruction of streets and subway crossings for railways commencing. (Total cost about 4 million.)

Windsor — Highway "Ambassador" suspension bridge, Detroit river, completed 1929.
Highway tunnel under Detroit river under construction; expect complete 1930.
Canadian National Railways terminal works and shop expected to commence 1930.

Collingwood—Ship building on Great Lakes; 3 new vessels from here in 1929.

Midland — New 2 million bushel grain elevator commenced to bring total capacity to 14 million bushels.

Northern Ontario — Power plant under construction Montreal river, 13,000 hp.. to be completed 1930.
New power plant completed Spanish river, 28,000 h.p.
Mining activity continuing, especially copper and nickel.
New 500-ton smelter under construction in Sudbury district.
Coal discovery, lignite near James Bay.
T. & N.O. extension to James Bay 1930.
Fire clay discoveries, same locality.
Chemical plant construction at Copper Cliff for sulphuric acid.
Kapuskasing; completion Spruce Falls Power 1929.
Power plants completed Michipicoten river, 11,000 h.p. and transmission line to Sault Ste Marie.

Northern Quebec—Mining activity continuing at Rouyn.
Noranda Copper smelter into full operation 1929 at 2,000 tons daily capacity. Estimated copper output for 1930 to be 50,000 tons.
Zinc plant under construction (third in Canada).

"Lakehead"—Additional grain elevator capacity at Port Arthur and Fort William building to bring total capacity about 55 million bushels.
The Ontario Hydro Commission is completing a second power development on the Nipigon river (Alexander) for 54,000 h.p.

Winnipeg—Power plant under construction Slave falls, Winnipeg river, by city, initial 25,000 h.p., ultimate 100,000. Expect into operation 1931.
Power plant of Winnipeg Electric Co. at Seven Sisters falls, construction commenced 1929; initial power about 70,000 h.p., ultimate 220,000. Expect into operation 1931.

Manitoba—Mining activity in north in gold, copper, etc.
Extensions of railway to mining areas.
Completion of Hudson Bay Railway, 154 miles to Churchill Harbour; first trains over in autumn of 1929.
Churchill terminal and harbour construction by Dominion Government and erection of grain elevators; expected into operation in 1930.

Saskatchewan — Mining activity in north in copper, gold, lead and zinc.
Coal (lignite) mining and development in south Concentrator at Flin Flon mine nearing completion to handle 3,000 tons per day.

Electrolytic zinc plant at Flin Flon nearing completion (second in Canada).
Power plant at Island falls on Churchill river (Latitude 56); 40,000 h.p. initial expected ready in 1930 for transmission to above mines; 84,000 h.p. ultimate.
Steam power plant of Saskatchewan Government at Saskatoon completed 1929.
Provincial programme of road construction proceeding.

Alberta —Railway extension to north and Peace river.
Much activity in coal mining, treatment and shipment to eastern Canada.
Oil fields in very active development and operation in Turner Valley.
Peace river agricultural region being opened up; roads, municipal works, etc.

Calgary—New Bow river power development "Ghost river" plant (30 miles west); one unit 18,000 h.p. into operation 1929, two more for ultimate 54,000. Transmission connected with other Bow river powers to Calgary and new line being built to Edmonton.
Additional water supply by city duplicating gravity system from foothills (expenditure 4 million.)

British Columbia—New power extensions of B.C. Electric Co. as follows:—
Ruskin Plant (Stave river) under construction first unit 43,000 h.p. in 1930 and a second expected in 1931.
Bridge river plant under construction includes 13,200 ft. tunnel and head of 1,500 ft. Ultimate capacity intended 600,000 h.p. Work has been progressing for several years. Expected initial installation 60,000 h.p. in 1933. Transmission 140 miles to Vancouver.
New power plant by West Kootenay Co. at Slocan, 75,000 h.p. completed 1929. Same company about to commence new one for 80,000 h.p. on Pend d'Oreille river.
Preliminary work started on railway in northern British Columbia from Stewart at coast eastward to Fort Grahame on Finlay river for new mines.
Extensions to plants of Consolidated Smelters (Trail) for copper, silver, zinc, lead, aggregating cost 7 million. This includes new sulphuric acid plant for fertilizer manufacture (soluble phosphate and ammonium nitrate form). All now under construction.
Nitrogen fixation plant in connection with above for making synthetic ammonia and hydrogen by electrolysis. Electric power from West Kootenay Co.
Additional hydro-electric power project of Powell River Co. at coast on Lois river now commencing. Initial 18,000 h.p.
Dominion Government Highway construction on new programme through Rockies, 150 miles, in progress.

Vancouver—Harbour works continuing on a large scale, total now 13 miles developed water frontage.
New grain elevators construction bringing total capacity to 14 million bushels.
New bridge under construction across "Narrows" to North Vancouver.
City street and municipal works extensions.
Building construction, third largest in value in Canada in 1929. Five commercial buildings aggregated 10 million.

Victoria, B.C. — Jordan river power plant of B.C. Electric now extending and installing fourth unit, 18,000 h.p. to be completed 1930.
Final completion 1928-1929 of Dominion Government dry dock at Esquimalt, 1,150 feet long, 126 wide at sill, 150 feet at coping and for 30 feet depth at low tide. The largest dry dock on the Pacific coast.

GENERAL

Agriculture — The introduction of the "Swather" and the "Combine" harvester into the Agricultural industry the past few years has culminated in a large production the past year by the manufacturers. The indications are this will increase in 1930 in all fields of agricultural mechanization.

Railway Extensions—During 1929 there has been a marked activity in railway extensions throughout Canada, mainly in the west, and all trending northward.
Betterments and new equipment have also formed a large part of the programmes of the two railway systems.
The Canadian Pacific Railway in 1929 completed over 300 miles of new lines in the west and spent 30 million in new engines and rolling stock as well as huge sums on new ocean ships.
The Canadian National Railways by authority given by parliament in 1929 commenced the construction of 700 miles of extensions on the 1929-32 programme, 550 of which is in Saskatchewan and Alberta. During the year construction was continued on several hundred miles previously authorized.
Programmes for 1930 for both systems include many miles of new lines and betterments. The Canadian Pacific Railway only yesterday, announced its programme for 1930 proposing to expend 50 million.

Civil Aviation—Increased activity in employment of air transportation across the country in 1929. New routes and establishment of air ports and "ground organization" by Government, municipalities and private interests. The Dominion Government in 1929 has lighted and prepared a total of 1,000 miles for night flying and follows in 1930 with a similar programme. Development of air mail, air exploration and air prospecting in northern regions. Large increases in industries supplying equipment. Indications are that these activities will increase in 1930.

Radio Communication—Expansion, by government and other agencies, of communication throughout country and especially to stations in far north, extending from Hudson Straits to Arctic Ocean.

In tracing through the increasing engineering activities of this country for the past decades, endeavouring to visualize their progress and sequence and to relate the quality of the engineering ability that has been necessary, it is quite obvious that what we have produced has been by our own initiative, by our own efforts and by our own native abilities. These things have been accomplished, in spite of what once appeared to be our geographical and climatical handicaps. We have gradually discovered our resources and our assets which our forefathers suspected but faintly guessed. Even today, we in this generation, can but dimly imagine the possibilities of the distant future, but we are beginning to appreciate the immensity of these natural assets and to realize how best they may be turned to our advantage with the march of discovery and the introduction of new methods of use with the changing times.

No one can say that we are at the end. Far from it. It does not now require much imagination to look into the more immediate future in view of the activities of the present. If these national activities be projected for a futurist picture of only the next five or ten years, we may gain a fair idea of where the country is heading in its material advancement. It may not be too optimistic to foresee in this picture many of the following developments in this further expansion:—

1. The extension of agriculture with new areas further north where newer types of weather-resisting hard wheat may be developed and grown, may bring into production in the Canadian west, quantities approaching a billion bushels yearly, enabling the export of two or three times as much as heretofore. When this happens the engineering of agricultural equipment and of grain storage, milling and transportation will double the present.
2. Rail transportation constantly reaching out northward into new zones, may alter its present geography. It is conceivable that the further development of agriculture, mining and forest resources may bring about new routes into northern Quebec and Labrador, to James Bay, to the regions west of Hudson Bay and Churchill and across to the Pacific between latitudes 55 and 57.
3. The inevitable further development of our ocean ports will carry them far beyond their present trade limitations on the Atlantic and Pacific, both in winter and summer.
4. The development of the enlarged St. Lawrence and Great Lakes waterway now almost within sight, will bring our inland ports into easy ocean connection for cargoes of large dimensions from the heart of the continent, either on direct routes or by single trans-shipments, and give a great impetus to water transportation.
5. Air transportation, now arrived, will expand far beyond present conceptions. No one can foresee what this may mean in Canada's development, particularly northwards.
6. Mining, now well started, will accelerate its development across Canada throughout the pre-Cambrian areas, not only in doubled or trebled outputs of precious and economic minerals now worked, but of others known to exist.
7. Metallurgical and similar processes will be very greatly increased in extent and application. Normal processes will develop with other progress. To treat Canadian ores or materials which have special peculiarities, however, new processes will inevitably be developed by necessity, as, for example, our low grade iron and coals, our oils and tar sands. Fuels in proximity to such mining and metallurgical works will be a large factor, especially in northern Alberta and northern Ontario (if coal is found in large quantity). The transformation of our coals into their chemical constituents by liquefaction or otherwise, following recent research progress, will doubtless be among the earlier steps.
8. Water power development will also continue to increase for some years to come at a still greater rate. Installations even in present programmes ensure this. More remote prospects and programmes themselves are not unduly optimistic when power is considered in conjunction with development in other fields. The most significant fact regarding water power development in Canada is that today the installations total less than 14 per cent of the aggregate developable power of all water sources. A marked economic advantage we have is that most of our water power is contiguous to the other great resources of the mine and the forest. When the great power resources of the St. Lawrence are fully brought in, to the extent in Canada of nearly four million horse power, and with deep water transportation alongside, these combinations will place Canada in a singularly advantageous position for further production of all kinds. It is notable that heretofore the curve of increasing Canadian production has closely followed the curve of increasing development of her water powers.

These are some of the tasks which we, as Canadians and Canadian engineers, have before us. If they are tasks which we may not approach lightly, we will the more readily remember that such tasks have their rewards. The rewards are in the progress and further development of Canada for the decades to follow. It is clear, from past experience and achievement, that we can carry our country a very great way along the road to national prosperity by diligent, careful, and skilful management. Moreover, as a nation of alert and energetic people, we can do it ourselves, with our own financiers, our own business men, and our own engineers.

OBITUARIES

Albert Thomas Spencer, A.M.E.I.C.

Members of The Institute will learn with regret of the death of Albert Thomas Spencer, A.M.E.I.C., which occurred at Montreal on January 26th, 1930, following a long illness.

Mr. Spencer was born at Port Morien, N.S., on February 18th, 1876, and received his primary and technical education in that province.

He commenced his engineering work in 1901 with the Dominion Coal Company, and the Sydney and Louisburg Railway, Glace Bay, N.S., in various capacities in connection with surveys, construction and mining work for these companies. From 1905 to 1907 he was transitman and chief of party for the Canadian Pacific Railway on grade revision surveys in New Brunswick, Quebec and Ontario. In 1907 Mr. Spencer joined the Montreal Park and Island Railway as special engineer in charge of surveys, and later was engaged on the construction of certain suburban electric railway extensions.

From the following year he was assistant engineer with the Montreal Street Railway and its successor, the Montreal Tramways Company, in the way and structures department, until February 1921, when he joined the staff of the Railway Department of the Hydro-Electric Power Commission of Ontario as assistant engineer. In May of the same year Mr. Spencer was appointed engineer of way for the Toronto Transportation Commission, and was in charge of the extensive rehabilitation and extension programme of trackwork done on the Toronto system from 1921 to 1923.

In April 1924 Mr. Spencer was appointed assistant to the general manager of the Toronto Transportation Commission, of Toronto, which position he held until December 1926, when he returned to Montreal as general superintendent of construction and maintenance for the Montreal Tramways Company.

Mr. Spencer's splendid executive capacity and outstanding ability as a street railway engineer won him a widespread reputation in the United States and Canada. He was appointed a member of the standing committee on the way and structures division of the American Electric Railway Engineering Association. As a chairman for a special committee of that Association, he conducted a study on the use of alloy steels in special trackwork. He was a member of the Association of Professional Engineers in both Quebec and Ontario, and a member of the American Society of Municipal Improvements. Mr. Spencer joined The Institute as an Associate Member on October 12th, 1905.

John William Harkom, M.E.I.C.

In the death of Lieutenant-Colonel John William Harkom, M.E.I.C., which occurred at his home in the Eastern Townships, Quebec, on February 16th, 1930, The Institute has lost one of its first members.

Colonel Harkom was born at Enfield, England, and was in his eighty-third year at the time of his death. He came to Canada at the age of twenty-one, and engaged on a survey for the Northern Railway from Toronto to Barrie, Ont. He was employed as an engineer by the Grand Trunk Railway, the Canadian Pacific Railway and the Canada Foundry Company. Colonel Harkom received his early training at the Enfield Rifle Works, England, and was one of the oldest members of the Canadian militia in Eastern Canada.

Colonel Harkom joined the Canadian Society of Civil Engineers at the time of its incorporation, on February 24th, 1887.

Ulric Valiquet, M.E.I.C.

It is with regret that we record the death of Ulric Valiquet, M.E.I.C., which occurred at his home at Ottawa, Ont., on February 3rd, 1930.

Mr. Valiquet was born at Terrebonne, Que., in 1856, and received his education at the Terrebonne College, with an additional two years of private tuition in mathematics.

In 1873 he secured the position of assistant engineer to the late William Kingsford, then chief engineer of the Department of Public Works, which then included Government railways. He was occupied at harbour works on lakes Ontario, Erie and Huron particularly, from 1876 to 1880, where he had charge of dredging work and wharf construction on the Great Lakes. In 1880 he was recalled to Ottawa to prepare contract plans for numerous public works undertaken at that time, remaining in that capacity until 1889 when he was appointed district engineer of Public Works at Quebec City, and superintendent of Lorne dry dock.

In 1900, Mr. Valiquet was again recalled to the head office in Ottawa to prepare the construction plans for the high level permanent piers of the Maisonneuve end of the Montreal harbour. During that period he acted as arbitrator to settle certain difficulties arising between the department and the contractors. Mr. Valiquet had much to do with the construction of the Canadian harbour developments. He was intrusted with the preparation of the plans for the dry dock at Levis, Que., and the harbour improvement in the rivière St. Charles at Quebec City, and later was put in charge of the Saint John harbour works which included the improvement at Courtney bay and west Saint John, until 1917, when he was appointed to examine works connected with the harbours of Halifax, Toronto and British Columbia, at the same time preparing the plans necessary for the dry docks at Halifax and Victoria. He was also during this period deputed to examine all applications filed in connection with an act of 1910 to provide subsidies to those desirous of building private dry docks.

Mr. Valiquet acted as chief engineer of the Department of Public Works on several occasions. In 1920 he was made chairman of a board of engineers to examine the contract plans from the different districts, remaining in that capacity until 1924, when he retired to private life after fifty-one years of continuous service with the department.

Mr. Valiquet joined The Institute as a Member on January 28th, 1892, and on December 23rd, 1924, was made a life member.

ULRIC VALIQUET, M.E.I.C.

PERSONALS

P. D. Dalton, S.E.I.C., has joined the staff of the Geo. A. Fuller Company of Canada, Ltd., Toronto, Ont. Mr. Dalton graduated from McGill University in 1928, with the degree of B.Sc.

John C. Aitkens, S.E.I.C., who was formerly located at Pointe du Bois, Man., is now with the City of Winnipeg Hydro-Electric System at Slave Falls, Man.

H. F. Donkin, A.M.E.I.C., a resident engineer with the Canadian National Railways, is now located at Aspen, N.S. Mr. Donkin was formerly at The Pas, Man., engaged on the Flin Flon survey.

J. E. McClung, S.E.I.C., has become connected with the Alcoa Power Company, Ltd. at Arvida, Que. Mr. McClung, who graduated from McGill in 1926 with the degree of B.Sc., was formerly on the staff of the Northern Electric Company at Montreal.

E. F. Good, S.E.I.C., is now on the staff of Messrs. Harkness and Hertzeberg at Toronto, Ont. Mr. Good graduated from the University of Toronto in 1924 with the degree of B.A.Sc., and since 1928 has been engaged as structural designer with Smith Hinchman and Crylls of Detroit, Mich.

J. E. Thicke, S.E.I.C., is now employed by Aluminum Ltd., Montreal. Mr. Thicke graduated from Queen's University in 1928 with the degree of B.Sc. Following graduation Mr. Thicke took the students' test course with the General Electric Company at Pittsfield, Mass., and was later located at Schenectady, N.Y.

Lewis N. Moore, S.E.I.C., who was formerly power engineer, Montreal division of the Bell Telephone Company of Canada Ltd., at Montreal, has been transferred to Ottawa where he is assistant equipment engineer with the Eastern Ontario Division. Mr. Moore graduated from McGill University in 1927 with the degree of B.Sc.

C. Oldrieve Thomas, A.M.E.I.C., has joined the engineering staff of the Dominion Rubber Company, Montreal. Mr. Thomas was formerly with the Dominion Bridge Company, Ltd., Montreal, and in 1928 was granted patents on a metal-to-metal flexible shaft coupling without springs or back-lash. From 1923 to 1928 Mr. Thomas was on the designing and estimating staff of Canadian Vickers, Ltd.

A. H. Pattenden, M.E.I.C., who was formerly industrial engineer of the new business department of the Montreal Light, Heat and Power Consolidated, Montreal, has resigned from that position to become sales engineer with Callard and Company, Montreal. From 1918 to 1928, when he accepted the position from which he has just resigned, Mr. Pattenden was electrical engineer of the eastern and western plants of the Dominion Rubber Company, Ltd.

J. J. White, A.M.E.I.C., has been appointed building inspector of the city of Regina, Sask. Mr. White graduated from the University of Saskatchewan in 1925 with the degree of B.E. From 1915 to 1919 Mr. White was overseas with the Canadian forces and the Royal Air Force. From 1920 to 1927 he was with Miners and Ball Limited, Saskatoon, from 1923 having been superintendent of general construction work and design. In 1928 he joined the staff of C. M. Miners Construction Company, Ltd. at Saskatoon, Sask.

H. J. Edwards, S.E.I.C., is now attached to the municipal department of the Hydro-Electric Power Commission of Ontario at Toronto, Ont. Mr. Edwards graduated from Queen's University in 1924 with the degree of B.Sc. and has been connected with the Commission since that time, having at one time been connected with the Employees' Relations Department at Toronto. Mr. Edwards was previously located at Oshawa, Ont., where he was assistant to the manager.

A. C. Fleischmann, A.M.E.I.C., who since 1926 has been technical engineer on sewers commission and the design of reinforced concrete works with the Technical Service of the City of Montreal, has entered private practice as a consulting engineer in the same city. Mr. Fleischmann graduated from the University of Cluny, France, in 1922, with the degree of C.E. He also graduated from the Artillery School of Fontainebleau (France.)

T. H. Nicholson, A.M.E.I.C., is now engaged as vice-president and general manager of the Compania Nacional de Electricidad, operating the principal electric light and power, telephone and tramway properties in Costa Rica. Mr. Nicholson was formerly consulting engineer with the Brazilian Telephone Company with headquarters at Rio de Janeiro, Brazil. With the exception of five years when he was with the New England Telephone and Telegraph Company, Mr. Nicholson was on the engineering staff of the Bell Telephone Company of Canada, Ltd. at Montreal continuously since 1904.

J. G. W. Campbell, M.E.I.C., who since 1919 has been town engineer of Truro, N.S., is now connected with the Halifax Harbour Commissioners at Halifax, N.S. From 1904 Mr. Campbell was town engineer of the town of Sydney Mines, N.S., being engaged on waterworks, sewerage design and construction. In 1914 he obtained the degree of C.E. from the Ohio Northern University and in 1914 and 1915 was engaged on land surveying in Nova Scotia. In 1917 Mr. Campbell was with the Nova Scotia Tramways and Power Company, Halifax, on design and construction work, and in 1917 and 1918 he was on the staff of the city engineer of Halifax.

J. P. Chapleau, A.M.E.I.C., is now connected with the Beauharnois Construction Company at Beauharnois, Que. Mr. Chapleau graduated from the Ecole Polytechnique in 1920 with the degree of B.Sc. and in 1923 was resident engineer for the Quebec Development Company on the Alma and Jonquiere Railway at St. Joseph D'Alma, Que. In 1927 he joined the staff of the Shawinigan Engineering Company and was for a time at Hebertville station, Lake St. John, Que., and later became field engineer at Shawinigan Falls.

Archibald Cox is at present chief engineer with the Brazeau Collieries at Nordegg, Alta. Mr. Cox was for several years superintendent engineer of the City of Regina Light and Power Plant, following which, in 1924, he occupied a similar position with the Winnipeg Standby and Central Heating Plant, and in 1926 he was town engineer and superintendent of utilities for the town of Estevan, Sask. He was later in charge of all construction and mechanical departments with the Corbin Coal Company at Corbin, B.C.

K. A. Dunphy, A.M.E.I.C., is now division engineer with the Canadian Pacific Railway Company at Fort William, Ont. Mr. Dunphy graduated from the University of New Brunswick in 1907 with the degree of B.Sc. and following graduation was engaged as a transitman on the location of the International Railway. In 1909 he entered the service of the Canadian Pacific Railway Company as rodman and transitman on maintenance and was located at Medicine Hat and Calgary, Alta. Later, he was resident engineer at Calgary and at the Vancouver terminals. From 1914 to 1920 he was division engineer and bridge and building master at Souris, Man., and in 1924 was appointed division engineer at Brandon, Man., which position he held up to the present time.

J. A. Knight, A.M.E.I.C., is now designing engineer with the Beauharnois Construction Company at Beauharnois, Que. Mr. Knight graduated from the University of Toronto in 1914 with the degree of B.A.Sc. He served overseas with the 2nd Canadian Tunnelling Company and the 11th Battalion Canadian Engineers during the war and was awarded the Military Cross. Returning to this country, Mr. Knight joined the staff of the Hydro-Electric Power Commission of Ontario, and was engaged on hydraulic design with the Commission until 1928 when he was appointed to the engineering staff of the Aluminum Company of Canada at Arvida, Que., where he was engaged on the design of the power plant at Chute à Caron on the Saguenay river.

W. T. Brickenden, Jr.E.I.C., recently joined the organization of Thorne, Mulholland, Howson and McPherson, of Toronto, as mechanical engineer, to take charge of the engineering department which has been inaugurated by that firm to work in conjunction with the practice of public accounting. Mr. Brickenden graduated from the University of Toronto in 1922 with the degree of B.A.Sc., and following graduation became connected with the Under-Feed Stoker Company of Canada, Ltd. as assistant engineer. In January 1923 he became sales engineer and assistant manager with the A. W. Cash Company of Canada Limited, and later in the same year returned to the Under-Feed Stoker Company as chief engineer. In 1928 Mr. Brickenden was appointed chief engineer of the Riley Engineering and Supply Company, Ltd., and remained with that firm up to the present time.

Professor E. A. Allcut, M.Sc., M.E.I.C., associate professor of mechanical engineering at the University of Toronto, Toronto, has been awarded a Herbert Akroyd Stuart prize for his paper entitled "Further Tests on a Two-Stroke Cycle Oil-Engine" which was published in the Proceedings of the Institution of Mechanical Engineers, London, England. The prize was offered for the best paper published in the Proceedings during the years 1927, 1928 and 1929 on the general subject of "The Origin and Development of Heavy Oil Engines." This is the first time that one of the Herbert Akroyd Stuart prizes has been awarded outside of Great Britain. Professor Allcut's paper contained the results of researches carried on by him in the Department of Mechanical Engineering at the University of Toronto. Professor Allcut, who has been on the staff of the University of Toronto for ten years, is a graduate of the University of Birmingham.

A. I. Cunningham, A.M.E.I.C., has been appointed vice-president and general manager of Merritt-Chapman and Scott, Limited, general contractors, Montreal. Mr. Cunningham graduated from McGill University in 1914 with the degree of B.Sc., and was employed for the next year by the Bathurst Lumber Company, and then for a time was with the Grand Trunk Railway. From 1915 to 1919 he was in the Canadian Siege Artillery with the rank of captain. Following the war, and until 1922, Mr. Cunningham was field engineer for the St. Maurice Lumber Company at Three Rivers, later joining the staff of the Parklap Construction Corporation as field engineer on the Sherman Island hydro-electric development at Glen Falls, N.Y. In 1923-1924 he was attached to the Moreau Manufacturing Corporation at Glen Falls, N.Y., as resident engineer on the construction of the Feeder dam hydro-electric development. From 1924 to 1927 Mr. Cunningham was in charge of the construction of an extension to the St. Maurice Lumber Company's paper mill at Three Rivers, and in 1927 was resident engineer for the Canadian International Paper Company at Gatineau, Que. In 1928 Mr. Cunningham accepted the position of resident engineer with the New Brunswick International Paper Company at Dalhousie, N.B.

Recent Additions to the Library

Proceedings, Transactions, etc.

PRESENTED BY THE SOCIETIES:
- The Royal Society of Canada: Transactions, Vol. 23, Part 2, Sect. 5, May, 1929.
- Institution of Engineers and Shipbuilders in Scotland: Transactions, 1928-1929, Vol. 72.
- Engineering Foundation, Inc.: History, Charter and By-laws, January, 1930.

PURCHASED:
- Society for the Promotion of Engineering Education: Proceedings, Vols. 1-15, 17-29, 31, 35. 1903-1928.

Reports, etc.

DEPARTMENT OF THE INTERIOR CANADA:
- Water Resources Paper No. 58: St. Lawrence and Southern Hudson Bay Drainage, 1925-27.
- Water Resources Paper No. 59: Pacific Drainage, British Columbia and Yukon Territory, 1926-27.
- Water Power Resources of Canada, January, 1930.
- Publications of the Dominion Observatory, Ottawa: Bibliography of Seismology, Vol. 10, Nos. 2 and 3.

DEPARTMENT OF LABOUR, CANADA:
- Investigation into the Amalgamated Builders' Council and Related Organizations, 1929.
- Prices in Canada and Other Countries, 1929.
- Wages and Hours of Work in Canada, 1920-29.

DOMINION BUREAU OF STATISTICS, CANADA:
- Statistics of Steam Railways of Canada for the Year ended December 31, 1928.

DEPARTMENT OF MINES, ONTARIO:
- Thirty-Seventh Annual Report, Vol. 37, Parts 1-6, 1928.
- Thirty-Eighth Annual Report, Vol. 38, Part 4.

GEOLOGICAL SURVEY, UNITED STATES:
- Water Supply Paper No. 578: The Mohave Desert Region, California.
- Water Supply Paper No. 598: Geology and Ground-Water Resources of North Dakota.
- Water Supply Paper No. 602: Surface Water Supply of the U.S., 1925: Part 2, South Atlantic Slope and Eastern Gulf of Mexico Basins.
- Water Supply Paper No. 603: Surface Water Supply of the United States, 1925, Part 3: Ohio River Basin.
- Water Supply Paper No. 604: Surface Water Supply of the United States, 1925, Part 4: St. Lawrence River Basin.

DEPARTMENT OF THE INTERIOR, UNITED STATES:
- Annual Report of the Director of the Geological Survey to the Secretary of the Interior for fiscal year ended June 30, 1929.

BUREAU OF STANDARDS, UNITED STATES:
- Commerical Standard CS12-29: Domestic and Industrial Fuel Oils.
- Commercial Circular No. 379: Care and Adjustment of Folding Testers of the Schopper Type.

BUREAU OF MINES, UNITED STATES:
- Technical Paper No. 456: Classification and Tabling of Difficult Ores with Particular Attention to Fluorspar.
- Technical Paper No. 457: Centrifugal Concentration.
- Technical Paper No. 458: Accidents at Metallurgical Works in the United States, 1927.
- Technical Paper No. 460: Design and Operation of Gas-Well Siphons.
- Technical Paper No. 462: Safety at Natural-Gasoline Plants.
- Technical Paper No. 463: Depths Attainable by Electrical Methods in Applied Geophysics.
- Technical Paper No. 464: Coal Dust Explosibility Factors Indicated by Experimental Mine Investigations, 1911-1929.
- Technical Paper No. 466: Effect of Managanese on Distribution of Carbon in Steel.
- Economic Paper No. 5: Summarized Data of Lead Production.
- Bulletin No. 314: Quarry Accidents in the United States, 1927.
- Miners' Circular No. 33: Advance Mine Rescue Training.

RENSSELAER POLYTECHNIC INSTITUTE:
- Bulletin No. 22: The Radiation Characteristics of Grounded Vertical "L" and "T" Antennas.
- Bulletin No. 23: A Study of the Colour Sensitiveness of Various Types of Photo-electric cells.

UNIVERSITY OF TORONTO:
- Bulletin No. 8, Sect. No. 3: Stress in Certain Thin Fillets.
- Bulletin No. 8, Sect. No. 2: Report on Pilot Tests Conducted for the Structural Steel Welding Committee of the American Bureau of Welding at the University of Toronto, 1927-28.
- Permissible Stresses on Rivets in Tension.

GEOLOGICAL SOCIETY OF AMERICA:
- Frost Heaving: Reprint from The Journal of Geology, July-August, 1929.

Technical Books, etc.

PRESENTED BY CANADIAN ENGINEERING STANDARDS ASSOCIATION:
- Standard Specification for Steel Structures for Buildings, Second edition, No. A-16-1930.
- Canadian Electrical Code, Part 1, Second edition, No. C22-1930.

PRESENTED BY ART, HISTORICAL AND SCIENTIFIC ASSOCIATION OF VANCOUVER:
- The Work of the Royal Engineers in British Columbia, 1858-1863.

PRESENTED BY E. & F. N. SPON, LTD.:
- Workshop Receipts for Manufacturers and Scientific Amateurs, Supplementary Volume.

PURCHASED:
- American Railway Association, Mechanical Division: Manual of Standard and Recommended Practice, 1929.
- Heaton's Commercial Handbook of Canada, 1930.

BOOK REVIEWS

Canadian Electrical Code—Part 1

No. C22-1930.

The long continued work of the Canadian Engineering Standards Association which resulted in 1927 in the publication of the first edition of Part 1 of the Canadian Electrical Code, received such general approval, and the code itself obtained such wide adoption, that in three years a second edition was found necessary and has now been issued.

This edition embodies the result of the work of the Canadian Engineering Standards Association Code Committee and its various provincial committees during a period of more than twelve months, and is considerably enlarged.

The new material included covers additional regulations for the protection of motor feeders and motors, and rules covering demand factors and wattage of outlets. Regulations covering garages and motion picture studios have been included in the section on hazardous locations, while motion picture and projection equipment have been dealt with in the section dealing with theatre installations. The book contains a very complete index and a cross reference list which will assist in comparisons between the present and previous editions.

This code affords an admirable illustration of the method adopted by the Association in the development of its work, for as may be judged from the list of committees given on pages 6 to 11, it is evident that no effort has been spared to obtain the co-operation and assistance of the local and provincial authorities throughout Canada, as well as authorities on electrical work who are not definitely connected with any provincial or city organization. The preparation of the code has in fact been handled on a Dominion-wide basis, and it represents a great step towards interprovincial agreement on this important subject.

Standard Specification for Steel Structures for Buildings—Second Edition

No. A16-1930

A copy of the Standard Specification for Steel Structures for Buildings, second edition, has been received from the Canadian Engineering Standards Association. This specification, originally issued in 1924, has been widely used, and the first edition having become exhausted, the committee has had the opportunity of making a thorough revision.

During the past five years the design of steel structures for buildings has undergone considerable development, and it is interesting to note that the specification now permits a unit stress for axial tension of 18,000 pounds per square inch as compared with 16,000 in the previous edition. Corresponding changes have been made in other units in order to correspond with the latest recognized practice; the column formula has also been revised, and certain changes have been made in the conditions for snow loads and wind loads. The specification for structural carbon steel has also been brought up to date.

In the preface, the committee very properly stresses the importance of making a competent professional engineer responsible for the computations involved in any structural design, and this point is of increasing importance, owing to the continued development in the size and importance of steel structures in our cities. The specification is in fact, careful to note many of the points on which the trained judgment of an engineer is indispensable, as for example in the paragraphs regarding welding and the methods to be adopted for protection against corrosion.

This publication is intended for the use of city authorities in the preparation of their building codes, and can be recommended as being eminently adapted for this purpose.

Workshop Receipts for Manufacturers and Scientific Amateurs Supplement
(Aluminium to Wireless)

By E. & F. N. Spon, Ltd., London, 1930, cloth, 7½ x 5 in., 458 pp., figs., tables, $1.50.

This volume, which E. & F. N. Spon have just issued, is supplementary to their well-known series of four volumes of workshop receipts, and brings up to date what is practically an encyclopaedia of workshop processes, dodges, and materials. The professional or amateur who consults "Spon" can get practical information on a variety of subjects, ranging from anemometers, basket-making, clock-mending, and engraving, to luminous paints, plastering, ropemaking and taxidermy, selecting only a few examples at random.

We now have a book containing recent information on subjects not to be found in the four original volumes, and the work is characterized by the same commonsense usefulness as before. It tells us how to cane chairs, test metals for hardness, do lacquering and use microscopes, use etching reagents, and do oxy-acetylene welding; these, with over seventy other topics, make up a most useful handbook.

An Introduction to Mechanics

By J. W. Campbell. Houghton Mifflin Company, Boston, 1929. Cloth, 5 x 7½ in., 384 pages, diagrs., $3.50.

Also

Numerical Tables of Hyperbolic and Other Functions

By the same author and publisher. Cloth, 5¾ x 8 in., 76 pages, tables, $1.25.

Dr. Campbell states in the preface of his book that the elementary principles of mechanics are more poorly understood by students than the elementary principles of any other subject. He quotes an eminent teacher by saying that students will solve successfully with complicated mathematical machinery problems that he is confident they do not understand, and will fail lamentably in the solution of simple commonsense problems where the canonical machinery is in the way.

The author's remedy is to teach the subject with the help of, and in conjunction with, the calculus. He has therefore used the calculus throughout. He is very sound in saying that the student should not have anything to unlearn as he progresses in his knowledge of the subject, but that rather the fundamental ideas he learns should be capable of expansion. It is a debatable point which should be taught first, calculus in order to understand mechanics, or simple mechanics to help in the comprehension of the calculus.

In order to understand Dr. Campbell's book the student should have an elementary working knowledge of the calculus and, as he proceeds, should expand this knowledge. The subject is treated rightly, with great pains, and from a purely academic standpoint. The book covers rectilinear kinematics and dynamics, plane kinematics and dynamics, gravitation, centres of mass, plane statics, some properties of matter such as Hooke's Law and friction, simple harmonic motion, plane dynamics of particles in the earth's field, moments of inertia, plane motion of a rigid body, flexure and torsion, kinematics of plane motion of rigid bodies, further conditions for equilibrium, flexible chains and strings, and the general motion of a rigid body.

The above chapter headings show that Dr. Campbell has written a very full introduction to mechanics, except in statics. His examples are designed to bring out the principles he is teaching, irrespective of whether they are practical or not. It is difficult to see how the student at the end of the chapter on "Flexure and Torsion" will be able to solve the problems, which cover a wide range in "Strength of Materials," without consulting other text-books.

The chapter on "Flexible Chains and Strings" is well written and should prove of use to engineers engaged in transmission work. Its use needs the help of the excellent tables on hyperbolic and other functions. The author has not considered the effect of comparatively long strings of insulators at the ends of relatively short spans. The existence of the tables and the fact that for long spans the effect of the insulators is usually neglected, ought to make the use of the hyperbolic formulae more general. By publishing these tables he has done a service for which engineers should be thankful.

G. J. Dodd, A.M.E.I.C.,
Assistant Professor in Civil Engineering and Mathematics, McGill University, Montreal.

Practical Design of Simple Steel Structures

Vol. 1: Shop Practice, Riveted Connections and Beams, etc.
Vol. 2: Plate Girders, Columns, Trusses, etc.
Vol. 3: Tables.

By David S. Stewart. Constable & Company, Ltd., London, 1929' cloth, 5½ x 8¾ in.; Vol. 1: 183 pages, illus., diagrs.: $3.65; Vol. 2: 215 pages, plates, diagrs.: $4.75; Vol. 3: 19 pages, tables: $1.50.

This book, which is published in three volumes, is intended as a textbook for students in engineering and for junior draughtsmen. All problems are, of course, worked out on the basis of British standard practice but the author points out where American practice differs.

The first eight chapters of volume 1 deal with problems which are usually neglected in books on structural design but which, when first encountered, present real difficulty to engineering students and junior draughtsmen. The first chapter gives a description of the various sections used in structural work together with a short section on the method of rolling structural shapes. Chapter 2 deals with the function of the structural drawing office and the amount of detail that it is necessary to show on a structural drawing to allow of the fabrication of the structure. Chapter 3 describes the method of making templates, and describes and illustrates the principal machines used in a structural fabricating shop. In chapters 4 to 8 the calculations necessary in designing and detailing splices in plates and angles are shown in great detail. Chapter 9 deals with wind pressure and factors of safety; chapters 10 and 11 with the design of simple beams and crane girders.

Volume 2 deals with the design of such structures as plate girders, crane girders, columns and their foundations, roof trusses, lattice foot bridges, and railway through plate girder spans. The method followed is to work out a design in detail in each case with accompanying notes explaining the reasons for the steps taken. The volume is illustrated with plates giving detail drawings of the structures designed. The method used in designing columns differs considerably from that used in this country as the allowable unit stress depends on the assumptions made as to the end restraint of the column. In chapter 8 a method of calculating the equivalent uniform live load for a series of wheel concentrations is given, and its use suggested in the design of short spans. In the writer's opinion, considerable time would be saved by using the actual wheel concentrations. Volume 3 contains 17 pages of tables.

The book is well printed and the illustrations are clear and well drawn. Volume 1 particularly is recommended to students and draughtsmen who are having difficulty in their first encounters with structural steel detailing.

R. S. Eadie, A.M.E.I.C.,
Assistant to the Chief Engineer,
Dominion Bridge Company, Limited

BRANCH NEWS

Halifax Branch

R. R. Murray, A.M.E.I.C., Secretary-Treasurer.
W. J. DeWolfe, A.M.E.I.C., Branch News Editor.

The January meeting of the Halifax Branch of The Institute was held at the Halifax hotel on January 23rd, Chairman W. P. Copp, M.E.I.C., presiding. The meeting was preceded by supper at 6.30 p.m. and there were 34 present, including Mayor Gastonguay and several other guests. The minutes of the annual meeting were read and approved. Committees were appointed as follows:—

Vice-Chairman	C. St.J. Wilson, A.M.E.I.C.
Papers and Meetings	R. R. Murray, A.M.E.I.C.
	C. St.J. Wilson, A.M.E.I.C.
	J. D. Fraser, S.E.I.C.
Membership	H. F. Bennett, A.M.E.I.C.
	J. L. Allan, M.E.I.C.
	W. H. Noonan, A.M.E.I.C.
	Karl Whitman, A.M.E.I.C.
Publicity	W. J. DeWolfe, A.M.E.I.C.
	L. A. Allison, A.M.E.I.C.
	J. J. Sears, A.M.E.I.C.
Students' Prize	F. R. Faulkner, M.E.I.C.
	H. R. Theakston, A.M.E.I.C.
	H. S. Johnston, M.E.I.C.

The Chairman then introduced the several guests, bidding them welcome and hoping for a pleasant evening for them all, after which he introduced the speaker of the evening, J. A. Wilson, A.M.E.I.C., who is controller of civil aviation at Ottawa, and addressed those present on "Civil Aviation in Canada."

Mr. Wilson was accorded a hearty reception on rising and he expressed great pleasure at being in Halifax again (Mr. Wilson had been here during the World War), and was pleased with the interest shown in aviation. He did not apologize for coming to speak before engineers because the members of that profession should, and do, lead in all matters which are of interest to the public and which come before them. He stated that aviation needs their help.

Mr. Wilson went on to sketch the history of flying and of experiments made by individuals and governments to foster and develop aviation, and then proceeded to the main topic of his address, "Civil Aviation in Canada."

In speaking particularly to Halifax, Mr. Wilson said that his Department does not wish any community to spend a lot of money on an airport with great expectations, only to be later disappointed in not realizing their hopes. An airport may be in or out of a city, according to conditions. With large areas of prairie land it is possible to be close in but otherwise, with the scarcity of large plots of level lands in the east, it is difficult and you must do the best you can—get in as closely as you can. Mr. Wilson explained that American fields were some distance from a city, in cases.

A very hearty applause greeted Mr. Wilson at the close of his address, which was heard with deep interest.

Mayor Gastonguay complimented Mr. Wilson on his clear and interesting address and was glad to be present. His Worship said that an airport in Halifax is a matter of financing which is engaging the active attention of the city council and he hoped for early results. He wished to resent the criticism of the local press and high government authority that Halifax is not doing all it might to put the city on the air mail route.

C. H. Wright, M.E.I.C., in a few words stressed the point that hydroplanes must be our first consideration but, to combat ice conditions in fall and in spring, and to accommodate planes from other places which use only wheels, we must have an airfield also if we are to retain our place as a high class commercial port.

W. J. DeWolfe, A.M.E.I.C., asked what effect airplanes, carrying mails from ships at sea, would have on an airfield in Halifax, in the matter of size of airfield to be constructed. Mr. Wilson could not prophesy, at present, though the subject is receiving the attention of his Department. He said we have the best of facilities for water planes but land fields are difficult because of the topography.

H. F. Bennett, A.M.E.I.C., agreed with Mr. Wright as to getting on with the job but he was not sure that all the possibilities had been exhausted. He referred to Moncton and Saint John airports and hoped to see one here in the near future.

Mr. B. F. Saunders, air pilot, and several other pilots expressed the view that the Halifax chosen site is a very good one for the purpose.

C. H. Wright, M.E.I.C., moved a vote of thanks to Mr. Wilson for his coming and his fine address, and coupled with it thanks to Headquarters for assisting in having Mr. Wilson come.

K. L. Dawson, M.E.I.C., seconded the motion and remarked that he now sees the airport question as he had not before seen it.

The motion was unanimously carried and Chairman, Prof. W. P. Copp, M.E.I.C., conveyed the thanks of the Branch to Mr. Wilson for his address, adding that we all have a clearer viewpoint than formerly.

Mr. Wilson in acknowledgment of the vote said he was glad to have been of assistance now and that he will be always ready to help out, incidentally remarking that he had made his first flight in Halifax. Several reels of motion pictures showing fire fighting by airplane, parachute jumping and other features were very much appreciated.

Kingston Branch

L. F. Grant, M.E.I.C., Secretary-Treasurer.

On January 10th, Mr. J. W. Kelly of the Portland Cement Association read a paper on "The Internal Structure of Concrete," an abstract of whieh has already appeared in the Journal.

Development of Architecture

On January 30th, 1930, a paper was presented by Major L. F. Grant, M.E.I.C., on "The Development of Architecture."

The speaker pointed out that a talk of forty-five minutes on such a subject must be remarkable for what it omitted, rather than for what it included, and then gave a brief résumé of the principles of design formulated by Ruskin.

He then gave a short discussion on Egyptian architecture, next describing that of Greece in the Periclean age, and illustrating his remarks with pictures of the Thesion, the Parthenon, and other Greek masterpieces. Next followed Roman architecture up to the time of the removal of the capital from Rome to Byzantium, which led naturally to a description of Byzantine work.

The speaker then spoke of the later Roman period, merging into the Romanesque school, and finally into the transition to Gothic, of which a number of examples were given. The Renaissance was next discussed, including the influence of the Turkish conquest of the Eastern Empire.

Turning then to modern architecture, the development of the skyscraper was traced, and a comparison made between its suitability and that of the classical type of building for modern conditions. In concluding the speaker pointed out that the skyscraper, formerly the "ugly duckling" of architecture, had been transformed into dignified and even beautiful structure, and suggested that a similar development was possible in the case of the grain elevator.

A few pictures of futuristic architecture closed the address.

Lethbridge Branch

On Saturday, January 25th, the Lethbridge Branch was singularly favoured by hearing two excellent speakers; namely, Mr. W. P. Campbell, chemist, Department of the Interior and Mr. R. S. Trowsdale, sales engineer, Canadian General Electric Company.

The subjects and subject matter were as follows:

The Water Problem in Oil and Gas Fields

by W. P. Campbell.

In what way is water a problem? What difficulties does it create?

(1) In drilling of wells.
(2) In maintenance of producing wells.
(3) In proper abandoning of wells which have become unproductive or have been abandoned for other reasons.

Only 10 to 20 per cent of oil underground is recovered, due to water being permitted to enter the oil sands from points above or below, in the drilling process, or is found in contact with the oil or gas in the drilling zone. Therefore, any measure which can be adapted to prevent this is to be welcomed.

Efficiency in oil field development is the production of oil free from water for the longest possible time in a manner to recover the greatest ultimate quantity from the underlying field.

Oil Sands

Oil and gas are found in sandstone beds and limestone formations. These act as reservoirs. Sandstone and porous fractured limestone offer less resistance to the movement of gas and oil than do shales and clay. Lack of uniformity of the structure has important bearing on recovery of oil from horizons in which water has penetrated, as the tendency is for the segregation of oil to take place in the tighter lenses of the sands, and be held there while water replaces the oil in the looser areas. The result is that the well will finally produce largely water in spite of the fact that a large quantity of oil is still in the oil sands.

Oil waters are classified in their relation to the oil producing zone as:

(1) Top water; (2) Middle water; (3) Lenticular water; (4) Edge water; (5) Bottom water.

Top water is above the oil sands.

Middle water between oil and gas sands.

Lenticular water is carried by water sands; but pinches out.

Edge water is found in oil sand in contact with the oil.

Bottom water comes from beneath the lowest oil bearing zone.

With the exception of edge water, all can be satisfactorily dealt with. When edge water appears it marks the beginning of the end of the field.

All water sands should be carefully recorded even in wild cat wells, where the primary object is information as to oil sands. The record so obtained may be of the greatest value in the event of the well proving to be a productive one. It is essential that the initial wells be drilled with percussion tools, of which the familiar cable tools are a type, for only by their use can the lesser water sands and oil and gas sands be detected and the exact depth at which they occur be determined.

In dealing with water problems, the petroleum engineer has to call in the chemist to his aid. Then in addition to logging carefully the exact depth at which water sands occur, he takes a representative sample of the water from the particular sands. The sample should be free from contamination of mud fluid and water used in the drilling operation. Government regulations make sampling of all oil water obligatory.

Oil fields are identified by the particular salts in the water. The constituents which predominate in oil field water, and the quantitative determination of which is sought are: sodium, potassium, calcium, magnesium, chloride, sulphate, lucarbarates and corborates.

There are various methods of reporting water analyses. The Palmer system is generally adopted, giving the chemical constituents of water in the exact proportions in which they are present. These may be represented graphically. This was shown on the lantern slides.

In Alberta and Saskatchewan deep waters are almost wholly chlorides of sodium and calcium of magnesium. An interesting fact is the entire absence of sulphates. The theory of this is that sulphate removal is brought about by dead organic matter or by the action of bacteria.

The amount of dissolved solids in surface water is very much lower than in deep waters.

With reliable records on hand, the petroleum engineer can estimate the depths at which water shut off jobs will have to be done, the amount and dimension of casing required for any new wells. Water which may make its appearance can be traced to its source and the trouble overcome.

The next step in a properly drilled well is to shut off the water. First ascertain exact depth of water sand; this is important as setting the casing too high is just as bad as a poor job. It is useless to attempt to pump a well dry. The only really effective method is cementation. This consists of surrounding the casing, at a convenient point below the water sand, with cement, from the bottom of the casing to a point well above the water sand. There is a feeling that anyone can do this but it really requires an expert, judging by the number of failures. No money should be spared in getting a complete shut off. Pure cement is used and ample time should be allowed for thorough setting before drilling is proceeded with. Agitation from gas or movement from other sources should be avoided during the setting period.

A simple case of cementation procedure is as follows:

(1) Circulation is established; that is, a free passage between inside and outside of casing.

(2) Neat cement is introduced into the bottom of hole.

(3) Pressure is applied on the column of cement and maintained until the cement is thoroughly hardened.

There are many methods though, and some are protected by patent.

Cementation applies chiefly to "top" and "intermediate" waters.

Water may get into producing wells through defective casing joints, or damaged casing. The producing zone itself may contain water in the form of edge water, or, bottom water may have been permitted to invade the producing zone.

When water does appear, the first step is to determine the source. If the samples have been well taken and classified, this can readily be done, and the depth at which the trouble is seated is known.

The next step is to find out how the water is getting in. When bottom water is under considerable head, the shutting off presents many difficulties. Lead and lead wool plugs have been employed with fair success but cementation, if possible, is more satisfactory. For edge water, little can be done. Examples of methods of dealing with water troubles might be multiplied. A number of slides were shown to illustrate problems as applied to producing wells.

Defective shut-offs were drawn, in which cementation had been made above or below the true water sands, thereby permitting water to travel either up or down and enter adjacent oil sands, resulting in their ruin as producing zones.

Another series of interesting slides depicted the migration of water from an abandoned well which had not been plugged. The water was shown to rise in the oil well hole and penetrate oil bearing sands to travel along these sands, entering and spoiling producing wells.

An interesting discussion followed, the subject being of very live local interest.

The paper by Mr. R. S. Trowsdale was entitled:

The Electrical Industry and its Control

Mr. Trowsdale proceeded to disillusion the members of the hope that they may have held of being admitted to some secret of the mysteries of big interests controlling the electrical industry by pointing out that the electrical industry was really in the hands of the small investors and users of power. His paper, he maintained, was to deal with administrative and mechanical control.

A short history of electrical development was given. Short because the life of electricity, as we know it, is short. A mere fifty years, the first incandescent lamp being developed in 1879. Some of the incandescent lamps were huge things, five feet high. Brief reference was made to the pioneers, Edison and Brush. The story of Edison erecting his first Canadian plant in Cornwall, Ontario, was an illustration by which to gauge the remarkable progress of electricity. Edison arrived personally at Cornwall in 1882 to install an electrical plant for the Canadian Copper Company. After an inspection the local newspaper brought out an editorial the next day, the gist of which was that electricity had seen its day and was due for failure for the simple and clear reason that the human eye could not stand the glare of the lamps. As contrast with this, in 1928 the total revenue from electricity in America amounted to 1,908,000,000 dollars. Behind this present-day huge production was a long, lone line of service which has made electricity an agency accomplishing more in production and in human comfort and convenience than any other known agency, and at a lower cost.

This has been achieved by endless research and application. Mr. Trowsdale described the setting of a research laboratory where the most eminent men obtainable of any and all nationalities are given unlimited means, time and assistance to develop and conclude their experiments.

Fifty per cent of the experiments proved at these laboratories are given to the industry in general and fifty per cent to the particular firm by whom these experts are employed.

The secondary unit in the process of development is the commercial laboratory. Here all the materials are thoroughly tested by the most scientific methods, cost of production computed and an economical commercial principle of production developed. Next are the shops and factories and so on down the line to the user.

Electrical, mechanical and chemical engineers constitute the main operative staffs and these huge electrical concerns are the greatest plants of absorption of trained technical men. Young university trained engineers from all countries are selected on the advice of their professors and invited to join the firm. At the plant they are given an extended course in their particular work, lasting 15 to 18 months. Another system is the training of apprentices for a four-year period. Positions are guaranteed. This applies to all the large firms.

With the theory of Brush and Edison, that "Work is the only thing that keeps a man fit," all encouragement is given to the employees to concentrate on their work, by relieving them of all sources of worry. This they achieve by insurance, pension and health schemes, house-building and investment clubs, etc. Also by offering valuable and large prizes for various experiments. Prizes so important that engineers throughout the world compete. Proof of the particularly fine treatment of the employees is evident by the very small labour turnover.

The consumption of electrical energy is far greater on the North American continent than in European countries, and Canada is branching out into Europe, buying up plants and installing equipment. In this country every man has as his disposal, 4½ h.p. As a result, man becomes the most productive unit.

In the material world of the industry, equipment changes are very rapid, an efficient article of to-day becomes obsolete in a couple of years. To-day a 5,000-k.w. hour machine is being reassembled, polished and placed on a pedestal in a museum, as a model for posterity, development has gone so far.

To meet the problem of the high value of real estate in congested areas, larger electrical power plants had to be designed to cover only the small floor space of the plants which they were replacing. This has been achieved by the development of the vertical compound or superimposed turbine machine. A later type is the mercury turbine, using mercury in place of water. Experiments with hydrogen as a cooling substance is proving a success. Hydrogen prevents oxidation of insulation and has lower density. Underground transmission is a goal that will soon be won and high voltage cables will then be hidden from sight and all the network of unsightly poles will be cleared away.

The magnetic switch control was greatly stressed, and it was pointed out that by its installation momentary drops in power can be provided against. Also, in plants consisting of a series of correlated units. by the adoption of the magnetic switch control if one unit breaks down all other units are automatically stopped, avoiding the necessity of a man having to turn off each individual unit.

In the branch of highways, some control of traffic from minor feeder roads to entrance to the main arteries was necessary. An electrical ear was developed, sensitive to the horn note of an automobile, the vibrations set up by the note turns on a red light on the one face and a green light on the other.

An electrical eye is used in the taking of traffic census. This consists of a light on the one side of the road trained on a sensitive cell at the other side. Passing traffic interrupts the beam of light and each interruption causes one to be registered on a dial attached to the cell. This device has numerous other uses.

Past achievements have only unlatched the door of an unlimited future in electrical development.

A film was shown illustrating the various principles and devices mentioned.

A truly interesting discussion followed.

A vote of thanks and a suitable compliment to both speakers was expressed by the chairman.

The meeting closed at a very late hour with all members very eloquent in their thanks to both speakers for two unusually interesting and well delivered papers.

Preceding the address was a dinner, and the orchestra, violin and vocal solos followed by folk singing, gave a cheerful tone to the meeting.

The Lethbridge Branch held its fortnightly meeting at the Marquis hotel on February 8th. The usual dinner preceded the meeting and orchestral selections were rendered by Mr. Morgan's orchestra, while Miss Allison entertained the gathering with very delightful vocal solos.

The speaker of the evening was Dr. K. A. Clark, research professor in road materials at the University of Alberta, who gave an illustrated talk on "The Bituminous Sands of Alberta."

Considerable prospecting has been done on the bituminous sand deposits of northern Alberta, and it has been found that in the neighbourhood of Fort McMurray there are about 1,000 square miles of these beds. They average in thickness 200 to 300 feet, and are covered by considerable overburden, except where outcroppings occur along the valleys of the Athabasca river and its tributaries.

Mining up to the present time has been carried out on a small scale, cutting back on the face of the outcroppings, but it is proposed to investigate the use of power shovels for this work.

The work on developing these sands is now being undertaken jointly by the Dominion Research Council and the Scientific and Industrial Research Council of Alberta, the latter being a committee appointed by the government of the province of Alberta, and whose activities are centred at the University of Alberta.

The Alberta organization is devoting its share of the work to the problem of extracting bitumen from the raw product, which is composed of 15 per cent bitumen and 85 per cent sand.

It was in 1920 that Dr. Clark first started his investigations and in the following two or three years he carried out many laboratory tests to determine the nature of the bitumen and the possible methods of treatment. Three general schemes of separation were considered; first: hot water separation; second: dissolving in organic material; third: retorting. The first method showed most promise and in 1923 a small experimental plant was erected at the University and good results were obtained. The process consisted essentially of mixing water glass solution with the raw sand which destroyed its viscosity, after which the bitumen was mixed in a jet of hot brine solution, and the sand permitted to settle, the bitumen rising to the surface of the settling tank and being scraped off as a scum.

The principle proved satisfactory and in 1925 a larger experimental plant was erected and 600 tons of sand were treated. Certain modifications in detail were effected, resulting in lower costs and better extraction. Last year the plant was moved to a point near Fort McMurray and was set up adjoining a quarry of sand which was suitably located near the railway. A few test runs were made before freeze-up and in 1930 it is hoped to carry out an extensive production programme.

The uses of the separated bitumen fall under two headings: road material and fuel.

Considerable experimental work has been done on various sections of Alberta highways and this material promises to play a large part in the future development of Alberta's rural highways.

Various oil refineries have investigated the possibilities of the bitumen as a fuel, and it has been found that it is readily treated by the existing cracking methods, and gives a high yield of good grade "anti-knock" gasoline.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

"The Progress of Aviation in Canada" was the subject of an address of unusual interest delivered before the Branch on January 22nd, by J. A. Wilson, A.M.E.I.C., Controller of Civil Aviation, Ottawa. The attendance taxed the capacity of the Y.M.C.A. banquet hall, and included not only members of the Branch but other prominent citizens, the staff of the local airport and almost the entire city council. M. J. Murphy, A.M.E.I.C., Chairman of the Branch, presided. During the evening the meeting was favoured with several excellent vocal selections by Mr. H. S. Austin.

The Progress of Aviation in Canada

Although the theory of flight had been known for many years, it remained for the Wright brothers to develop an engine light enough to make human flight possible. The new science progressed rapidly and by 1914 aviation was a recognized mode of transportation. During the war the scientific development of the airplane was interrupted. Since then enormous studies have been made, particularly in the United States and Europe.

In Canada, planes were first used in forest protection and exploration, a service which has now reached a high state of perfection. It was next employed by the surveyor in mapping unexplored sections of Canadian territory. Already the aviator has accomplished with his camera what would have taken 100 years to do if carried out by ordinary ground methods.

In 1927 the Canadian Air Mail was instituted, first for the benefit of parts of the country inaccessible by ordinary means, such as the Yukon and the winter service between Moncton and the Magdalenes. The air mail service has since been considerably extended.

Aviation is on the verge of great development, and that within the next two or three years. It will cost money but so do our railways, canals, telephones, etc., yet who would dispense with these. Our aerial progress depends entirely upon public opinion—"the man in the street" is the one who is to determine just how soon we are to take our proper place in the sphere of aviation.

Following Mr. Wilson's address, four reels of motion pictures were shown depicting aerial meets, parachute jumping, and also in a very graphic manner the use of the plane in fighting forest fires.

Brief remarks were made by Deputy-Mayor R. A. Frechet, Ex-Mayor C. H. Blakney, City Engineer J. D. McBeath, and Alderman Fred Brown of the Civic Airport Committee.

A vote of thanks on behalf of the Branch, moved by C. S. G. Rogers, A.M.E.I.C., and seconded by T. H. Dickson, A.M.E.I.C., was tendered Mr. Wilson by the presiding Chairman.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Montreal Branch was held on January 9th, and was honoured by the presence of the President, Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., Vice-Presidents Dr. O. O. Lefebvre, M.E.I.C., and W. G. Mitchell, M.E.I.C., and a number of members of Council.

The reports covering the activities of the Branch were read and will be found in the report to Council contained elsewhere in this issue. Appropriate remarks were made by the retiring and incoming chairmen, Messrs. J. A. McCrory, M.E.I.C., and D. C. Tennant, M.E.I.C., respectively.

General Mitchell, in addressing the meeting, referred to the many activities and their importance, emphasizing the necessity for increased financial support by the members. Charts and figures were shown, giving comparisons of expenditures of The Institute as compared to similar bodies in other countries.

Many other prominent members followed the President in urging the importance of raising more money for the support of The Institute's activities. A number of other important matters presently under discussion were also presented and explained to the meeting by the members of Council present.

Scientific Developments Leading to Sound Pictures

On the evening of January 30th, Mr. Paul B. Findlay, managing editor of the Bell Laboratories Record, delivered a most instructive address entitled, "Scientific Developments Leading to Sound Pictures."

Descriptions of the photo-electric cell; the string oscillograph, an instrument designed to record accurately and sensitively, alternating current wave forms used to test the new high-speed permalloy cables and their associated terminal equipment and mechanical resonators for analyzing complex currents, were given. Again emphasis was placed on the important part played by duraluminum which vibrates with the voice from the microphone, and on the intensive research work carried on in the Bell Telephone Laboratories of study of sound pressures and microscopic photography.

Mr. Findlay's explanation of the sound picture film was as follows:—Air-waves of the original sound create through the microphone, a faithful representation of themselves in an electric current. Enormously amplified, this current controls the intensity of a beam of light which is focussed on the moving films. After development and printing, the trace on the film constitutes, in its variation from light to dark, a record of the original sound waves. When this trace or sound track passes between a steady light and a photo-electric cell, the current from the cell is a copy of the microphone output. Again amplified, this current through loud speakers recreates the original sounds.

Through the courtesy of the Northern Electric Company, Ltd., a novel talkie picture was presented. This portrayed in an entertaining manner the different stages through which the "finished product" passed before completion.

Process of Zinc Coating Steel Wires

A paper entitled "The Process of Zinc Coating Steel Wires" was read by A. D. Turnball, S.E.I.C., before the Montreal Branch on January 16th, 1930.

The author, in his paper, referred to the following factors that influence the rate of corrosion of metals:

1. Chemical composition of the metal.
2. Contact with relatively electro-negative metals.
3. Stray currents.

4. Dissolved oxygen in moisture in contact with the wire.
5. Rate of motion of water in contact with the wire.
6. Acids, salts or alkalis in the water.
7. Previous rust conditions.
8. Temperature.
9. Physical condition of the metal.
10. Quantity of light falling on the metal.

It will be seen from the above possible causes of corrosion that the phenomenon is very complicated.

One of the methods of protecting iron wire from corrosion is by coating it with zinc, which gives an efficient protection as long as the zinc remains intact. Even though the zinc coating is scratched exposing the iron, the zinc being electro-positive to the iron protects the latter.

Zinc-coated wires may be classified as: (1) wiped wire; (2) unwiped wire; (3) annealed galvanized wire.

The first and second classes of wire are differentiated by the method of removing the wire from the zinc pan, while the third class covers wire that is heat-treated subsequent to the galvanizing process.

Iron and steel of the best grade should be chosen so as to eliminate the exaggeration of any defects while rolling from an ingot 2½ feet thick down to a ¼-inch rod. The ingots pass through the roughing rolls of the blooming mill and are then reheated and further rolled in the billet mill. The billets are again reheated and go to the rod mill to receive the last rolling operation. The rods are then passed to the wire mill to be acid washed or pickled. Twelve pickling vats will usually handle about 240 tons of rod in a 10-hour day. The pickling solution usually contains about 3 to 4 per cent sulphuric acid and is kept hot to accelerate the cleaning action which must be thorough to prevent trouble in the subsequent drawing and galvanizing operations. The pickling solution sometimes consists of cold hydrochloric acid, which greatly reduces the danger of dissolving out any iron carbides. The pickling acid is inhibited by the use of organic carbohydrates which prevent the action of the acid on the steel after the oxide scale has been removed. The rods are then washed and rusted, the rust acting somewhat as a lubricant in the subsequent drawing operation. The rods are then dipped in a hot lime solution and baked at about 400° F. to drive out any occluded hydrogen which might spoil the lubricant. The wire is then ready for the drawing operation. The wire-drawing dies consist of steel plates with holes of suitable size. The wire passes through successively smaller holes until it is of the desired size. The wire drawing lubricant may be either grease, soap, flour, graphite or lard depending on the type of metal, the condition of its surface and the purpose to which it is to be put. After the wire has been drawn to the desired size, it is ready for galvanizing.

In the galvanizing mill, the wire is annealed to reduce the ferrite and cementite to a finegrained austentite. This annealing is performed in pans of molten lead, and is continuous. The wires pass from the annealing bath over rollers to be air-cooled, into a tank of water to be washed, into an hydrochloric acid tank for cleaning and then into another wash-tank of water. The wires then pass into a fluxing tank containing either zinc chloride or sal-ammoniac, and are dried by passing over a hot metal plate.

The wires are now ready to be zinc-coated, two different methods being used according to whether the wire is to be "wiped" or "unwiped." The wire passes through a long bath of molten zinc. "Wiped" wire passes through two asbestos wipes to remove the excess zinc, leaving a coating that is comparatively high in iron. The wire then passes through a bath of cold water, or if a particularly tough coating is desired, the cooling bath is omitted, and the wire is then bundled. In "unwiped" wire there is no wiping action other than that caused by the surface tension of the molten zinc which forms a cone around the wire where it emerges from the zinc bath.

The zinc used in the galvanizing of wire should be of the best quality and cadmium-free, as cadmium affects the tightness of the coating. Lead impurities do not alloy readily with zinc and will settle to the bottom of the bath.

The thickness of the zinc coating may be tested by the Preese copper sulphate test or by the lead acetate test. The toughness may be tested by subjecting the wire to a wrapping test. Photomicrographs of "unwiped" wire show several layers of different alloys of zinc and iron as well as the layer of pure zinc.

Development of Communication Systems Throughout World

Mr. J. L. McQuarrie, vice-president and chief engineer of the International Telephone and Telegraph Company, presented on January 24th a comprehensive review of the development of communication systems throughout the world.

Charts and tables were presented showing graphic comparisons of the use of telephones in different cities and countries, indicated that European and other countries were for the most part very far behind Canada and the United States in this respect. Comparisons were also made between the extent and development of public and privately owned systems, the latter controlling 69 per cent and the former 31 per cent of the world's systems. Government control of communication predominated in Europe and was, in Mr. McQuarrie's opinion, largely responsible for the backwardness of development in those countries. On the other hand, the speaker pointed out that considerable progress was being made in long distance communication between the larger cities and from one country to another. An instance of this was that a person could speak from London to Madrid without difficulty.

The grouping of all kinds of modern communication methods into one system had reached a very advanced state and an experimental communication recently joined Stockholm with certain cities in the United States, a connection of over 14,000 miles, which used the telephone, radio-telephone, and submarine telephone cable, and excellent results were reported.

For twenty-four hour service, Mr. McQuarrie considered that it would not be possible to depend on the radio-telephone service alone, so that the day of the cable was by no means past. In fact, he believed it to be due for expansion in the near future and said that in two years' time there would be a telephone cable across the Atlantic. Volcanic submarine disturbances caused the greatest trouble to the cable companies. The most recent one having affected ten out of the twenty-one cables—and even with seven cable ships at work only four had been put in working order to date.

The extent of some of the various communicating mediums was illustrated by Mr. McQuarrie in the following statements, "Capital invested in radio telephone systems,—$200,000,000; annual messages transmitted between the continents of Europe and North America,—18,000,000; investment in submarine cable companies,—$450,000,000; miles of telegraph line in the world,—306,000; offices,—4,800; annual messages,—15,000,000; total investment,—$1,000,000,000."

A brief historical résumé, illustrated by slides was used by Mr. McQuarrie in introducing his talk, which was greatly appreciated by the large audience.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

Executive Meeting

An executive meeting was called for the afternoon of January 29th, to consider the questionnaire recently sent out by Headquarters.

Our Committee on Publications took grave exception to the manner in which this question has been dealt with and presented to the membership and particularly to the use of the word "demand" in paragraphs 3 and 19 which suggested that some Branch has been attempting to dictate to Council. The Committee advised in effect as follows:—

> This Branch has been advocating, not demanding, a change in the size and method of publishing the Journal, also a return to the issuance of yearly transactions. We have also pressed Council to thoroughly investigate the whole matter and lay the results before the membership at large with a view to getting a definite expression of opinion prior to attempting any change. To some members, transactions are valuable; others prefer to limit the size of their library and keep only such papers as are of particular interest to themselves.
>
> Quite appreciating the fact that the Journal almost pays its own way due to the revenue from advertising, yet we have submitted that the ultimate value to members should be the prime consideration. More and better papers will be sent in if the writers feel that such papers will become part of a permanent record and available to other societies for reference.
>
> With this in mind we have been consistently "advocating," for more than a year, that the Journal should be continued as a monthly publication but decreased in size to either 7″ by 10″ or 6″ by 9″ and that it be punched and bound in a manner suitable for tearing apart and thus incorporating individual papers in a loose-leaf system.
>
> Our reasons have been threefold; firstly that the smaller size is most suitable for the standard book-case; secondly that the punching will allow members to separate individual papers and file them in cardboard binders which could be supplied by The Institute at a cost of not more than ten cents each; thirdly, and most important, that no re-setting of type will be necessary in order to print the extra copies required to take care of the demand for yearly bound transactions or for individual papers and distribution to other societies.
>
> Value to our membership and to the public should precede the question of cost; and yet cost is important. Failing to get any detailed comparative estimates from Council, or from the committees appointed by Council, this Branch has made certain inquiries which lead it to believe that the net cost of issuing the Journal in the smaller size would be about the same as at present and not one-third more as indicated in the questionnaire. The size of the sheet is not so important to advertisers as the circulation and if the circulation can be increased through larger sales or distribution to outsiders then the value of the advertising space is increased. It has come to our notice that at least two privately owned technical publications of the smaller size subsist entirely on the revenue from their advertising pages. One of these magazines is published in Toronto and the other in Chicago.

This Publications Committee had also drafted a resolution of protest which was read and received the support of the twelve executive members present, who unanimously voted that it be forwarded to Headquarters.

The Future of Engineering

Professor C. R. Young, M.E.I.C., department of civil engineering, University of Toronto, was the speaker at a dinner meeting held by the Branch at Niagara Falls on January 29th. The meeting drew a larger attendance than was expected and consequently some of the wider or lengthier members laboured under a grave disadvantage at the tables. Despite this handicap however the meeting was voted a success and Prof. Young's speech was followed with close attention.

The first proceeding after dinner was in the nature of a presentation to our esteemed confrère Emmet Patrick Murphy, A.M.E.I.C., of semi-Irish extraction, who, according to newspaper reports, has recently resigned his position as canal manager in order to take over and fill the vastly more lucrative station of habour master at Port Colborne. With a few graceful words and gestures Chairman Cameron presented to this astonished young man a full-fledged H.M. regalia, or shipping toque, which will command the instant respect of every rum-runner on Lake Erie.

Probably the title of Professor Young's address held a promise of surprise or a hint of mystery which accounted for many turning out who had failed to send in their cards to the secretary. The Professor however, at the start, disclaimed any pretentions to necromancy and explained that he proposed to deal with the subject in the only way a true engineer could comprehend—that is to say by the use of a curve projected into space. One feature of this method, he went on to say, was that no one would be in a position to contradict either his axioms, his hypothesis or his finally proved conclusions.

The commencement of his curve was laid in or about the year 175C. There were no civil engineers at that period, or at least the men who did engineering work were not known by that name. "Undertakers" was what the public called them—men who "undertook" to design, carry out and personally supervise, with the limited technical data at their disposal, the construction of canals, bridges, dykes and other progressive or constructive works. Civil engineering was not then a profession; many of these early builders were projected, or rather self-ejected, from entirely different pursuits because of some inherent spiritual quality which demanded that they should turn their attention towards subduing the forces of nature and making them available for the use of man.

James Brindley was a millwright before he constructed the Bridgewater canal and the Barton aqueduct; Smeaton and Watts were instrument-makers; William Edwards was the son of a farmer and later becoming a mason built the famous Pont-y-Prydd arch of 140-foot span after two failures; John Metcalf was a blind carrier and yet he is known as the pioneer of highway engineers; truth was that society—particularly literary society—did not recognise engineering as other than a species of manual labour and, as such, looked down upon it; thus the "commoner" was the only class fit or willing to tackle such problems.

This state of affairs lasted well into the nineteenth century when the advancement of education and the experiences of the past masters led to an accumulation of data which formed the basis of a new science—the science of engineering.

From about the year 1850 the curve has taken on a strong upward trend and the rate of increase has been especially marked, therefore with the aid of few sound premises and facts the future is not so very hard to read.

John Perry popularized calculus and this much maligned branch of mathematics is one of the absolute essentials in real scientific progress despite the attempts to side-step it by some educators.

An intense mechanization of society has been in progress during the last half century and we cannot stop; Stuart Chase has estimated that we are now employing some one and a half billion horse power on this little sphere or the equivalent of nine billion tireless slaves. It has been so easy and it is still so easy to create these mechanical servants that why indeed should we stop?

Many are the ways to be yet devised whereby other forms of energy may be harnessed and made available as power.

Big business is now recognizing the value of the engineer, of his scientific training, and employing him in greater and greater numbers at either executive work or in pure research.

Engineers are no longer traitors to the profession who forsake the slide-rule and transit for other fields of constructive usefulness where their scientific training counts for what it is worth. As many as 20 per cent of the Toronto graduates find their life work in business careers and a personal friend of the speaker has discovered that the larger department store contains many scientific problems.

It is significant that practically all the corporations which have made the greatest strides during the last few decades are those which have employed engineers and given them positions of responsibility. This is true not only of railways, municipalities, mines and such like but also of banks, bond houses, real estate, chain stores, moving pictures and other industries not commonly associated with civil engineering in the stricter meaning of the term.

There is a particular reason for this, namely that an engineering training demands exactness. Elbert Hubbard once said that a successful business man is one who guesses right more than 50 per cent of the time, but the engineer must do better than that; he is accustomed to dealing with an exact science where it is useless to guess and still less to bluff, he is not satisfied unless he is right nearly 100 per cent of the time because otherwise natural laws would quickly call his bluff.

These are some of the reasons why we see fewer consulting engineers than we did say 20 years ago. Regular work and regular salaries as executives or research workers in the larger industries are absorbing the best brains of the profession with mutual benefit.

With this in mind the present trend of university teaching is to give a broad training in the fundamentals of the science rather than to attempt the teaching of practice which is continually changing. The young man who graduates with the fundamental laws firmly fixed in his mind can enter practically any walk in life with the very best chance of success. The department of civil engineering in the University of Toronto is merging four fourth year options with this object in view.

Not all engineers have executive ability. Some of the most famous like Watt and Steinmetz were primarily interested in engineering as a science and cared little for the concrete results of their labour, but the great majority of engineers should be trained, or train themselves, to direct.

One of the prime requisites of an executive is that of being able to choose assistants wisely and then of being able to unload responsibility upon their shoulders. No man can successfully direct any large enterprise such as say, the Welland ship canal, and burden himself with detail. Thrust responsibility upon a good man and he will rise to it, withhold responsibility, or fetter him with restrictions, and he will either break away or deteriorate. Sir Joseph Flavelle has made his name great as an organizer by devoting his interest to the selection of his subordinates rather than to the exact details of how they performed their tasks.

The engineer should also cultivate his moral characteristics, should be dependable and imbued with resourcefulness, frankness and tact. The latter is becoming of more importance now that the trend is from the field to the office. The "rough diamond" character can be vastly improved upon and better results obtained by smoothness rather than forcefulness.

In moving a vote of thanks Mr. F. S. Lazier said that Professor Young had drawn an extremely rosy picture and one which held out great encouragement to every engineer. Personally he felt a distinct relief at hearing of the diversified pursuits which engineers could enter and still retain the right and privilege of being accepted as a brother by engineers. Since that time a few years ago, when he had changed his status from engineer to contractor, he had felt much tribulation which was now lifted. Mr. E. P. Johnson, another ex-chairman, seconded the motion and the meeting adjourned with a feeling that it was indeed a matter of pride and joy to belong to the ranks of this noble profession and with expressions denoting many a secret resolve to "hit the boss for a raise in the morning."

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

Development in the Mining Industry

A regular meeting of the Branch was held on Thursday, January 23rd, 1930, at which W. R. Rogers, B.Sc., A.M.E.I.C., Director of Publications and Statistics of the Department of Mines, Toronto, and Chairman of the Toronto Branch of the Canadian Institute of Mining and Metallurgy, gave an interesting address on the above subject.

Mr. Rogers' paper was of a very comprehensive nature, dealing with all aspects of the mining industry in a general way. The four stages of geological growth of the North American continent were illustrated by slides, and it was shown that of the total pre-Cambrian area of the world, in which all famous metal mines are found, some two million square miles are located in Canada. Many details and statistics of the production of copper, silver, nickel and gold were given, commencing with the discovery of copper and nickel in Sudbury in 1887, the Cobalt area in 1904, and the Porcupine gold district in 1910.

It was pointed out that although gold still heads the list in value of output, it is probable that with the increasing variety of uses for nickel, this metal will soon become the leader. Particulars of the enormous deposits at the Frood mine and the great expansion occurring there at the present time were given.

With regard to iron, the present situation is that Canada imports approximately one and one-quarter million tons of ore per annum from the United States, but attention is being given to the possibility of beneficiation of the vast quantities of available Canadian ore.

The speaker dealt briefly with non-metallic minerals, such as gypsum, building stone, traprock, lignite, etc., the total value of which is about 30 per cent of the mineral output of the Dominion.

The address was followed by an interesting discussion, during which Mr. Rogers answered many questions. B. Ottewell, A.M.E.I.C., acted as Chairman for this meeting, and the vote of thanks was proposed by A. L. Killally, M.E.I.C., and heartily approved.

The Age of Speed

Mr. Phillip N. Cooke and Mr. M. N. Smith, of the Norton Company of Hamilton, carried on a very instructive meeting on the above subject, before the Branch on February 13th, 1930.

Mr. Cooke read a paper on the scope of the grinding industry of to-day. This paper outlined the manufacture and application of the modern grinding wheels. Particular attention was paid to the unusual developments in abrasives and bonds.

The importance of research was stressed and it was pointed out that this was necessary to meet the new demands of the present designs of grinding machine tools, particularly those that have hydraulic speeds and feeds.

Full and semi-automatic, and centreless grinding machines have made necessary extensive research to provide wheels that will meet new conditions.

Four reels of film were projected illustrating many applications of the grinding wheels in industry. These illustrated the application of grinding wheels directly or indirectly in the production of almost every commodity. The manufacture of grinding wheels was illustrated from the raw material to the finished product.

A discussion following the picture brought out the importance of the grinding industry to the low cost and low maintenance expense in connection with internal combustion engines. The balance of the discussion related to questions pertaining to local grinding problems.

A short film entitled "The Thirtieth Part of a Hair" was also shown. This picture show how precision grinding machine tools are being manufactured to limits of accuracy down to one ten-thousandth of an inch.

Mr. Cooke spoke as follows:—

"I know you will all agree with me that grinding today is now one of the major machining operations. Forty years ago it was not known except for the application of the clumsy independable sandstone. The grinding industry can be truly said to be only 45 years old. We can also say that the greatest strides in the industry have occurred since 1914, the outbreak of the war.

"The precision, external cylindrical grinding machine came into existence at the very early part of this century. At first it was a machine for fine finish and accuracy, but never a production tool. Today grinding machines of all descriptions, external cylindrical, internal cylindrical, plain surface grinding, and off-hand snagging machines are all production tools.

"There would be no exaggeration in the statement that the motor car, so common in use today, would cost from eight to ten times more than it does, if it were not for the grinding machine and the grinding wheel. That would assume that the present rate of production would be maintained even at those high selling prices, which of course would be impossible. Then too, without the grinding machine and the grinding wheel, other methods of machining could never produce the working parts in a gasoline engine of the refinement and accuracy that are required to give the motor long life with continuous use. Every year we expect our purchase of an automobile will provide a steady increase in number of miles before the car must be replaced. This has been a part of our education to expect the car to be better each year and so it has proved itself. We can all remember when 10,000 miles was considered excellent for the use of a car without an overhauling and yet today we know of cars that are running several times that with hardly any maintenance expense. Let me assure you, gentlemen, that the grinding industry is to a great measure responsible for this remarkable improvement in motor car performance. We say this in no way attempting to steal the laurels from other industries who have likewise contributed in a large way to this improvement in service.

"It will interest you to know that in the United States the grinding wheel alone has become more than a $25,000,000 commodity in annual sales, and there is at least one individual concern in the United States who can be reckoned as a million dollar consumer.

"The enterprising grinding wheel manufacturer must be ever alert and his research must be unending. New machine tools are continually appearing on the market which introduce new problems to the wheel manufacturer. New alloys of steel or other metals continually introduce new problems and wheels must be manufactured to meet the changing conditions everywhere. The most striking example of a new problem coming before the wheel man is the very recent introduction of tungsten carbide as a cutting tool, known under the trade names of "Carboloy," "Widia" and several others. This gave the wheel man a real problem but it has been quite satisfactorily solved and today tungsten carbide metal can be ground very successfully.

"Centreless grinding machines, automatic cylindrical machines, automatic internal machines, hydraulic table traverses and feeds, have all introduced new problems for the wheel man within the last few years. New wheel processes have had to be developed to meet all these different conditions. Of late we hear a lot about high speed grinding. Until comparatively recently a wheel that travelled between 5,000 and 6,000 surface feet per minute was about the maximum for any grinding wheel. A few rubber-bonded wheels have been used for some years back which were strong enough to operate safety at 9,000 feet per minute, but now with the introduction of Bakelite as a bond, there are many grinding operations performed with wheels operating at 9,000 feet per minute. We are going to hear more about this as time goes on. We do not believe that the surface has been scratched with the high speed wheel idea. We are convinced that the removal of metal is proportional within limits to surface speed and if the metal is there to be removed, the high speed wheel is going to rapidly replace the former 6,000 feet per minute type.

"Lately perhaps you have heard of cutting-off wheels, wheels that are made extremely thin, 3/32, 1/16 or less, running at 12,000 to 15,000 surface feet per minute. For cutting off certain materials you can readily imagine the speed and economy of the work done in this manner.

"Production grinding jobs in a manufacturing plant should constantly be studied with the greatest care. With new abrasives at the disposal of the wheel man, new bonds for manufacturing the grits into wheel shapes, new structures that are coming more and more under exact control, there are bound to be possibilities for decreasing factory costs. Any production grinding items should be continually checked to make sure that the lowest possible cost is present. As engineers, I know you will agree with me, that a grinding wheel that shows maximum life in hours service is not necessarily, and in fact is seldom, the most economical wheel to use. We may say that the longer the life the slower the cutting ability within limits of course and that if we could plot a curve with rate of metal removed per unit of time on one axis and hours life on the other, we are going to get a distinct curve which will first start up at a definite rate and reach its maximum point sloping rapidly down again toward the horizontal axis as the life of the wheel is increased.

"Many grinding wheel users will talk hours life as the measure of the wheels' performance but we are happy to say that more and more we hear of rate of metal removal as a proper measurement rather than hours in service.

"In the reels of pictures we will have the pleasure of illustrating grinding wheels in use varying in cost from 15 cents each to $6,000 each. We will show you operations where manufacturing limits are specified in tenths of thousands. It is common commercially to grind to .0002 inch. It will probably interest you to know too that in the machine shops of the automobile manufacturers who are placing the lowest-priced cars on the market today, are many grinding operations where these limits are specified and are definitely held."

Every person attending this meeting seemed to be particularly interested in the subject under discussion.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

About forty members were present at the regular dinner meeting of the Branch, held at the Kitchener hotel, Regina, on January 24th, 1930. Stewart Young, A.M.E.I.C., acted as chairman in the absence of Chairman H. R. Mackenzie, A.M.E.I.C.

Engineers' Legislation

P. C. Perry, A.M.E.I.C., chairman of the Legislation Committee, reported progress on the bill respecting the engineering profession in Saskatchewan. The bill has been drafted and reviewed by the committee and will be placed in the hands of counsel with instructions to pilot same through the Committee of the Legislature.

Dinner to Dr. W. C. Murray—President University of Saskatchewan

On February 27th, a dinner will be given at the Saskatchewan hotel, Regina, in honour of Dr. Walter C. Murray, President of the University of Saskatchewan. H. R. Mackenzie, A.M.E.I.C., chairman of the Branch, will attend this function as a representative of The Institute. The following resolution voicing the opinion of this organization with respect to the public services of Dr. Murray was unanimously passed at the regular meeting of the Branch:—

"We, the members of the Saskatchewan Branch of The Engineering Institute of Canada, take this opportunity of placing on record our appreciation of the eminent services rendered to this province and the Dominion of Canada and to the cause of education in general by Dr. Walter C. Murray, President of the University of Saskatchewan.

"During the twenty-one years in which he has acted as president of our provincial university we have seen many changes and improvements and none more striking than the rapid progress which the university has made under his guiding hand until to-day it is everywhere recognized as one of the leading educational institutions on the continent.

"We as engineers are particularly concerned with engineering education and view with much satisfaction the achievements of the faculty of engineering."

The Nipawin Bridge

H. D. Brydone-Jack, A.M.E.I.C., assistant engineer, Canadian Pacific Railway, next gave an interesting address on the Nipawin bridge which has just been completed.

Designed to take the heaviest locomotives likely to be built, this magnificent structure, a little more than 1,907 feet long, spans the North Saskatchewan river at a point leading from the more definitely agricultural section into timber and mining districts of recognized magnitude. It will afford ready access to still unexhausted farm lands and direct transportation possibilities for those who will explore and develop mineral expanses rich in promise.

This bridge was begun in October 1928 and is one of the exceptionally large steel structures in the west. In symmetrical spans it connects the north and south banks of the Saskatchewan at about 150 feet above water level of the river. It provides not only railroad transit calculated for 60,000 pounds axle load on the engine drivers, but is made in double-deck fashion with a 16-foot highway for vehicular traffic on the lower chords designed for 15-ton loading.

This steel roadway, built on a creosoted understructure with a two-inch untreated wearing surface, will carry the Saskatchewan government's provincial highway across the river. Legislative forces co-operated with the railway company in relieving a situation which naturally proved a hindrance to agricultural development.

Mr. Brydone-Jack reviewed briefly the method of erection, the difficulties met with and illustrated his remarks by snapshots taken during the course of erection.

It was necessary that the five main piers, three of which are in the water (requiring cofferdams) be completed above water level during the winter of 1928-29. For this purpose four pile drivers, three clam shell excavators and five electric pumps were used. A steam generating plant supplied power for the mixers, hoists and for the heating of the materials used in the concrete.

Most of the work was carried out from trestles extending across the river. A 2,000-foot cableway 85 feet high, capacity 6 tons, extending from the high river banks was used to transport men and materials. All gravel was supplied by gravity to the mixers, after which it was elevated to the cableway by a small hoist.

Considerable difficulty was experienced in finding a suitable supply of gravel, but this was ultimately obtained from Foam lake, Sask. It contained much fine material and a high proportion of cement was therefore necessary to obtain the desired strength for the concrete.

The excavation for piers and approach on the south shore of the river was rendered difficult owing to boulders etc., but these only extended to a depth of four or five feet. Below this was a very hard blue clay which had to be bored and blasted as the clam shell excavators would not operate in it. A primitive test of the bearing pressure of this clay was carried out which showed no settlement whatever.

The cofferdams were erected after the river froze up. Two rows of Lackawanna steel piling were driven with the pile drivers. This allowed the cofferdams to be satisfactorily drained. The depth of the water at the three piers in the river was respectively twelve feet, five feet and five feet.

The concrete in all piers was poured in the winter season before the ice in the river broke up. One pier was poured in three days. Movable forms were used. By spring all piers were up 30 to 40 feet, the forms removed and noses protected by steel. The ice went out very gently on May 2nd and 3rd, 1929, after which the tops of the piers were completed.

By August 1st the foundations were completed and erection of the steel commenced by the Dominion Bridge Company on August 5th. Falsework was erected on all except one span where the cantilever system was used. A travelling crane weighing 90 tons when loaded was used on this work.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting was held in the Y.W.C.A., on January 24th. C. H. E. Rounthwaite, A.M.E.I.C., chairman of the Branch, presided.

Mr. J. Kelleher, manager of the Superior Alloys, addressed the meeting on the subject, "Electro-Chemical Appliances." He traced the growth of the electric furnace from its beginning, where a battery of dry cells furnished the energy, through the various stages to the present. At first they were all of the arc type and many of these are in use at present. The speaker himself was more interested in the resistance type of which the electric lamp and the electric stoves are examples. In the furnace as developed by Mr. Fitzgerald, a pure graphite element was used and temperatures so high were obtained that the refractory was melted.

A porcelain kiln was developed with temperatures up to 1,800° C. for making spark plugs. The electric furnace was recently adapted to firing ceramics and with such success that where formerly three dozen green pieces were required to ship one dozen, with the electric furnace but thirteen pieces were required to ship a dozen.

The chief advantage of the electric furnace lies in the ability to control the heat exactly, continuously, and automatically. In conclusion the speaker mentioned some products of the electric furnace, as tungsten filaments, grinding wheels, fertilizer, case hardening compounds, etc.

A short discussion followed.

A vote of thanks was tendered Mr. Kelleher, for his excellent talk on motion of Messrs. Jenkinson and Seymour.

W. S. Wilson, A.M.E.I.C., chairman of papers committee, reported a paper on snow removal for the near future and a paper on "Insulating Materials and General Insulating Practice," by Mr. Jas. Govan, expected about second week in February.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
Archie B. Crealock, A.M.E.I.C., Branch News Editor.

A meeting of vital interest to engineers was held by the Toronto Branch on January 9th, when Mr. J. W. Kelly of the Portland Cement Association came from Chicago to deliver a lecture. The title of Mr. Kelly's paper was "The Internal Structure of Concrete." As this subject is of general interest to contractors, etc. as well as engineers the meeting was an open one and it was largely attended by representatives from all branches of the profession.

Mr. Kelly in introducing his subject said that probably a better title for his paper would be "How can we make better concrete?" The speaker then made a brief basic analysis of the make-up of concrete in which he showed how the complete process of making concrete consisted of three stages—materials—proportions—and field methods of manufacture. First of all Mr. Kelly described the part played by the cement industry in the studies made by them to produce a better cement and also of the investigations carried out on aggregates as well as the study of the concrete itself, especially with regard to durability.

In elaborating on the subject of durability Mr. Kelly stated "that during the past year alone, more than two hundred surveys were made of the condition of existing structures in all parts of the country, including dams, bridges, pavements, seawalls and other structures subject to severe exposure. These surveys will soon be published, but for the present it is safe to say that they have simply confirmed our laboratory researches, with the added conclusion that improper construction methods are responsible for the greater percentage of all unsatisfactory concrete work."

Following this the speaker then took up the question of curing or protection of concrete during its early life, and also the effect of vibration on dry mixes. A description of the research work on the fire resisting qualities of concrete was then outlined.

Continuing, Mr. Kelly stated that in practically all of the cases of unsatisfactory concrete which had come to their attention the cause of the trouble had been found to be a result of either an improper mix or poor placing and curing and that a realization of the joint responsibility for good quality on the part of the owner, engineer, architect, contractor, cement manufacturer, machinery and accessory manufacturer, inspection organizations, and allied interests is necessary to produce good concrete. It is impossible to cover the complete story of the making of concrete in this brief talk except to say: use standard cement, clean and sound aggregates, proportion with as little water as possible, be sure to have a plastic mix, mix well, handle and place without allowing separation of the materials, don't overpuddle or overfinish, and by all means cure or protect the concrete from drying out as long as possible.

A description of some of the more common faults of concrete then followed and were subdivided under the usual headings of materials, proportions and field methods and a description of how to obtain and the pitfalls to be avoided in obtaining a high quality concrete. In concluding his address Mr. Kelly referred to the excellent specification recently issued by the Canadian Engineering Standards Association.

A fitting vote of thanks was tendered to Mr. Kelly for his interesting and educative address which had been thoroughly enjoyed by all those present.

A Pioneer Canadian Industry

"A Pioneer Canadian Industry" was the title of an interesting paper presented to the members of the Toronto Branch of The Engineering Institute on the evening of Thursday, January 23rd, 1930, by Mr. C. E. MacDonald of the International Nickel Company of Canada, Limited.

In his address Mr. MacDonald first gave an historical sketch depicting the trials and failures incident to the establishing of the nickel industry in Canada from the time that Mr. S. J. Ritchie obtained control of the Copper Cliff, Stobie No. 2 and the Creighton mines in 1885. In the following year the Canadian Copper Company was formed by Mr. Ritchie to take over these mines and later the Frood and Evans mines were acquired, the Frood mine being one of the richest mines ever discovered anywhere. In February 1889 the first smelter commenced operations with a capacity of 150 tons per day. A second furnace was added the same year and the plant rapidly developed to a capacity of 700 tons of ore per day.

Considerable trouble was experienced in the early stages in obtaining a refining process that was satisfactory and finally after much experimenting the process developed by the Oxford Copper Company of New Jersey was adopted. This is the process in use to-day but with many changes and improvements. The second major handicap that faced the builders of this industry was that now they could extract and refine the nickel in their mines the market for it was very limited being only about 1,000 to 1,500 tons in 1890 or less than the amount produced in the same year by the New Caledonia mines. Following an intensive campaign by Mr. Ritchie, United States navy finally adopted nickel steels for their armaments and they were closely followed by the French and British navies. In 1902 the International Nickel Company was organized and secured entire control of the Oxford Copper Company, the Canadian Copper Company and several other companies interested in nickel so that they now controlled the refinery end and the disposal of the metal as well as the production. Mr. MacDonald then showed some 70 slides which visualized the complete industry from the mining operations to the finished product. These were all ably described with particular attention to the refinery at Port Colborne. Following this a description of the various nickel alloys with the particular uses to which each are employed was given as well as the uses of pure nickel and from this description one wondered if there was any metallic substance in use to-day that did not contain nickel in some degree. The lecture was thoroughly enjoyed by all those present and a hearty vote of thanks was tendered to Mr. MacDonald for his address.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Wanted

ELECTRICAL ENGINEER, M.Sc., A.M.E.I.C., graduate, seven years experience in high tension calculation design and construction, seeks connection with consulting engineer. Present employed, married, age 30. Apply Box No. 7-W.

CHIEF ENGINEER, twenty years industrial construction, production and operation. Structures, equipment, steam, hydro. Experienced in conferences, preliminaries, organizing, preparing plans, estimates, specifications, negotiation contracts. Apply to Box No. 36-W.

CIVIL AND MECHANICAL ENGINEER, aggressive practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mill, desires change. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

MECHANICAL ENGINEER, with twenty years experience in design, construction, sales and management desires position of an engineering, commercial or executive nature. College graduate, M.E.I.C., M.A.S.M.E., M.P.E.Q., and formerly chief engineer. Apply to Box No. 92-W.

RETIRED LIEUT.-COMMANDER, Canadian, aged 32, A.M.E.I.C. Specialized in engineering from executive rank. Two years and six months chief engineer marine 31,500 s.h.p. Desires position with manufacturing or business concern in Montreal—management. Apply to Box No. 106-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal exgineering, construction work, inspection, estimating. Opening sought with architects as reinforced concrete designer and engineer; other opening considered. Toronto-Hamilton area preferred. Apply to Box No. 107-W.

CIVIL ENGINEER, graduate '26, with fair knowledge of French. Experience as instrumentman on surveys, maintenance engineer on railway construction, and resident engineer on railway construction. Available at once. Apply to Box No. 149-W.

GRADUATE ENGINEER, University of Sask. '25, age 26, desires position. Experience includes one year surveying, one year architectural draughting, three years general construction draughting and superintendence and two years paper mill design and maintenance. Services available immediately. Apply to Box No. 150-W.

ELECTRICAL ENGINEER, B.Sc., E.E., A.M.E.I.C., Canadian, age 29, single, graduate Canadian university 1924. Have been with large power company in U.S.A. since graduation, ten months on sub-stations, remainder of time on design, construction and operation of overhead and underground distribution and transmission system. At present employed by same company. Would like return to Canada. Available on reasonable notice. Apply to Box 236-W.

Situations Wanted

CIVIL ENGINEER, with office in Toronto and extensive connection, is in a position to act as agent for contractors' equipment, building materials or allied lines, or would consider position as sales engineer with large manufacturer or distributor. Apply to Box No. 311-W.

INDUSTRIAL ENGINEER, thirty-five years of age, graduate of a well-known university, twelve years experience in design, construction, maintenance and changes in production methods in industrial plants, including several years in pulp and paper industry in complete charge in large mills of all engineering, maintenances, and development work; still engaged; desires to establish new connection. Apply to Box No. 320-W.

CIVIL ENGINEER, B.A.Sc., A.M.E.I.C., M.P.E.O., age 37, desires a permanent position as chief draughtsman or plant engineer, preferably in Toronto or district. Seventeen years experience with consulting engineers on industrial, structural and railway work, hydro-electric plants and pulp and paper mills. Some mechanical and electrical experience. Apply to Box No. 332-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country; twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Province. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, graduate '29, desires engineering position with possibilities of advancement. Work in hydro-electric, construction, municipal, railroad, or mining preferred. Past experience consists chiefly of survey work. Location in western provinces preferred. Apply to Box No. 338-W.

CIVIL ENGINEER, B.Sc., fifteen years experience, including surveying, construction, mining and tunnelling. Available at once. Will go anywhere, but prefer Eastern Canada. Apply to Box No. 346-W.

MECHANICAL ENGINEER, Jr.E.I.C., Irish, age 28, graduate '27, seeks connection in British Columbia, varied outdoor and indoor experience. During vacation and since graduation in mechanical, electrical and civil engineering. Versatile, intelligent, and quick to learn. Fast and accurate with slide rule transit T-square or electrical equipment. Prefer maintenance or research work or any opening with opportunity for advancement. Apply to Box No. 349-W.

MECHANICAL DESIGNER, 33 years of age. First class English and Canadian experience (Rolls-Royce, Ford, Platt Bros., G. M. C.) on special machine tool jig and tool designing, maintenance, and production methods; excellent references; desires position. Montreal district preferred. Available immediately. Apply to Box No. 351-W.

Situations Wanted

CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Apply to Box No. 352-W.

SUPERINTENDENT, competent electrical superintendent, wishes position with large industrial or power supply company. New construction programme preferred. Experienced in engineering, designing and electrical construction of power houses, sub-stations and industrial control work. Available on short notice. Apply to Box No. 353-W.

CIVIL ENGINEER, graduate A.M.E.I.C., P.E.Q., with sixteen years varied field experience on construction and building work of all types, mostly with contractors' organizations, seeks opening as superintendent or engineer, preferably in Quebec or Eastern Ontario. Apply to Box No. 354-W.

INSTRUMENTMAN, with a total of five years experience in railroad and highway construction, desires a position which holds some prospects for advancement. Would prefer work in Ontario, but not essential. Permanent work most desirable. Apply to Box No. 355-W.

ELECTRICAL ENGINEER, graduate McGill Univ. Experience, draughting, checking, short wave radio research, radio operating (ship and shore), demonstrating, electrical measurements and radio laboratories, department electrical engineering; at present demonstrating physics department. Desires position with opportunities, preferably radio work. Location immaterial. Apply to Box No. 356-W.

CIVIL AND STRUCTURAL ENGINEER, B.Sc., M.E.I.C., and A.M.Inst.C.E. Exceptionally thorough mathematical and theoretical training, 20 years experience, Canada and abroad. Railway location and construction, specialized in bridge and structural design, steel and reinforced concrete, design and construction of harbour and dock works, water and sewerage, grain elevators and industrial buildings, specification writing. Nine years of experience with engineers and contractors, engineering, superintending and estimating, considerable executive work. Just completed engagement on large project. Apply to Box No. 357-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., is open for engagement. Twenty-four years general experience both as engineer and as contractor. Has specialized in the construction of wharves, dams, foundations, etc. Apply to Box No. 358-W.

ELECTRICAI ENGINEER, graduate N.S.T.C., Halifax, 29 years of age, two years experience in power transmission and distribution with a large power company in province of Quebec, two years electric test and inspection, W.E. and Mfg. Co., East Pittsburgh, Pa., one year electrical maintenance in large mill. Experience with telephone transmission, sub-station layout, electrical installation and layout for factories. At present employed. Apply Box No. 361-W.

MINING ENGINEER, graduate, age 32, A.M.E.I.C., ten years experience in design, construction, erection and maintenance of paper mill and mine buildings and machinery. Several years on hydro-electric work in charge of surveys and investigation; desires permanent connection with mining or paper company. Apply to Box No. 362-W.

Situations Wanted

ELECTRICAL ENGINEER—Part time work wanted by experienced graduate electrical engineer. Reports, designs, layouts, power factor, relay and short circuit studies. Apply to Box No. 364-W.

Situations Vacant

STRUCTURAL DRAUGHTSMEN, experienced in detailing steel for industrial plants, city buildings or bridges, for a bridge company located in Winnipeg. Give age, experience, whether married or single, and other particulars to Box No. 474-V.

MECHANICAL ENGINEER, about 35 years of age, with experience in pulp and paper mill maintenance, and to take charge of small construction work in connection with mill. Location Western Province. Apply to Box No. 492-V.

CHEMICAL ENGINEER. Large newsprint company in St. Maurice Valley desires recent graduate in chemical, electrical or mining engineering, who would like to make a permanent connection with the industry. Good living conditions. Apply to Box No. 495-V.

ELECTRICAL ENGINEERS. Wanted, two young electrical engineers with about two years experience since graduation, for three to four months survey of large distribution and transmission system in province of Quebec. Work may result in permanent employment. State experience and salary expected. Apply to Box No. 496-V.

SALES ENGINEERS. Two experienced industrial paint salesmen wanted by a large paint manufacturing company; one for Toronto City, one for London and Border Cities. Applicants should state fully experience, names of three references. Apply Box No. 497-V.

Situations Vacant

DESIGNING ENGINEER, capable of handling details problems or general layout work in a large newsprint mill centraly located. Only men with at least five years experience in this line need apply. State fully experience and salary expected. Apply to Box No. 498-V.

TOWN MANAGER—A new mill town in northern Quebec requires a young civil engineer as town manager. French-Canadian with fluent knowledge of French and English essential. Previous experience in municipal work preferable. State full particulars in application. Apply to Box No. 500-V.

DESIGNING DRAUGHTSMAN wanted by a large pulp and paper mill, ideally situated. The work will comprise general drawings and details for building construction and alterations. Applicant should be able to design reinforced concrete and structural steel. State age, education, experience, salary desired, and other particulars. Apply to Box No. 503-V.

ENGINEER, wide awake and progressive, preferably technically trained man with several years sales experience, familiar with sanitary requirements of municipal and industrial water systems. Submit with application complete details of education and positions held to date. Apply to Box No. 505-V.

DRAUGHTSMEN. Experienced in A.C. and D.C. machines, switchboard wiring diagrams and station arrangements, industrial control apparatus. State age, experience in detail, and salary expected. Location, central Ontario. Apply to Box 506-V.

GRADUATE MECHANICAL ENGINEER required, preferably single man about twenty-five years of age, with special training, operation, maintenance boiler plant equipment. Preferably junior engineer who has completed apprenticeship course offered by Babcock-Wilcox or other boiler manufacturers. Applicant please state particulars, experience, references, etc. Location Mexico. Apply to Box No. 507-V.

RECENT GRADUATE, in electrical or mechanical engineering, for general industrial work. Work part in office and part in the plant. Must be competent to do transit work and levelling in connection with laying out new building sites. Location, Northern Quebec. Apply to Box No. 508-V.

MECHANICAL DRAUGHTSMAN wanted, with good technical training and acquainted with heavy duty cranes, regulating gates, movable bridges, etc. Not over 30 years of age. Apply, giving full personal particulars and salary expected, to Box No. 509-V.

DRAUGHTSMEN—One or two good draughtsmen familiar with heavy wood mill construction. Acquaintance with gold milling desirable but not essential. State age, education, experience, references, if employed, married or single, salary wanted, and how soon you can report, to Box No. 510-V.

CIVIL ENGINEER, with mechanical experience in construction and maintenance work for a pulp and paper company in southern Ontario. Apply at once to Box No. 512-V.

CONSTRUCTION ENGINEER, on hydro-electric power development; capable of taking charge of laying out of work. Reply, stating experience, age and salary. Apply to Box No. 513-V.

MECHANICAL ENGINEER, graduate with three or four years experience in industrial plant maintenance, for metallurgical plant in province of Quebec. Permanent connection for right applicant. Please give complete information. Apply to Box 516-V.

SEALED TENDERS addressed to the undersigned and endorsed "Tender for Esplanade Wharf Reconstruction, Cobourg, Ont.," will be received until **12 o'clock noon, Thursday, March 20, 1930,** for the reconstruction of Esplanade wharf, at Cobourg, Northumberland County, Ont.

Plans and form of contract can be seen and specification and forms of tender obtained at this Department, at the offices of the District Engineers, Equity Building, Toronto, Ont.; Toronto Builders Exchange and Construction Industries, 1104 Bay Street, Toronto, Ont., and at the Post Office, Cobourg, Ont.

Tenders will not be considered unless made on printed forms supplied by the Department and in accordance with conditions contained therein.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, equal to 10 per cent of the amount of the tender. Bonds of the Dominion of Canada or bonds of the Canadian National Railway Company will also be accepted as security, or bonds and a cheque if required to make up an odd amount.

Note.—Blue prints can be obtained at this Department by depositing an accepted cheque for the sum of $20.00, payable to the order of the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,
N. DESJARDINS,
Secretary.

Department of Public Works,
Ottawa, February 27, 1930.

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for a Strauss Trunnion Bascule Bridge, Burlington Channel, Ont.," will be received until **12 o'clock noon, Tuesday, March 25, 1930**, for the construction of a Strauss Trunnion Bascule Bridge, at Burlington Channel, Wentworth County, Ont.

Plans and form of contract can be seen and specification and forms of tender obtained at this Department, at the offices of the District Engineers, Equity Building, Toronto, Ont.; Postal Station "H," Montreal, P.Q.; Toronto Builders Exchange and Construction Industries, 1104 Bay Street, Toronto, Ont., and Builders Exchange, 118 New Birks Building, Montreal, P.Q., also at the Post Office, Hamilton, Ont.

Tenders will not be considered unless made on printed forms supplied by the Department and in accordance with conditions contained therein.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, equal to 10 per cent of the amount of the tender. Bonds of the Dominion of Canada or bonds of the Canadian National Railway Company will also be accepted as security, or bonds and a cheque if required to make up an odd amount.

NOTE.—Blue prints can be obtained at this Department by depositing an accepted cheque for the sum of $25.00, payable to the order of the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,
N. DESJARDINS,
Secretary.

Department of Public Works,
Ottawa, March 3, 1930.

Institute Committees for 1929

FINANCE

G. R. MacLeod, Chairman
J. L. Busfield
F. A. Combe
F. C. Laberge
F. P. Shearwood

LIBRARY AND HOUSE

W. C. Adams, Chairman
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Preliminary Notice

of Applications for Admission and for Transfer

February 24th, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in April 1930.

R. J. DURLEY, *Secretary.*

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* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

> The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

CARR-HARRIS—GORDON GRANT MACDONNELL, of Kingston, Ont., Born at Kingston, Ont., April 23rd, 1897; Educ., 1915-16, R.M.C., Kingston, Dec. 1916, took R.E. Commission; 1922-23, 1st and 2nd years, Mech'l. Sciences Tripos, Cambridge University; 1924-25, School of Military Engrg., Chatham, England; 1916-19, overseas. C.F.A. and R.E. Italian "Al Valore" Medal, 1918; 1915, geod. survey party, Quebec-Maine border; 1916, hydrometric survey, St. Lawrence River; 1920-22, ap'ticeship, engr. and traffic depts., South Eastern and Chatham Rly.; 1926-27, instr'man., city engr's office, Vancouver; 1928-29 (summers), instr'man., Ont. Prov. Highway Board; 1927 to date, asst. professor, civil engrg., Royal Military College, Kingston, Ont.

References: E. J. C. Schmidlin, L. F. Grant, G. A. Walkem, H. F. J. Lambart, O. T. Macklem.

GILLESPIE—JAMES, of 54 Belcourt Road, Toronto, 12, Ont., Born at Cromarty, P.O., Ont., Sept., 10th, 1895; Educ., B.A.Sc. (Hons.), Univ. of Toronto, 1921; Summer work: 1919, bridge inspr.; 1920, timekeeper and material man, bridge constrn.; 1921, head chainman, twp. outline survey, No. Ont.; 1922, 23, 24, 25, res. engr., 1926, bridge designer, concrete bridges, A. W. Connor, M.E.I.C.; 1927, municipal drainage surveys, estimates, reports, etc., S. W. Archibald, A.M.E.I.C.; 1928, waterworks and sewers, design, Blind River, F. A. Dallyn, M.E.I.C.; 1929, steel design and detail, automotive bldg., A. W. Connor, M.E.I.C.; 1929, municipal drainage, S. W. Archibald, A.M.E.I.C.; 1922-27 (Sept.-June each year incl.), instructor, dfting., applied mechanics, structural design and steam engrg., and 1927 to date, director of engineering, Central Technical School, Toronto, Ont.

References: A. W. Connor, J. T. Belcher, C. B. Ferris, N. L. Crosby, J. J. Spence.

HOPKINS—CECIL GEORGE, of Toronto, Ont.; Born at Waterford, Ont., Jan. 22nd, 1900; Educ., Hamilton Technical School, 1914-15; Special course, D.S.C.R., 1920-21; 1915-19, overseas; 1919-20, surveying, Speight & Van Nostrand; 1921-23, on bridge and dept. constrn., Dept. Public Highways, Ont.; 1923 to date, plans and field work for rural distribution in elect'l. engr. dept., H.E.P.C. of Ontario.

References: C. B. Ferris, W. B. Redman, A. Hay, A. LeP. Clifford, C. Anderson, T. H. Hogg, A. V. Trimble, W. G. Hewson, J. W. Falkner, W. Harland.

LEGATE—JOHN JAMES deCONLAY, of 1714 Dorchester Street, Montreal, Que., Born at Warwick, Queensland, Australia, April 13th, 1907; Educ., 1921-25, Saint John High School, Saint John, N.B.; 1926-27, instr'man., Gatineau-Toronto Transmission Line, H.E.P.C. of Ontario; 1927 (July-Nov.), instr'man., Crown Land surveys; 1928 (Apr.-Sept.), chief of party, track mtce., C.P.R., 1928-29, junior engr., John MacGregor Limited, contractors and engrs.; 1929 (Feb.-Dec.), asst. res. engr., gen. constrn., and in charge of investigation survey on the Tusket power development, Nova Scotia Power Commission; at present, with Arthur Surveyer & Co., Consltg. Engrs., Montreal, gen. asst., estimating, valuations and dfting.

References: J. E. Sproule, H. S. Johnston, J. A. Grant, R. M. Legate, A. M. James, S. L. Fultz.

McDONALD—DONALD JOHN, of Montreal, Que., Born at Glen Nevis, Ont., Dec. 7th, 1903; Educ., B.Sc., Queen's Univ., 1926; 1926-27, test course, General Electric Company, Schenectady, N.Y.; 1927-29, on staff of transmission engr., and from 1929 to date, on staff of transmission engr. of eastern area, at present responsible for foreign wire relations, Bell Telephone Company of Canada, Montreal.

References: D. M. Jemmett, L. M. Arkley, D. G. Geiger, J. L. Clarke, G. A. Wallace.

PRENDERGAST—RALPH MACAULEY, of 138 Second Avenue, Ottawa, Ont., Born at Toronto, Ont., Jan. 18th, 1899; Educ., B.A.Sc., Univ. of Toronto, 1921; 1918 (summer), operator in power house, Orillia Light & Power Commn., Swift Rapids, Ont.; 1919 (summer), machine tool operator, Chapman Ball Bearing Co., Toronto; 1920 (summer), meter inspr., H.E.P.C. of Ontario, at Chatham, and from May 1921 to Oct. 1922, meter inspr. at Belleville; Oct. 1922 to June 1923, test. dept., Can. Gen. Elec. Co. Ltd., at factories in Peterborough and Toronto, and from June 1923 to date, with same company as sales engr., in Toronto, Montreal, and Ottawa.

References: J. E. St. Laurent, S. J. Chapleau, C. R. Coutlee, V. Meek, N. Marr.

TYRER—THOMAS GEORGE, of 2708 Regina Ave., Regina, Sask., Born at Halifax, Yorks., England, March 29th, 1884; Educ., Private study—articled to W. M. Stewart, A.M.E.I.C., 1916-23. Sask. L. S., 1923. Qual. Lieut., 1926, Capt., 1928, Royal School of Military Engrg., Esquimalt, B.C. 1927 to date, active command 14th Field Co., C.E.; 1900-11, plumbing and sanitary engr. contractor, Formby, England; 1912-16, bookkpr., dftsman and transitman, Phillips, Stewart & Lee, Civil Engrs., Saskatoon, Sask.; 1917-19, overseas; 1919-21, transitman i/c survey party, on rly. work, road work and gen. survey, for Phillips, Stewart & Lee; 1921-23, transitman, dftsman and checker, and from 1923 to date, Sask. Land Surveyor and asst. field inspr., Surveys Branch, Land Titles Office, Regina, Sask.; 1923-26, engaged on special survey, City of Regina, and 1923 to date, gen. land survey investigation work dealing with field work inspection, plans, etc., re land titles; special survey investigation re court cases, inquests, etc., involving field work for preparation of plans showing profiles, cross sections, etc., for submission to court as expert witness.

References: W. M. Stewart, A. C. Garner, R. W. E. Loucks, G. R. Chetwynd, R. H. Murray, S. Young.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

BOWMAN—HENRY ALEXANDER, of Winnipeg, Man., Born at London, England, August 13th, 1855; Educ., Private tuition; 1902 to date, with Dept. Public Works of Manitoba, as follows: 1902-04, asst. engr.; 1904-10, engr. in charge D.D. No. 4, D.D. No. 6, and municipal work; 1910-12, office engr.; 1912-13, acting deputy minister; 1912-18, acting chief engr., public works; 1918 to date, chief engr., reclam. branch, Dept. Public Works, Winnipeg, Man.

References: E. E. Brydone-Jack, J. G. Sullivan, T. R. Deacon, C. H. Attwood, E. W. M. James.

DESSAULLES—HENRI, of 99 Maple Avenue, Shawinigan Falls, Que., Born at St. Hyacinthe, Que., Dec. 1st, 1879; Educ., B.A., B.Sc., 1903, Ecole Polytech., Montreal; 1901-02 (summers), instr'man and concrete inspr., and May 1903 to Sept. 1904, constrn. and office work, Shaw. Water & Power Co.; 1904-05, instr'man., Nat. Transcon. survey; 1905-06, inspr. on constrn. for architects; 1906-08, transitman and res. engr. on constrn., Quebec, Montreal & Southern Rly.; 1909 to date, with Shawinigan Water & Power Company as follows: 1909-11, on engrg. staff, constrn. work and transmission lines surveys; 1911-13, constrn. of Manonan River storage dams and in charge of surveys for Gouin dam; 1913 to date, local agent and res. engr., in charge of real estate, house constrn. and general supervision, at Shawinigan Falls, Que.

References: J. C. Smith, J. Morse, S. Svenningson, F. S. Keith, C. R. Lindsey.

McCOLL—CHARLES ROSS, of Sandwich, Ont., Born at Chatham, Ont., July 20th, 1881; Educ., B.Sc., Queen's Univ., 1908. O.L.S. 1909; 1908-13, chief asst. to (late) Owen McKay, C.E., Walkerville, Ont., who was engaged in a general practice as an Ontario Land Surveyor and Civil Engineer; 1914 to date, general practice as an Ontario Land Surveyor and Civil Engineer, from 1916 to date, engineer for town of Sandwich, in full charge of all work.
References: J. J. Newman, M. E. Brian, H. W. Patterson, W. J. Fletcher, R. J. Desmarais, C. G. R. Armstrong, O. Rolfson, J. Clark Keith.

TAYLOR-BAILEY—FRANK WHITHAM, of 1321 Sherbrooke Street West, Montreal., Born at Montreal, March 7th. 1891; Educ., B.Sc., McGill Univ., 1916; 1916-19, overseas, Can. Engrs., Capt., M.C.; 1916-17, in charge of constrn. of 13 aerodromes for War Office; 1919-20, mech'l. engr., Eastern District, D.S.C.R. With Dominion Bridge Company, Montreal, as follows: 1908-12, dftsman., summers, 1912-15, checker, 1915-16, designer; 1920-24, asst. to gen. mgr.; 1924 to date, in charge of sales; at present, vice-president.
References: F. P. Shearwood, D. C. Tennant, F. Newell, G. H. Duggan, L. R. Thomson, L. R. Wilson.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

JULIAN—FENNELL T., of Woodstock, Ont., Born at Brampton, Ont., August 31st, 1896; Educ., B.A.Sc., Univ. of Toronto, 1920; 1916-19, overseas. Can. Engrs.; 1920-21, H.E.P.C. of Ontario—St. Lawrence investigation, junior engr., river metering and backwater studies; 1921 to date, foreman and supt., with J. A. Vance, A.M.E.I.C., gen. contractor, Woodstock, Ont., in charge of various works, bldgs., bridges, waterworks, sewers, etc.
References: J. A. Vance, W. G. Ure, J. R. Rostron, W. R. Smith, M. C. Hendry.

MARCH—JOSEPH WADE, of Gaspe Basin, Que., Born at Bridgewater, N.S., March 28th, 1896; Educ., B.Sc. (C.E.), N.S. Tech. Coll., 1923; 1912 (summer), rodding and instr'ment work, 1913 (summer), inspecting highway constrn., and culvert bldg., N.S. Highway Dept.; 1914-15, and summers 1920-21-22, instr'man. for town engr. of Bridgewater and Lunenburg, with private practice; 1916-19, overseas; 1923-24, survey, erection and inspection of 66,000 volt transmission line, Nova Scotia Power Commission; 1924-25, i/c of field party obtaining topography, laying out town, etc., Corner Brook, Nfld., for Pickings & Wilson, Halifax, N.S.; 1926-28, instr'man., extension of paper mill, International Paper Co., Three Rivers, Que.; 1928 (Feb.-May), dfting office, International Fibre Board Co., Gatineau, Que.; 1928 (May-July), investigation, Campbellton mill site; 1928-29, i/c instrument party on constrn. of N.B. International Paper Co., Dalhousie, N.B.; at present, investigation of mill site, Gaspe, Que., for Canadian International Paper Co.
References: A. I. Cunningham, R. P. Freeman, C. St.J. Wilson, F. R. Faulkner, L. H. Robinson.

MITCHELL—JOHN CLARENCE, of Toronto, Ont., Born at Kingston, Ont., Sept. 12th, 1894; Educ., B.A.Sc., Univ. of Toronto, 1921; 1912-14, surveys, P.W.D. and Dept. of Interior; 1919-22, bldg., bridge and dam constrn.; 1922-26, engrg. office, and 1926-29, asst. mech'l. supt., Sarnia Refinery, Imperial Oil Refineries, Limited, Sarnia, Ont.; 1929 to date, engr. in charge of constrn. and mtce., Domestic Storage & Forwarding Co. Ltd., Toronto, Ont.
References: T. Montgomery, C. B. Leaver, C. R. Young, J. P. Anglin, H. B. R. Craig, F. W. Farncomb.

WALKER—MELVYN LOTHIAN, of 690 Wilson Avenue, Montreal, Que., Born at Bristol Twp., Que., March 16th, 1894; Educ., B.Sc., (Mech.), McGill Univ., 1919, extension course in struct'l. design, "Theory of Internal Work," Univ. of Michigan; 1920 (summer), dftsman., Brompton Pulp & Paper Co., East Angus, Que.; 1920-25 designer, Imperial Oil, Ltd., Sarnia, Ont.; 1925-27, design of high pressure central station boilers, heat balance calculations, etc., Detroit Edison Company, Detroit; 1927-29, mech. engr., constrn.-mtce. divn., Packard Motor Car Co., Detroit; August 1929 to date, mech. engr., Dominion Rubber Company, Montreal, engrg. investigations and reports, supervising, design and layout of equipment (plant).
References: T. Montgomery, A. R. Roberts, C. M. McKergow, R. Ford, J. A. Coote, T. M. Moran.

WOOLWARD—CHARLES DESMOND, of 3618 Oxenden Avenue, Montreal Que., Born at Port of Spain, Trinidad, B.W.I., Oct. 3rd, 1896; Educ., B.Sc., McGill Univ., 1922; 1916 (summer), checker on munition work; 1916-19, overseas, C.E.F., 1920 (summer), instr'man. on track work, Montreal Tramways; 1921 (summer), Hollinger Gold Mines; 1922-23, track mtce. with C.N.R., Montreal; 1923-25, steel design with John S. Metcalf Co., Montreal; 1925 to date, general design with the Foundation Company of Canada, Ltd., Montreal, Que.
References: H. M. MacKay, W. Walker, C. E. Herd, G. J. Dodd, R. E. Chadwick, W. Griesbach, R. DeL. French.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BOULTON—BEVERLEY KNIGHT, of Beauharnois, Que., Born at Ottawa, Ont., Oct. 27th, 1903; Educ., B.Sc., McGill Univ., 1925; Summer work; 1923, rodman and part time instr'man., Quebec Development Co., on constrn. of Isle Maligne development; 1924. elect'n. and conduit boss for same company; 1925, elect'n. on P.H. constrn. for same company, and asst. to power house supt., Duke-Price Power Company; 1925-26, with Quebec Development Company as engr. in charge of constrn. of 154 k.v. transmission system for Duke-Price Power Co. Ltd., and also as office engr.; 1927, engr. in charge of design and constrn. of 110 k.v. transmission system, and 1927-29, elect'l. engr. at Arvida, Que. for Duke-Price Power Co.; Nov. 1929 to date, elect'l. engr., Beauharnois Construction Company, Beauharnois, Que.
References: W. S. Lee, F. H. Cothran, D. F. Noyes, C. V. Christie, R. E. Parks.

BOWMAN—RONALD FRASER PATRICK, of Lethbridge, Alta., Born at Lethbridge, March 17th, 1904; Educ., B.Sc., Univ. of Alberta, 1928; 1920-21-22 (summers), rodman on location and constrn., Lethbridge Northern Irrigation District; 1923 (summer), rodman, New West Irrigation Dist., Vauxhall; 1924-25 (summers), rodman, doing instrument work, Alberta Highways Dept.; 1926-27 (summers), transitman, mtce. of way, C.P.R., Cranbrook, B.C.; May 1928 to date, transitman, mtce. of way, C.P.R., Lethbridge, Alta.
References: H. R. Miles, G. N. Houston, T. Lees, F. Lee, R. S. L. Wilson, R. W. Boyle, F. W. Alexander.

BRYANT—JAMES SANBORN, of 6973 de la Roche Street, Montreal, Que., Born at Montreal, Nov. 16th, 1900; Educ., B.Sc. (E.E.), McGill Univ., 1927; 1921-22, telephone exchange install'n., Northern Electric Co., and three summer vacations, long distance install'n. for same company; 1926-27, elect'l. prospecting; at present, ap'ticeship course, Southern Canada Power Company, Montreal.
References: J. S. H. Wurtele, D. Anderson, J. H. Trimingham, G. H. Kohl, J. F. Roberts.

CRAIG—JAMES WILLIAM, of Ottawa, Ont., Born at Halifax, N.S., Feb. 12th, 1906; Educ., B.Sc., 1925, B.E., 1927, Univ. of Sask.; 1924-27, lab. instructor, Univ. of Sask.; Summer work: 1925-26, statistics, Dept. Municipal Affairs, Regina; 1926, recorder, Geod. Survey of Canada; 1927, field and lab. asst., Bureau of Labor and Industries, Regina; 1927-29, ceramic engr. on special lab. research, National Research Council, Ottawa; 1929 (Aug.-Dec.), ceramic engr., Dept. Mines, Mines Branch, Ottawa; at present, ceramic engr., research investigation, National Research Council, Ottawa, Ont.
References: C. J. Mackenzie, W. G. Worcester, G. M. Williams, J. McLeish, H. B. Brehaut, J. J. White.

GOOD—EARL FRANKLIN, of Toronto, Ont., Born at Doon, Ont., Feb. 6th, 1900; Educ., B.A.Sc., Univ. of Toronto, 1924; 1921 (summer), yard checker of bldg. materials, Hollinger Gold Mines; 1922 (summer), dftsman., for Herbert Johnston, O.L.S., Kitchener, Ont.; 1923 (summer), instr'man., and 1924 (May-Nov.), asst. to dist. engr., Dept. of Northern Development of Ontario, Muskoka and Parry Sound; 1925 (Feb.-June), i/c of field party for Warner & Warner, of Detroit, Mich.; 1925-29, struct'l. design of bldgs., for Smith, Hinchman & Grylls, Detroit, Mich., also some field work pertaining to above bldgs.; May 1929 to date, struct'l. design of bldgs., for Messrs. Harkness & Hertzberg, Toronto, Ont.
References: A. H. Harkness, C. S. L. Hertzberg, H. C. McMordie, D. T. Welsh, W. A. M. Cook.

HAGUE—EDWARD COUSINS, of Montreal, Que., Born at Montreal, Nov. 15th, 1902; Educ., B.Sc., McGill Univ., 1923; 1923-26, telephone switchboard engrg., asst. engr., broadcasting station C.H.Y.C., asst. engr. gen. communications lab. work; 1926-27, asst. engr., line survey and final install'n. of carrier telegraph and telephone repeaters for Can. National Telegraphs, and asst. engr., carrier telegraph and carrier telephone systems, all with Northern Electric Company, Ltd., Montreal; Oct. 1927 to date, research engr., with Victor Talking Machine Company of Canada, Ltd., in charge of all engrg. and lab. work connected with manufacture of radio receivers, electric phonographs and elect'l. phonograph recording.
References: P. F. Sise, W. C. Adams, H. J. Vennes, W. B. Cartmel, J. G. Bishop.

MITCHELL—JAMES MURRAY, of 596 Lansdowne Avenue, Westmount, Que., Born at Westmount, Aug. 27th, 1900; Educ., B.Sc., McGill Univ., 1923; 1918 (summer), stillman, Can. Electro Products, Shawinigan; 1919 (summer), lab. asst., Milton Hersey Co., Montreal; 1923-24, material testing, Quebec Development Co., Isle Maligne; 1924-25, student engr., and from 1925 to date, district traffic supt., Bell Telephone Company of Canada, Montreal.
References: C. M. McKergow, R. DeL. French, H. G. Cochrane, H. M. MacKay, J. S. Brisbane, N. E. D. Sheppard, E. Brown, E. L. Zealand.

PEACH—WILLIAM HERBERT, of Port Arthur, Ont., Born at Gopsall, Leicestershire, England, Feb. 1st, 1903; Educ., 1915-17, George Dixon Secondary School, Birmingham, England; 1917-19, gen. asst. to res. engr., on rly., canal, dock and bridge constrn., also ironstone mining, for Logan & Hemingway, Rly. & Public Works Contractors, Doncaster, England; 1922-23, (4 mos.), asst. to bldg. constrn. engr. on yard constrn., C.N.R.; 1923 to date, on design and supervision of grain elevators, C. D. Howe & Company, Port Arthur, Ont.
References: C. D. Howe, W. H. Souba, M. H. Jones, J. M. Fleming, F. C. Graham, G. H. Burbidge, M. W. Jennings.

STEEVES—SAMUEL MERRITT, of Ottawa, Ont., Born at Dorchester, N.B., Sept. 29th, 1897; Educ., B.Sc., Univ. of Man., 1925; 1916 (6 mos.), rodman, Dept. Rlys. and Canals, Cape Tormentine: Summers: 1917-18, student asst., Geol. Survey: 1918-19, rodman, C.N.R., Port Arthur; 1920-24, student asst. Geol. Survey; 1925-28, junior topog'l. engr., and 1928 to date, topog'l. engr., i/c party, Geol. Survey, Ottawa, Ont.
References: W. H. Boyd, D. A. Nichols, J. N. Finlayson, L. L. Bolton, J. V. Butterworth, N. M. Hall.

STYLES—HUGH JOHN, of 5 Geneva Street, St. Catharines, Ont., Born at Arnprior, Ont., Sept. 30th, 1898; Educ., B.Sc., Queen's Univ. 1929; 1917-19, mechanic, McLaughlin Bros., Arnprior, Ont.; 1926-27 (summers), elect'l. mfg., English Electric Co., St. Catharines, Ont.; 1928 (summer), hydro-electric development, Shawinigan Engrg. Co.; 1929 to date, elect'l. inspr., and testing, Welland Ship Canal, St. Catharines, Ont.
References: D. M. Jemmett, A. J. Grant, A. L. Mudge.

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CONTENTS

Volume XIII, No. 4

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The Engineer's Work in Surveying and Mapping

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INTRODUCTION

It is a difficult task to prepare a paper on the mapping of Canada so as to give a true conception of what is the very foundation of the orderly and economic development of our great country. The mapping of half a continent is an undertaking requiring the utilization of all resources of the science of surveying and mapping.

Today we live in a world built upon engineering work and it would seem that particularly in a young country like our own — rich in so many undeveloped natural resources — our future growth and expansion must primarily depend upon the work of engineers and surveyors. No engineer would commence to develop an estate without first having a plan to show what there is to be developed, and it is equally true that a country cannot be developed economically without accurate maps.

When Jacques Cartier discovered Canada in 1534, he saw perhaps a few hundred square miles of it and no doubt in some rough way mapped as much.

When the first French explorers travelled up the Ottawa river and put it on the map they, in a sense, rubbed the philosopher's stone and created something new in our universe. Since that time explorers, surveyors and engineers have expanded our great country by putting it on the map until in area it is the third largest country in the world.

Looking at the best map available today of Canada and noting the vast blank spaces, some of them of the size of the province of New Brunswick, we feel that they are well described by two lines of a well-known poem by Robert W. Service —

"There's a land where the mountains are nameless,
And the rivers all run God knows where."

Turning to the map of New France, 1754, showing the latest discoveries of La Verendrye and other French trader explorers, it will be realized how much of our country had not yet been brought into existence by the map-makers. Or to get down to more practical facts, explorers' reports written so recently as from 1840 to 1860, described what are now the great wheat growing lands of the west as an arid or a semi-arid waste, and stated that there was no practicable route from east to west through British territory. And to go a step further and come a little closer to home, it is still possible to step into an aeroplane, travel for a period of perhaps an hour and a half and within a hundred and fifty miles of Ottawa or Montreal reach a district of which no reasonably accurate map is yet available.

Just as the necessity exists for mapping the outlying and unknown districts, so it exists also for more detailed mapping of the older districts already settled and partly developed, because as development progresses the need increases for more accurate and more complete maps. In the newer districts a map may be satisfactory if it serves the requirements of the forester, the geologist, the builder of power transmission lines and the like; in the settled districts the map to be sufficient must serve the requirements of the drainage engineer, the road builder, the water supply engineer and many others.

In order to indicate that the necessity for good maps is not peculiar to Canada a short extract from a recent report of the Royal Survey Department of Siam may be quoted as follows:

> "Not only is science in general benefitted, but every branch of the industrial and commercial development of a country is advanced, if good topographical maps of the area of operations are available. The general administration in all its branches, the location of railways and highways, the planning of schemes for water supply, for irrigation, and drainage projects, the installation of electric transmission lines, even the location of the boundaries of reservations and holdings are all dependent on the supply of good topographical maps. Therefore, in order to mobilize all the available resources of this country and to enable them to be exploited to the best advantage, it is expedient that all the territory within its borders should be triangulated and topographically surveyed at the earliest possible date."

MAPS NECESSARY FOR DEVELOPMENT

In addressing a body of professional engineers it is probably quite unnecessary to stress the importance of accurate mapping as a prerequisite and basis for the economic development of the country. But it is a gospel that requires to be preached, because many people do not realize that to try to develop a country without accurate maps is as unsound, and usually in the end as costly, as starting to develop a mine without first diamond drilling.

The history of what has been done in the past by Canadian engineers and surveyors, in building up the maps of the country, is more than interesting — it is inspiring. Engineers are always leading in development and are perhaps more interested in the present and the future, than in the past. This paper will therefore attempt to give a statement descriptive of all the different kinds of maps we have in Canada, and what their particular features are. This is a difficult task, due to the many requirements which exist, and the resulting variety of maps.

To indicate the present situation, however, it may be noted that surveys made especially for the production of maps are now generally carried on by departments of the Federal Government and also by some of the provincial departments. While this paper is largely a description of the undertakings of the Federal Government, there must be no misunderstanding as to the valuable work which has been done and is being done by surveyors and engineers employed by provincial departments, because they are all contributing a very generous share in the work by co-operating in every possible way, and the provincial cadastres have been of inestimable value as control for mapping work.

Provincial Land Surveys

As the provincial cadastres or legal land surveys have been so freely used for developing our earliest accurate maps and as they constitute the basis of all legal titles to land, it may be of interest to indicate the extent to which they have been developed in different parts of the country.

Our garden province of Prince Edward Island has the distinction of being the one where the cadastre has been laid down most completely over all of it. In Nova Scotia the cadastre covers about 17,828 square miles, or 83 per cent of the province, the uncompleted portions being along the central ridge of the peninsula. The cadastre in New Brunswick covers, with more or less completeness, the whole of the province. In our largest province of Quebec, the cadastre covers about 55,000 square miles, or only 10 per cent, the remainder being accounted for in the vast areas still untouched and roughly speaking lying north of the latitude of lake St. John. The Ontario cadastre covers 131,000 square miles, representing 32 per cent of the total area, and includes broadly the portion south of the Canadian National Railway. In Manitoba the cadastre covers 55,080 square miles, or 22 per cent, the area north of the

Figure No. 1.

north end of lake Winnipeg being as yet untouched except for a shoe string along a part of the railway to Churchill. In Saskatchewan 116,340 square miles, or 46 per cent, represents the area of the cadastre which covers approximately the south half of the province. In Alberta the cadastre covers 111,555 square miles, or 44 per cent, including all of the prairie lands and extending northwards into the Peace river district. The area of the cadastre in British Columbia is 44,744 square miles, or 13 per cent, scattered through the fertile valleys and in general south of the Canadian National Railway running to Prince Rupert.

Classes of Maps

The maps now available may be roughly divided into three classes. First of all, there are the small scale maps—say from thirty-five miles to one hundred miles to an inch—of Canada, which show its full extent in outline, but as they progress from the developed, or partly developed areas in the south to the undeveloped, or largely undeveloped areas in the north, they show only the meagre detail, usually as supplied by explorers who have perforce had to keep to the coast-line, or main inland waterways. Then secondly, there are what might be termed medium scale maps of provinces or rectangles, varying in scale from four to perhaps twenty miles to the inch. These maps have been compiled from the best information available and they contain considerable detail, but not always reliable as to accuracy, and again in parts and usually as they go farther north, the information shown is less accurate and less complete in detail. And thirdly, we have the accurate topographic maps based on mapping surveys complete in detail and consistently so throughout any sheet.

A predominant distinction in this rough classification is that the first two are maps compiled in the office from all available sources of information. They are reliable and accurate when the information available is so, but obviously they must fail when the information available is not reliable. And it will be obvious that maps produced in this way are not consistent as to completeness and accuracy throughout. Judged by the strict standards of what a complete geographic map should be, they are not good maps, but they are the best obtainable, and therefore, by comparison, they are very good. There is no doubt that the compilers who have prepared these maps have used great skill and knowledge in their production, and when one thinks of the difficulties of the early explorers and those who have executed what field work has been done upon them, the maps are indeed a monument to their skill and endurance. It must be remembered that, because we have such an immense country with so small a population, it is always a pressing and real necessity to consider economy in expenditures for mapping work, and to use a nice discrimination in determining what kind of map is justified for the different parts of the country. It would not, for example, be reasonable or economical to produce an accurate one-mile map in Baffin island, and in the far north districts the existing maps may be adequate to meet the present requirements. There is little doubt, however, that with regard to the closer-in parts of our unsettled areas, where there is presently being carried on so much prospecting and development, we are behind-hand with maps that are adequate to assist in orderly and economical operations.

The main distinction of the third class of topographic maps is that they are based on mapping surveys executed for the purpose and they are consistently complete and accurate throughout.

Summarizing the last few paragraphs, it will be seen that Canada is in size the third largest country in the world. It comprises an area of 3,684,723 square miles. Of this area about 525,046 square miles or 14 per cent have been accurately mapped. We have maps showing considerable detail, but inaccurately, of an additional 487,559 square miles, or about 13 per cent, and there remains about 2,672,118 square miles, or 73 per cent, of which our maps show only the most meagre outlines of the coast-line and the main inland waterways.

Canadian Practice Up to Date

It will no doubt be apparent to those who study the following descriptions of our typical maps, that Canadian mapmakers are keeping well abreast of the times and that their methods in general represent the best practice of the day. The most outstanding innovation and improvement of recent times has been in the application of aeroplanes to, and the use of air photographs in, mapping work. In this field Canada has been particularly to the fore in developing methods of technique specially suited to her requirements, and it may be said without fear of contradiction that, as regards the actual application of the new methods and the actual production of maps made from air photographs. Canadian surveyors and engineers have done far more than those of any other country in the world.

Standardization of Measures of Length

All lengths measured by Canadian surveyors and engineers are based on the legal standards of the Dominion for the yard and the meter. The reference standards are metal rules of the type usual in laboratory operations of first order precision. These rules have been compared directly with the legal Dominion standards, in the custody of the Department of Trade and Commerce, as well as with prototypes of the British Imperial Yard and of the International meter. They have also been directly compared with the standards of the United States. In this way, and by periodical study, the accuracy of these reference standards is ensured.

There is maintained at Ottawa a physical testing laboratory which is equipped with apparatus for verifying and comparing primary standard rules, and with a reference base for determining the lengths of field tapes. The base consists of a series of concrete piers, set at four-meter intervals, each pier bearing a polished and finely graduated plate forming a bench mark. By means of an Invar (36 per cent nickel-iron alloy) rule, four meters long, the length of the whole base can be measured, one pier interval at a time. Micrometer microscopes are employed in the operation, and an adjustable bench-mark provides means for verifying tapes the length of which is not an exact multiple of four meters.

As the base is housed in an insulated building (having no windows) and provided with electrical heating under thermostatic control, in addition to determining the lengths of tapes at one temperature, it is possible to repeat the operation at different temperatures and determine the thermal dilation coefficients of measuring tapes.

The Problem of Projection

The earth being round, and maps being flat, a difficulty arises, for it needs little consideration to see that it is impossible to represent a spherical surface on a flat plane, without distortion of some kind. The larger the area the greater the distortion would be. In a small area, such as one degree of latitude or longitude, or less, there will be no appreciable distortion; but if a map is to include several degrees, the difference between the curved surface and the plane will begin to manifest itself; whilst in the case of a large area, such as a continent or a hemisphere, the distortion must become very serious.

To meet this difficulty we must resort to the use of some form of map projection. Map projection is the art of depicting on a flat sheet the features of a spherical surface by means of some consistent mathematical formula.

Various Purposes Served

In Canada, there is a great variation in the type of country to be mapped, which is apparent to anyone who travels on one of our transcontinental railways from Montreal to Vancouver and observes the wide differences between the rough tree-covered lands in the east, the smooth and treeless plains of the middle west and finally the mountain regions.

Many different methods have been developed by Canadian surveyors and engineers in order to overcome the difficulties and peculiarities of the different types of terrain. It is to be noted, however, that there are two major divisions of the work which are common to them all. The first necessity is to establish accurate control by which the four corners of the map sheet can, as it were, be pinned down into their proper position on the surface of the earth, and also to provide fixed points from which the features in the interior of the map sheet may be placed in their correct relative positions. And following and dependent on this is the work of locating and drawing in by the use of standard conventional signs all the details of the topography.

Geodetic Control

That country is fortunate in which it is possible to inaugurate a geodetic survey preceding development. Subsequent surveys are connected to the main framework, the governing survey prevents the accumulation of errors and discloses mistakes in surveys made with a lower degree of precision, the effect of any errors is confined to the area between the governing points, surveys for all development purposes, land settlement, irrigation, railways, water-powers, etc., can be co-ordinated and the results of each made available to the greatest extent for the other. The economies which such a policy renders possible save the cost of a geodetic survey many times over.

Vertical Control

As early as 1883 precise levelling had been executed by a federal department in connection with Dominion Government improvements, and subsequently that department has carried on precise levelling mainly in the vicinity of the St. Lawrence river and the Great Lakes. However, nothing in the nature of a national system of levels existed and, prior to the furnishing of vertical control by the federal Geodetic Survey, each engineering project—railway, hydro-electric development or engineering scheme of a municipality—was ocmpelled to take whatever datum was available, or, as was generally the case, to assign an assumed elevation to an initial bench mark, thus marking the beginning of a new arbitrary datum. It was not unusual to find in our larger cities as many as six different datum points, with consequent confusion. To remove this chaotic condition and to co-ordinate such discordances in a country extending 4,000 miles in length, was no mean task.

The geodetic organization started precise levelling in 1906, beginning at Rouses Point, New York state, from a bench mark established by the United States Coast and Geodetic Survey. As the demand for vertical control was received from all parts of the Dominion, the levelling operations were carried simultaneously into the Maritimes, Ontario and Quebec, the Prairie provinces and British Columbia. It was not until 1916 that a transcontinental line of Canadian levels was completed, connecting the Atlantic to the Pacific.

When precise levelling was started in Canada it was manifestly impossible to publish adjusted values, although such values are superior to the observed instrumental values as they represent the composite mean of all instrumental determinations. Accordingly, unadjusted instrumental values for the elevations of bench marks were released as soon as possible after field operations. These values were held until 1928, when the precise level net of Canada was sufficiently developed to permit one general adjustment, and adjusted values of the elevations of the bench marks were then published. This information was issued in nine volumes, grouped geographically according to provinces and these publications are now available for distribution. The amount of precise levelling, which has been carried out almost entirely along railways, has now reached a total of 23,800 miles.

At the same time the need for vertical control in districts untouched by railways led to the establishment of a secondary grade of control levelling of a standard slightly lower than precise. These secondary levels have, in general, been carried over highways and are adjusted to the standard datum by connections to the precise level system. The secondary net comprises, roughly, 11,000 miles at present.

The field operations are confined to control levelling, that is precise or secondary, and the bench marks established during these operations form the starting point for tertiary and detail levelling which may be required in a specific area. This tertiary levelling is carried out by the particular organization which requires such information. For instance, if a topographical map is to be made of any area, the organization conducting this survey receives, on request, the description and elevation of every bench mark which has been established by the federal survey in the district under investigation.

With the object of rendering increased service, a central collecting bureau for all level data of all classes was established. Arrangement was made with the various federal and provincial departments whereby the records of their levelling operations would be filed in this bureau. Similar arrangements were also made with the railways and other organizations performing levelling. This information, when received, is tabulated, correlated and placed on standard datum and is readily accessible to the public. The compilation of tertiary levelling information is not yet completed, but organizations contemplating an engineering project in any area of the Dominion may, on request, receive whatever information is now on record in this bureau, and in addition will be notified of the source where information not on record may be obtained.

The standard datum for elevations is mean sea level, in conformity with the resolution adopted by the International Union of Geodesy and Geophysics, of which practically every country is now a member. In Canada the actual determination of mean sea level was made by the hydrographic service, and was based on the long period tidal records of five primary tidal stations, namely, Halifax, Yarmouth and Father Point on the east coast and Vancouver and Prince Rupert on the west. The published adjusted elevations of bench marks, resulting from the general adjustment of the Canadian net in 1928, are expected to be held indefinitely without further change. The obvious benefits of having Canadian elevation records placed on a standard datum are well known to engineers. It is not to be expected, however, that municipalities and private corporations will transfer immediately to standard datum the enormous mass of records which have been based on arbitrary datum points, although certain corporations, such as the Canadian National Railways, are doing so at present. In this respect it is suggested, in order to reduce the clerical work involved, that all new levelling carried on should be based on standard datum and from time to time as old work is being revised the opportunity should be taken to transfer it to the same datum.

Horizontal Control

The present status of the horizontal control situation in Canada is that a federal geodetic survey is actively engaged in laying down the main and secondary frameworks of triangulation and related operations. The map on page 2 shows its distribution. Other federal and provincial organizations are co-operating with the federal organization by laying down subsidiary frameworks, which already have been or are designed to be co-ordinated with the primary network. In the Prairie provinces the splendidly executed Dominion Lands Survey serves admirably as a secondary and tertiary system which meets all requirements inside the main nets. In British Columbia the Department of Lands is laying down a subsidiary triangulation in close harmony with the federal operations. In the province of Quebec a triangulation organization is being gradually worked out which is also co-operating with the federal survey to an increasingly desirable degree. In Ontario also the provincial survey and federal geodetic organizations work in close accord, with the purpose of gradually increasing the accuracy of geographic data in the province. In the Maritime provinces the primary framework of triangulation is largely completed. Wherever possible all over the country older surveys are being connected to the main nets, their results checked and co-ordinated, and a mass of older data is given new importance. New surveys are naturally connected to and co-ordinated with the primary framework where the latter exists.

In outlying districts, to which the main or subsidiary nets have not yet penetrated, astronomically determined positions, latitude and longitude, are being used for the present to give the best information which the situation permits.

Thus while the primary horizontal control in Canada is far from the desirable position of being everywhere ahead of development, the situation is being met as energetically as possible, having in mind the short time in which geodetic operations have been carried on.

Triangulation

In the ultimate Canadian system the primary triangulation will be laid down in loops of such a size that few points will be farther than one hundred miles from these main nets. The present primary nets are naturally placed where the needs are greatest, such as along coast lines, large waterways, railroads, or near cities, or where easy transportation exists. Lately the aeroplane has had an increasing influence as a means of economical transport, and present nets are being laid down in regions dotted with smaller lakes where planes can land close to the geodetic stations. Fortunately these same regions are also those

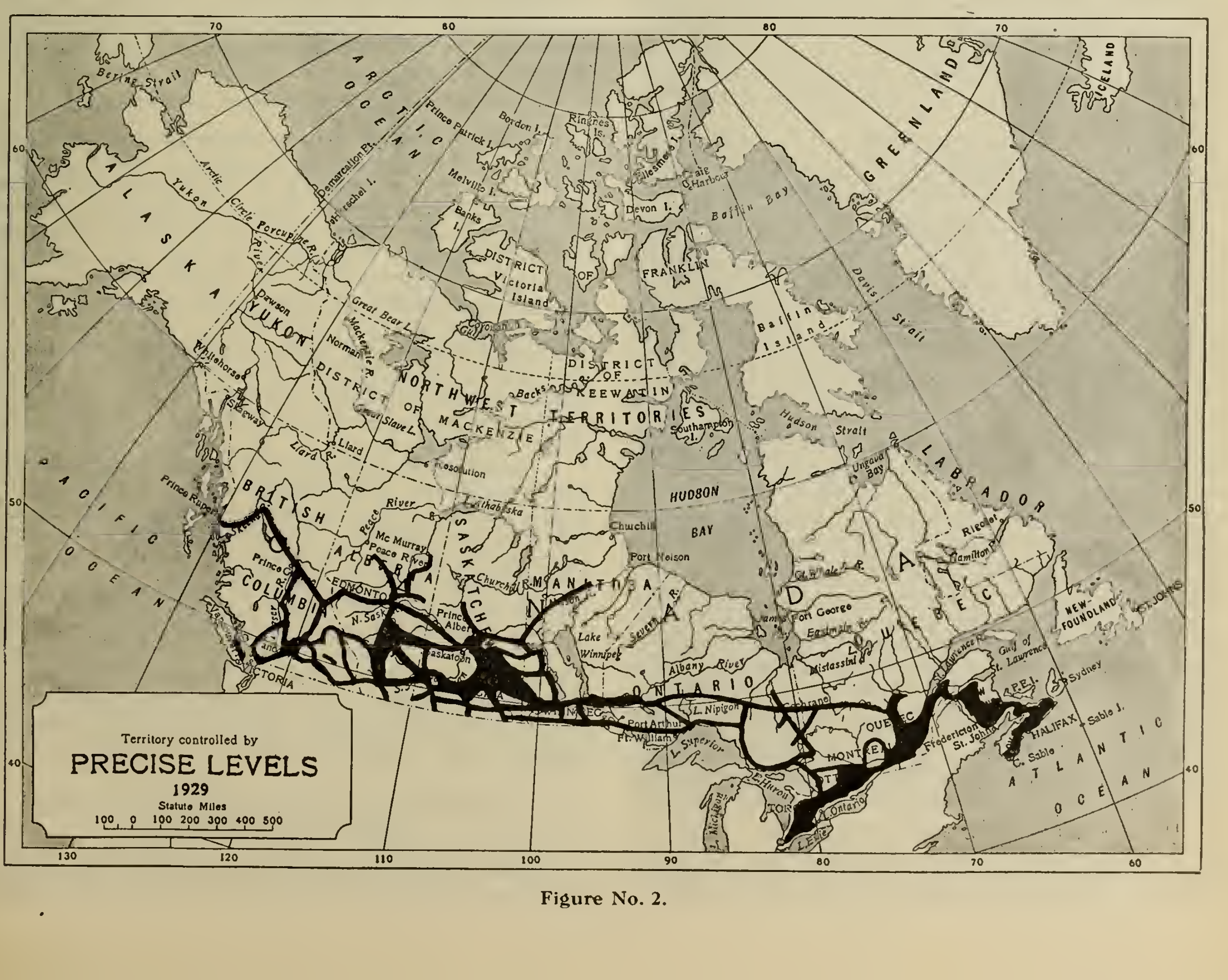

Figure No. 2.

Figure No. 3.—Instruments used in Topographic Mapping

Some of the instruments used by a ground party on topographic mapping in the foothills of the Rockies. Prominent in the display are the following:—surveying camera, small and large transit-theodolite, and range-finder, each with its respective tripod, photographic plates, barometers, stadia rod, binoculars, instrument cases, field books, etc.

in which mining and water power development is taking place and which consequently require accurate surveys.

In primary nets the distances between triangulation stations vary according to the topography from ten to one hundred miles or more, the economical distance being about fifteen miles. The accuracy of the calculated distances between primary triangulation stations is of the order of 1 in 100,000 or greater, that is, the error of these distances is generally less than one foot in a distance of twenty miles.

Even in primary triangulation the angular errors accumulate and their effect on the distance between stations and the azimuth of the lines must be periodically checked.

Base Lines

Every 150 miles or so one of the distances between triangulation stations must be measured to determine the difference between the calculated and measured distance. A short triangle side is chosen which passes over comparatively flat land and this distance is measured by the most precise methods. Fifty-meter "invar" tapes under a constant tension are employed on this work, this alloy of 64 parts of iron and 36 of nickel having been chosen because of its very small coefficient of thermal expansion.

Before and after the measurement of each primary base line, the field tapes are standardized. The unit of length used is the International meter, the standard of length employed being a 1-meter nickel bar number 10239 which is frequently compared with international standards.

Laplace Observations

These are astronomical observations for longitude and azimuth at triangulation stations for detecting any azimuth error in the triangulation due to the effect of errors in the angular measurements. It is well known that all astronomical observations are subject to errors due to the unequally distributed density of the earth's crust as typified by mountains and valleys. Latitude and longitude observations may be in error due to this cause by as much as half a mile or more in mountainous regions, and azimuth by as much as 15 seconds. Fortunately the errors of azimuth and longitude are related, and, by observing both, the true or Laplace azimuth can be calculated from the observed. These Laplace observations are made at intervals of six or seven stations in a triangulation net, about every 100 to 150 miles. The highest class of astronomical instruments are employed for primary observations of this kind.

Secondary Triangulation

This class of triangulation has often a more intimate appeal to the engineer than has primary work. The stations are closer together, are generally more conveniently situated to the engineer's work, and the precision is ample for checking most survey operations (except city surveys, in which the requirements are more rigid and for which primary control is needed). This class of triangulation is that generally employed where control is required within 50 to 100 miles of primary nets. The principles underlying the work are similar to the more accurate operations but the methods employed are less rigorous.

Secondary or tertiary triangulation, in conjunction with the primary, is especially valuable in connection with investigations of large areas such as hydraulic studies of large watersheds, timber and other resources of large limits, where the cumulative errors of ordinary surveys produce discrepancies of very appreciable proportions.

Precise Traverse

An economical and accurate substitute for primary triangulation is necessary in flat wooded country where the high cost of primary triangulation is a serious factor. Precise traverse measurements along roads or railroads have a useful place in certain parts of Canada supplementing or substituting for triangulation.

In the class of secondary or tertiary traverses are the meridian and base lines established by various provincial land surveys.

Triangulation Adjustment and Research

It will be realized that, in the primary control of such a large country as Canada, the greatest care is necessary to prevent the accumulation of errors which will destroy the virtue of the control. Thus while the field work must be done with the highest accuracy the proper distribution of the field errors, as disclosed by field tests and by the measurement of base lines and Laplace observations, is an equally important operation which requires the greatest skill and mathematical knowledge. The problems confronting those in charge of the adjustment of triangulation nets are of great complexity, and research work is continually going on to develop the methods by which these problems can be handled and the nets placed in their correct position.

The adjusted angles are used to calculate the distances between stations, the azimuths of lines and the latitude and longitude of all triangulation points, in which shape the data are published. Preliminary results, unadjusted, are available before adjustment for use where such data are sufficiently accurate for the purpose.

All of the triangulation in Canada, the United States and Mexico is based on the North American Datum, that is, all latitudes, longitudes and azimuths are based on the position of one point in Kansas and are calculated on the same assumed spheroid, Clark's Spheroid of 1866. Thus all the geodetic results along the borders separating these countries are in complete agreement, a very important international advantage.

Standard One-Mile Topographical Map—Using Plane-Table Methods

The plane-table method for topographical mapping on the scale of one mile to one inch, constitutes the general method by which the greater part of this work is carried out. It is the method that is best suited for low lying country or country of moderate relief, whether it is open or bush covered. Consequently, it is used extensively over that part of Canada that lies to the east of the Rocky mountains. It is also used in some of the lower lying portions of British Columbia and Alberta.

The standard unit of map sheet for this scale embraces an even 15 minutes of latitude and an even 30 minutes of longitude. This includes an area of about 422 square miles in latitude 45 degrees and about 300 square miles in latitude 60 degrees.

Control Required

In all topographical mapping, the area to be mapped must first be considered in its entirety and a system of control points established over it which will form a rigid framework upon which the whole map is based. In this way alone are the correct relative positions of different portions of the map established, and the necessary accuracy maintained in all of the minor surveys connected with the topographical mapping operations. This control, therefore, to fulfill these requirements must be well distributed over the area.

The general methods followed in mapping an area can be divided into two main groups, namely:—(1) The control, both horizontal and vertical, (2) the topographical mapping.

Horizontal Control

Horizontal control is obtained either by triangulation or traverse, depending on the character of the country. When triangulation is used, there are two requirements that are kept in mind when selecting control points. These are, to place the points where they will be readily accessible as tie points for the topographical mapping surveys and, at the same time, to spread them judiciously over the whole area. To carry this out successfully requires careful judgment as well as a good knowledge of the conditions over the whole area and of the requirements of the topographical work.

A reconnaissance is first made of the area to be mapped; station sites are selected and signalled. The base line and check base line sites are chosen and cleared. If two or more previously located triangulation stations are in or near the area, the necessity for base lines is done away with. During the progress of the reconnaissance, points, other than triangulation stations, which will be useful as tie points and which have no definite object to sight on, are flagged. Objects, such as windmills, churches, water towers, flag poles, lone conspicuous trees, etc., are always "cut in" during the course of the triangulation. They constitute good tie points for topographical traverses.

The triangulation for the control of a 15 by 30 minute sheet is carried out with a transit reading to one minute. Angles are measured by repetition, in sets of three direct, and three reverse. By using care in centreing, pointing, having signals vertical, and by observing great care in obtaining initial azimuths from pole star observations, sufficient accuracy can be obtained for the control of the sheet.

In general, it can be said that for the triangulation control of a 15 by 30 minute sheet only, the accuracy should be such as to give a 15-second or 30-second triangle closure. Base lines, if required, should be measured with an accuracy of 1 in 50,000 or more.

Traverse control is undertaken in areas where triangulation is not feasible or is too expensive, owing to the absence of sufficient relief or to timber obstructing the range of vision. This type of control consists of transit and tape traverses carried over the area with a view to cutting it up into comparatively small blocks. The traverses are run in circuits or tied to some previously located points. The routes of the traverse generally follow the course of railways or roads. In portions of the area where there are no roads, or an insufficient number of roads to fulfill the requirements, the traverses are carried across country. Every part of the area must be controlled.

Transits reading to one minute or 30 seconds are used. Distance is obtained by using a 300-foot steel tape and taking slope measurements. Slope angles are taken with the transit or with an Abney level. Record is kept of all crossings of county and township lines, railway and road crossings, road forks, mileposts, stream crossings and so on. The number of every fifth transit station is painted in a conspicuous place at the side of the route for identification purposes by the topographer.

For the control of a 15 by 30 minute sheet alone by the traverse method, an accuracy of 1 in 5,000 should be obtained. This can be accomplished by taking ordinary care in all of the operations. Observations for azimuth on the pole star are taken at intervals of from 5 to 8 miles depending on conditions.

If the horizontal control is being carried out for more than one 15 by 30 minute sheet, the accuracy with which

Figure No. 4.—Plane-table Mapping

Plane-table with open-sight alidade and Indian clinometer. The open-sight alidade lies to the left and the surveyor is shown sighting with an Indian clinometer for obtaining elevation.

Figure No. 5.—Photo-topographical Surveying.

Camera station on mountain peak. At the right a stone cairn is being built to mark the location of the station. At the left is a surveying camera shown mounted on its tripod. This tripod is also adapted to supporting the transit-theodolite head. Angles to other stations and prominent points are taken with the transit-theodolite, the topographic detail being filled in from the photographs.

the work is carried out is naturally increased to meet the requirements.

The horizontal control, when completed, is adjusted and plotted on a projection sheet on the scale of one-half mile to one inch. All information relative to the map is laid down.

Vertical Control

Vertical control is obtained by instrumental levelling carried in circuits over the area. Bench marks are established about every 3 miles. Ground elevations, for use by the topographer, are painted in conspicuous places along the routes.

Topographical Mapping

This includes all the operations connected with the work of obtaining the topographical data over the whole map area. The instrument used throughout the major part of these operations is the plane-table. The method of carrying out the operations depends on whether the control was completed a year in advance of the topographical mapping or is carried on concurrently with it.

When traverse control is completed in advance of the topographical work, the control information is transferred to plane-table sheets. These sheets are then used by the topographer in the field. The general procedure in obtaining the topographical information on each plane-table sheet is to travel along the routes of the control surveys, eatablishing locations and elevations on either side of the route, and completing the mapping along the route and as far on each side as possible. The unmapped areas between the routes are then controlled by means of plane-table surveys, using either stadia, tape or pace for distance, depending on the requirements, and the topographical detail completed as before. In this way the plane-table sheets covering the whole area are completed.

When the triangulation or traverse control is carried on concurrently with the topographical mapping operations, the procedure is somewhat different. Plane-table sheets cannot be prepared beforehand, consequently the topographer has to build these up as the work progresses The control survey party and the topographical party have to work in close touch with one another, in order to avoid duplication or omissions. Knowing where the control points or control routes are to be established, the topographer blocks out areas between these by running plane-table and stadia traverses along roads, trails or streams, or across country if need be. The topographical detail is completed along these routes and as far on either side as possible. The areas thus blocked out are then cut up by traverses with plane-table and stadia or tape, until the topography of the whole area is obtained.

In carrying out all of the topographical mapping operations, there are certain things that must be borne in mind in order to obtain an accurate well-balanced map. Briefly stated, some of these are: the proper adjustment of all the surveys; the necessary accuracy in plotting directions and distances; keeping a balance between the precision with which a survey is executed and the degree of accuracy with which it can be plotted on the field scale; obtaining the proper amount of detail and generalization in keeping with the scale; avoiding omissions of important features; obtaining legibility in all that is shown; sketching contours to represent the shape of the ground as well as to give the elevation, maintaining consistent accuracy over all parts of the map.

One-Mile Mapping Using Vertical Aerial Photographs

Vertical aerial photographs have been used in Canada as an aid to mapping since 1924. They are used principally in the production of one and two-mile maps.

Control Used

Prior to the adoption of air photography for mapping, the horizontal ground control for one mile mapping consisted of a network of primary traverses along roads, with practically all roads within each primary circuit controlled by secondary traverses. It was found that detail within the primary traverse network could be plotted from photographs with as great, if not with greater accuracy than by the use of the secondary traverses, and at the present time the horizontal control consists of transit chain traverses run along roads or across country, enclosing areas of approximately seven and a half minutes in latitude by five minutes in longitude, or of about thirty-five square miles. Water areas of sufficient expanse to cause difficulty in the construction of the photographic control are enclosed by traverses. The lines are chained with a 200-foot Invar tape and such detail as will definitely appear on the photograph is recorded. The traverse angles are measured with a one-minute instrument, but at all intersection stations observations for astronomic azimuth are taken with a one-second instrument. The traverses are connected to all geodetic stations within the area and the closure errors of circuits average about 1 in 18,000; with no circuit showing an error of 1 in 5,000.

The vertical control consists of primary level lines run over the traversed roads, with secondary lines within the primary circuit sufficient to leave no point of country more distant than one mile from some elevation thus established. All levels are connected to precise bench marks and the circuit closure aim for primary lines is $.2\sqrt{N}$ feet, where N is a number equalling the number of miles in the circuit. Twice this error is allowed on secondary lines. The level party paints in white, on nearby fence or post, the elevations of all turning points and road intersections for the convenience of the topographers, and notes the elevations of culverts, schools, summits, depressions, transit stations and other important details. A copy of these notes is supplied to the topographer.

A complete control party consists of nine men, including a cook and chauffeur. In a season of six months and in average country one party will run about 1,000 miles of transit line and 1,500 miles of levels, which is sufficient control for about 1,600 square miles of country for one mile mapping.

Plotting the Control

The horizontal ground control is plotted on paper mounted on zinc to prevent expansion and contraction. For convenience in plotting photographic detail, the size of these control skeletons is 10 minutes of longitude by 15 minutes of latitude, three skeletons forming the sheet, which is eventually reproduced on the one mile to one inch scale. After the ground control has been plotted at one mile to two inches a photographic control is constructed over the area within each traverse circuit by one of the graphical methods of plotting. This photographic control fixes on the paper the centres, or points near the centres, of every photograph within the area concerned.

Plotting the Detail

After these points have been fixed, the detail is plotted between them by proportional dividers. Where relief is sufficient to cause distortion at the scale of the plot, additional selected points on hill tops and in valley bottoms are fixed by radial intersections before detail plotting is commenced.

Relief, when sufficiently pronounced to be viewed in the stereoscope, is indicated on the photographs by form lines, which are plotted on the skeletons along with the other detail.

All plotting of control and of photographic detail is carried out by the field staff during the winter months.

Preparation of Base Field Sheets

On the completion of the plotting, all detail is inked in black, the plots are photographed and each skeleton is reproduced in blue on three aluminum mounted plane-table sheets, each including an area of 10 minutes of longitude by 5 minutes of latitude. These form the base upon which the topographer works. All detail is thoroughly checked on the ground, and such as is to be shown on the

Figure No. 6.—Oblique Aerial Photograph and Grid.

A Canadian development, applicable to much of our northern country, has been the use of the oblique aerial photograph for mapping intricate water features on scales of four miles or more to the inch. In this method, grids are selected and superimposed over the photographs as an aid in interpreting the topographic detail. In the selection of the particular grids to be used, ground control must be taken into consideration, the actual data governing the selection in each case being recorded in the upper left hand corner.

Figure No. 7.—C. G. S. "Acadia."

Single screw high-powered steel steamer of some 1,100 tons displacement, built especially to meet surveying requirements and strengthened to withstand ice. This ship is equipped with the latest devices to promote efficiency and economy in charting, including the following:—gyroscopic compass; British Admiralty pattern echo sounding machine; usual radio equipment with the most up to date type of radio compass; deep-sea water bottles with thermometers attached, for oceanographical work; several chronometers, transits, base-measuring chains, sounding and observing sextants, etc.

map is inked in the appropriate colour, the streams being in brown for photographic reasons. The contours are added with the aid of the Indian clinometer and of the form lines where obtained from the photographs, based on the level control.

After the field sheets have been completed they are reproduced and compiled in the one mile to one inch sheet form in the usual way.

In the above method of one-mile mapping what might be termed the straight line method of assembling the details shown on vertical photographs is used.*

Radial Intersection Method

In the radial intersection method, also in use in Canada, each flight line is plotted separately between control points and horizontal control parallel to the flight lines is not required. The spacing of control lines varies with the relief of the country, control being required at greater frequency in rough mountainous country with quickly changing relief than in level or slightly undulating country. Probably an average could be from 5 to 8 miles for one-mile mapping and from 8 to 12 miles for two-mile mapping

In this method the distance between the centres of the first two photographs as shown on the first photograph of the flight line is used as a base from which points are intersected on each side by radial lines from the principal points. A series of such intersections across a flight line gives a plot of the principal and intersected points to the scale of the air base on the first photograph. Additional points to control the sketching of details and to locate points common to adjacent flight lines are located by intersecting rays drawn from principal points. The reduction to the projection scale is obtained by the distances between corresponding points on the strip and on the projection. It is usually made by photography. The reduced strips are assembled directly on to the projection.

*The method is described in detail in the Canadian Defence Quarterly of July, 1925.

Other Methods

Another method commonly used in Canada is to take the photographs themselves into the field and identify and mark on them the details to be shown on the map. Elevations of points are determined by any of the different methods available and the contouring done directly on the photographs with the aid of the stereoscope. The assembly of the details onto the projection is done after the field interpretation and the contouring have been completed.

The use of vertical air photographs in mapping has, without doubt, raised the standard of mapping in difficult country without undue increase in cost, so that the standard in all classes of country has been made more nearly uniform.

Two-Mile Mapping—Using Plane-Table

There are large areas of partly developed country in Canada where maps are urgently needed but for which sufficient money is not available to do standard one-mile to an inch mapping. Methods have been devised to plane-table these areas rapidly for the production of maps on a scale of two miles to an inch.

Control

Control for such mapping is based on primary triangulation, which is extended by secondary triangulation and control traverse. This traverse is of two kinds, the longer lines being chained transit work with an accuracy of better than 1 in 5,000, and stadia control lines usually less than ten miles in length and with an accuracy of better than 1 in 800.

Spirit levels are run over the area in convenient circuits, usually along the chained traverses, with an accuracy of better than one-tenth of a foot multiplied by the square root of the distance in miles between the precise bench marks. Stadia levels are obtained, along the stadia control, that must close within 3 feet on the spirit level bench marks.

It is the practice to leave a great number of marks of the control painted up on the ground for the guidance of the topographer. All traverse stations are painted up distinctly by number as well as their elevation above sea level. Also specially constructed permanent monuments and bench marks are established at about 3-mile intervals along the main control. These monuments are carefully placed and described so that they may be easily found for years to come.

All traverses are reduced by latitudes and departures in the field, and the closings checked. When the survey has been properly closed and adjusted, the plot is made on a Gauss conformal projection of the map sheet.

Plane-Table Sheets

Plane-table sheets are prepared by pricking through the triangulation and traverse stations. All stations are named or numbered on the plane-table sheets in blue or violet inks and the elevations added in pencil. Thus the plane-table sheet is given to the topographer with the positions and elevations of several hundred points accurately located upon it.

Instruments

The instruments with which the topographer is usually supplied consists of a full size plane-table, trough compass, opensight alidade, Cooke transit, a 15-foot self-reading stadia rod, and a Barr and Stroud coincidence range-finder fitted with a special clinometer for work in open country, and for work in the bush a set of three surveying aneroid barometers, trailer tape, military compass and pedometer.

The use of the Barr and Stroud range-finder F.T. 32, Mark 2, with a meter base and fitted with a special clinometer has been a great aid to the topographer in rapid mapping. This range-finder is constructed on the coincidence principle, the upper image being inverted. In the right eyepiece the two images separated by a halving line are seen and brought together, or a coincidence made by a working head on the inside of the right operating handle. Distances are read directly on the scale visible through the left eyepiece.

A table of uncertainty of observation under favourable conditions is given by the marks as follows:

Distance Yards	Uncertainties of Observation Yards
500	1.0
1000	3.8
2000	15.0
3000	34.0
4000	61.0
5000	95.0
6000	137.0
7000	187.0
8000	244.0

The probable error would be about one-half these values.

The figures are based on the best conditions available as to light and ranging objects. It is found in practice that the probable error of observation increases very rapidly with poor visibility and with the indefiniteness of the object ranged on, and one should be prepared to accept a probability of error slightly in excess of the values given above. Thus errors are quite small and unimportant up to about 1,000 yards, but become greater as the distance increases so that at 1,500 yards they are an important factor, and the range-finder cannot be used except for rough measurements over 2,000 yards.

In measuring angles the standard instrument in the past with plane-tables has been the Indian clinometer. This instrument has no means of magnification so that its reliability is restricted to distances of not over half a mile. A new clinometer has recently been designed at Ottawa, that has many advantages. It is attached to the range-finder so that one pointing of the range-finder to read distance may also be used to read the vertical angle, thus saving a second reading and giving the observer the benefit of the range-finder magnification. The clinometer is of the micrometer drum type and is attachable to the platform of the range-finder, which formerly carried the sighting vane, a new sighting vane having been substituted.

The topographer usually finds that his plane-table sheets are prepared with an accurate traverse of the roads and railways, giving both the vertical and horizontal control. Plane tabling in the usual way around the blocks, the topographer finds that the range-finder permits him to map from 300 to 1,500 yards either side of his control. He has the facility of rapidly obtaining the distances and elevations to all objects such as houses, hills and the shores of streams, lakes, etc. Also, when using this range-finder, the topographer always has his helper beside him, and this man may be an inexpensive labourer.

In the bush areas the rivers and lakes are mapped from stadia traverse, creeks by compass and trailer tape traverse, and the contours laid down by cross sectioning, with barometers. This work with barometers in bush requires experienced men who can pace and sketch accurately. The barometers are used in sets of three and their readings adjusted from the gradient obtained by a set of camp barometers that will be more fully described under mapping the three miles to an inch series.

One-Mile and Two-Mile Maps—Using Photo-Topographic Methods

The mountainous regions of Western Canada furnish an ideal field for the application of photo-topographic mapping on account of the physical and climatic conditions which prevail.

The first photographic survey in these regions was undertaken forty-three years ago in the area adjacent to the Canadian Pacific Railway at Banff. During the succeeding seven years methods and instruments were improved and the success of the system was demonstrated by the production of a map, covering about 2,000 square miles, on the scale of 1 to 20,000 and with a contour interval of 100 feet.

Since that time many other surveys of a like nature, plotted on various scales and with varying contour intervals, have been made in Canada by the Dominion Government and more recently by the British Columbia Government.

Instruments

The instruments to be used on photo-topographic surveying should be light and compact, and should be kept in good adjustment. The transit theodolite may be of ordinary pattern with a 3-inch circle, reading to minutes, and with telescope of sufficient power to pick up signals readily from 12 to 15 miles away.

The camera used has a camera box of fixed focus type with lens generally of F. 6.3, and is specially constructed so that the horizontal plane through the centre of the lens and the plane of the photographic plate may be placed at right angles. Photographic plates are of a size, 4¾ by 6½ inches; the camera having a field in a horizontal position of about 51 degrees and in the vertical position of about 37 degrees. Eight plates are usually required in the horizontal position to photograph the horizon completely, providing sufficient overlap between the successive views. Level bubbles are attached to the camera so that it may be kept in a level plane at the time the exposures are made.

Figure No. 8.—Mapping on the Northern Plains.

View taken at survey monument. The man at the left is drilling a hole in which to sink a short bronze survey post. Next to him the rodman is holding a stadia rod. The third man is using a range-finder (mounted on a tripod) for obtaining distances. The surveyor's transit-theodolite and the stone cairn to mark the position of the monument are also shown. View taken on east side of Artillery lake.

The transit and camera should be interchangeable for use on the same tripod, the latter being of very light construction and with either short legs for high mountain peaks, or with legs of standard length for use in country where there is more or less bush at the higher levels.

Methods

In the photo-topographic method, the elements of perspective are made use of. The object of the survey is to record on photographic plates images of the country from each of two or more properly located fixed points, or stations. The resulting photographic prints enlarged twice are then used in pairs, the common points being identified in sufficient number to enable the plotting of the detailed topography of the country.

The surveyor in the field must constantly keep these requirements in mind, and, through experience, he gains an aptitude for the work which allows him to visualize the country to be mapped, and to determine what construction he will apply and what views are necessary for that construction.

Photographic surveys are usually based on a calculated triangulation control accurately plotted. The camera stations may be fixed, either by angles taken from the triangulation points, or by angles measured at the camera stations themselves. It is much easier and more accurate to plot a camera station by means of intersection angles read from two or more other stations, rather than by means of resection with angles read to three or more other stations from the station occupied. Field work, therefore, should be laid out and camera stations selected so as to avoid the resection method, and to make the re-occupation of stations as few as possible. Stations are marked by either a tripod covered with cotton or a stone cairn, according to their location.

The camera work is done at the same time as the transit occupation. Occasionally, it may be necessary to set up the camera, in order to include certain parts of the landscape, at points close to the tied-in station (a few hundred feet, or less). Such subsidiary points may be connected up with the adjacent station by measurement with a light tape and an angle read by the transit.

The experience of the surveyor in laying out his work will be the best guide in his programme of taking views from each station. Every view should be taken from the point where it is best for the construction of the resulting map. A large number of subsidiary stations gives very little extra work, either in taking the angles for fixing their positions, or in plotting them.

In some cases it may be difficult to obtain views which will furnish horizontal intersections of a certain part of the ground. In these cases the method of vertical intersections may be employed, views being taken from different altitudes. If the difference of altitude is large enough, and the points to be determined not too far distant, a similar degree of precision may be obtained, as with horizontal intersections.

Figure No. 9.—Solar Observation for Watch Correction.
Surveyor with transit-theodolite taking observation of the meridian passage of the sun at noon for the purpose of obtaining the correction to his sidereal watch. This watch correction is an important element in other observations as for azimuth, etc.

Knowledge of Photography Required

In addition to his knowledge of ordinary survey practice, of descriptive geometry, and of the principles of perspective, the surveyor on photo-topographic work must be cognizant of the main principles of photography in relation to the comparative values of light, as affecting the sensitized plate. He will gain this last mentioned understanding best through experience.

The photographs must be clear and full of detail, the points to be plotted being well defined and easily recognized. In this connection there will be certain difficulties to overcome inherent in mountain landscape, such as the effect known as "aerial perspective," or the merging of the landscape into a uniform tint in the distance.

To aid in the solution of these and other problems, in connection with the photography in these regions, panchromatic plates, that is, plates susceptible to all rays of light, are used in combination with a yellow light filter, "G." These give excellent results.

Notes and Plotting

The notes of the survey consist of a record of the angles observed to determine the positions of stations and their elevations, of the photographic data such as the numbers of plates and description of the views, the direction of the view and description of fixed points appearing in each. Sketches serve to identify these points with more certainty than a mere designation by letter or figure.

In plotting the features from the photographs after the control itself is laid down, the first operation is to define on each view the horizon and principal lines. This is done by reference to test views which are made at the beginning of the survey to determine the position of the camera bubbles when the plane through the lens is horizontal. The second is the identification of common points, and their numbering in coloured ink, on different pairs of views. These common points should be selected so as to define the topography as accurately as possible with a minimum number of points.

It will quite often happen that a given area cannot be mapped from two stations only, owing to projecting shoulders or intervening ridges. In these cases, of course, views from other stations must be utilized to fill in detail.

After the points have been identified, a strip of paper one-half to three-quarters of an inch wide, and a little longer than the view, is taken. A line perpendicular to the edges of the slip is ruled near the centre. Keeping the strip on the horizon line of the view the distances of the various points identified on the photograph from the principal line are marked on the slip. The slip is then reversed and on the opposite side the distances of the points above and below the horizon line are marked in a similar manner. On the side of the slip showing the horizontal distances it is customary to write the name of the station and the number of the view, and on the opposite side the number of the view and the elevation of the station, using the same coloured ink as for the points. The distances may be marked in pencil or ink, on the photographs when the several points have been identified and the horizon and principal lines have been ruled in their proper positions.

The traces of the principal lines and the picture plane are then laid down on the working plan. The lines from the stations to the line first drawn on the slip represent the principal lines of the views. The slips showing the distances of the points from the principal lines are then placed on their proper traces. Then the line of sight from the station to any point is found by drawing a straight line from the station to the projection of the point shown on the slip, and the position of the point is given by the intersection of two or more of these lines of sight.

Practical Methods Employed

In practice an adaptation of this method is the use of fine threads or hairs, one end of each of which is looped and secured over a needle inserted on the working plan to mark a station, and the other end attached to a small weight. When the hairs lining from the stations to the respective points in each view as marked on the slip, intersect, the intersection represents the points to be plotted. These points are pricked on the plan by a fine needle or pricker, and are marked with a number in coloured ink, as on the view.

In order to facilitate the laying down of traces, methods have been devised consisting essentially of the use of sheets of transparent celluloid cut to convenient size, on which been have previously etched straight lines representing respectively the principal line and the horizon line at right angles thereto.

The elevations of points may be determined mathematically, but for the purpose of the usual mapping operation graphical methods are employed. The instrument known as the "elevation computer" has been successfully used on Canadian surveys.

The precision of a survey executed by the methods described, when all the points are established by intersections, is the same as that of a plan plotted with a very good protractor or made with the plane-table. There is, however, this difference: the number of points which may be plotted by photography is greater than by the other methods.

The photographic survey is weak when there are "blind spots"—areas which do not appear in detail on a pair of views, or which appear only on one view. The experienced photographic surveyor will have very few of these, and when they are apparent sketching must be resorted to, as in the case with the plane-table survey.

The advantage of the photographic method for mapping Canada's mountainous areas is that it enables the topographer to gather conveniently, economically and rapidly during the short field season on the ground, by photography, the material for his maps, and then construct them afterwards at his office during the winter season.

Figure No. 10.—Surveyor receiving Time Signals.

With the advent of the radio and wireless, the taking of observations for longitude has been much simplified. In the illustration, the surveyor is shown receiving time signals for use in connection with such observations.

Three-Mile Sectional Sheets

The map sheets of the Sectional Map series, published on a scale of three miles to the inch, include eight townships north and south and fourteen or fifteen ranges east and west, comprising an area of about 4,200 square miles, and cover the Prairie provinces and the railway belt and Peace river block of British Columbia. These map sheets were first published in 1892 and were compiled from the township subdivision surveys with the addition of information regarding railroads and post offices. In 1919, the policy was adopted of changing these sheets in the more settled parts of the country into topographic maps, and for this purpose field parties were sent out to obtain the necessary information as economically as possible.

The settled parts of Western Canada consist largely of vast tracts of prairie country with comparatively little relief. To map this country accurately and rapidly to the scale required presented a new problem to the topographers. The ordinary methods of topographic mapping were far too costly, so a system of sketching the topography on a much larger scale than the finished map was devised. This system, which makes use of motor cars and aneroid barometers, controlled by lines of instrumental levels, for contouring, has given remarkable results and has solved economically the problem of mapping large areas of settled country to a small scale.

Control

The Dominion Land Surveys System with townships six miles square, and with monuments every half mile on road allowances which run every mile north and south and every one or two miles east and west, provide ample horizontal control. Possibly in no other country have the cadastral surveys been so well planned and executed that no additional horizontal control is required for topographic mapping.

Vertical control is provided by all the level lines previously run, and consists of precise levels along the railways, secondary levels along the base lines, the profile of railways along which precise levels have not been run, provincial road surveys and levels run for drainage and irrigation purposes.

Figure No. 11.—Triangulation Control for One-Mile Mapping.
A typical triangulation station for the control of one-mile mapping in eastern Canada.

With these levels as a skeleton, a net work of levels is run with transit and stadia on practically all east and west road allowances. Each map sheet is thus covered with lines of instrumental levels from 2 to 6 miles apart.

Before commencing field work all the existing information relative to surveyed roads, water areas, edges of valleys and railroads, available in Ottawa or at the Provincial Government offices are plotted on township plans (scale half a mile to the inch).

The available level lines are reduced to mean sea level, and the elevations of all section and quarter section corners, the crossings of the section lines by the railways, as well as the elevations of the summits and depressions are entered on the township plans. In addition to this, the intersections of the contours by the levelled lines are plotted.

Organization of Party

A field party consists of a surveyor in charge, an assistant, a leveller, a camp draughtsman, three helpers and a cook. For transport, three light cars and a truck are used. The field work has been systematized so that the party can cover a map sheet of this series in a field season of about five months.

Field Methods

The party is divided into three working units, each consisting of a technical officer and a helper, and each provided with a car. The leveller is employed in running stadia levels and doing any instrumental traversing required. These levels are run with transit and stadia rod in circuits of from 15 to 25 miles and are controlled by the lines of spirit levels. The chief and assistant do the topographic mapping. Using the township as a unit, the country to be covered from each camp is divided between them. By travelling the road allowances and using the car speedometer for distances between the half-mile survey posts, the following topography is plotted on the township plans, different coloured pencils being used:—

Buildings, streams, railways, telephone lines, water areas, wooded areas, roads in four different classes, pipe lines, irrigation canals, drainage ditches, ferries, dams, mines and quarries, etc.

Contouring

With the network of spirit and stadia levels as control, the townships are contoured to 50-foot intervals by the use of aneroid barometers. The barometers, which have previously been tested and passed by the Physical Testing Laboratory, are carried in sets of three and the mean of the readings taken. During the field day, three barometers are read in camp every half-hour from which the curve or gradient showing the changes in atmospheric pressure is plotted.

The field watches are synchronized with the camp watch and the time of all field readings recorded. In reading the barometers, the foot scale is used and the nearest five feet taken. Care is taken to overcome friction by tapping the glass and to see that the relation between the three barometers remains fairly constant. One barometer may go up twenty feet while the other two only go up ten feet, but this difference should not be exceeded. This relation can usually be kept fairly constant by repeated tapping.

On the average map sheet in Western Canada two distinct classes of country are usually encountered: the one thickly settled with good roads on practically every road allowance, and the other where the country is sparsely settled and very few road allowances are travelled. A different method of contouring has been developed for each of these classes.

In the first case the level control lines are from two to four miles apart. The field barometers are read at a known elevation and carried by car as quickly as possible along a road to the next known point, readings being taken and the topography sketched at all intervening section and quarter section corners, as well as at the more prominent summits and depressions. By arranging the work so that the interval between readings on known elevations does not exceed 30 minutes the elevations of the points noted can be determined directly from the readings. The contours can then be sketched on the township plans, using a hand level for tracing their courses across the interval between the roads. In this case, the camp gradient is only used in checking the accuracy of the elevations as determined in the field, as it has been found that when the interval between readings on known elevations does not exceed 30 minutes, no corrections are necessary to the elevations used in the field. When the time intervals exceed 30 minutes, it is usually necessary to use form line sketching and complete the contouring in the camp office, or else to contour in the field after the barometric readings have been reduced with the aid of the camp gradient.

In the second case, cars can only be partly used and walking has to be resorted to. It is also seldom that more than one line of levels can be run in any one township. The barometers are read as often as possible on known elevations, and when the time interval exceeds two hours the work is laid out to include repeat stations, that is, points whose elevations have been determined barometrically two or more times. In the final corrections to the readings, the mean of the elevations of the repeat stations are used as known elevations. The contours are then drawn in the office with the aid of form line sketching.

Using good barometers, taking care in reading them, and by having the interval between readings on known elevations to be less than one hour, surprisingly accurate results have been obtained. It has been found that approximately seventy-five per cent of the barometric elevations are within five feet of the true elevations and that very rarely is one found to be more than ten feet in error. When the barometers are carried by hand and repeat stations used, no reading should be twenty feet in error, while most of the elevations will be within ten feet. For good barometer work the elevation of camp should not vary more than about 200 feet from the mean elevation of the country worked in. Work should not be done more than twenty miles from camp. The crossing of deep valleys should be avoided during the day as much as possible.

There are, of course, days when the barometers are unreliable owing to high winds, thunderstorms, etc. These days, however, are comparatively rare and when they occur other than barometric work is carried on.

On completing a township in the field, the information shown on the plan is carefully checked to see that no discrepancies exist. This is specially done with the borders of the adjacent townships.

The surveyor returns from the field with all the topographic information shown on township plans. At the head office a projection of the map sheet, on a scale of two miles to the inch, is laid down on cross-mounted bond paper. The topography collected in the field is transferred to this projection which, after it has been checked and place names added, is inked in. The completed projection is then turned over to the photographic and lithographic divisions for the preparation of copies for the use of the map draughtsman.

Four-Mile Maps Using Oblique Aerial Photographs

A large part of Central Canada consists of relatively flat country with numerous water features, and presents a most attractive field for mapping by oblique aerial photography. Recent map sheets issued on the four-mile scale have been prepared in this manner. Each four-mile map sheet extends over one degree in latitude and two degrees in longitude; in latitude 54 degrees the sheet measures 81 miles in an east and west direction, and 69 miles in a north and south direction, comprising an area of about 5,600 square miles. The operations in connection with the preparation of the four-mile map sheet fall into three major divisions consisting of: first, the actual oblique aerial photography to cover the area; second, the ground control for fixing the geographical outlines of the sheet and for determining the scale of the oblique aerial views obtained; and third, the plotting of the oblique aerial photographs, the assembly of the individual plots to form the map, and the finished drafting, photography and printing of the resulting map sheet.

Oblique Aerial Photography

For photographing obliquely the area comprising a four-mile map sheet parallel photographic flights, spaced usually 6 miles apart, are made at an altitude of about 5,000 feet above the area in an easterly and westerly direction across the map sheet, together with north and south flights at the easterly and westerly limits of the sheet and two or three additional north and south flights spaced apart one-third or one-quarter the length of the map sheet. These latter intersect the east and west flights, and serve to supplement the limited ground control and to facilitate flying the long east and west flights in their proper location. To assist the pilot in this work, he is provided with a map compiled from any existing information upon which is projected the lines of flight to be followed.

To be suitable for oblique mapping work the aeroplane or flying boat used must have a "free nose" so that the camera when mounted in front of the forward cockpit has an unobstructed view, not only in the direction of flight, but also 90 degrees to the right and left thereof and downward from the apparent horizon, towards the vertical, through an angle equal to that of the camera angle. To enable the pilot to fix his altitude he is supplied with an altimeter and strut thermometer. He is instructed either to maintain a uniform altitude in photographing or otherwise record the readings of his altimeter or barometer and thermometer, in order that the altitude of the "flying boat," at the time the different photographs were obtained, may be subsequently determined for use in plotting the views. To maintain his direction he depends on ranging and on his compass, nosing his plane into the wind so that the course made good agrees with that projected on his flight map. A surveyor-observer is frequently attached to the flight and assists the pilot in directing the plane over the desired routes. He may also sketch in supplementary information upon the flight map to facilitate the making of subsequent flights and assist the photographer in obtaining the desired photographs with the required overlap. The rate of travel is usually from sixty to seventy miles an hour. At intervals of 2 miles along the routes flown, a set of photographs is taken, the set consisting of a photograph in the direction of travel over the ground, together with one to the left, slightly lapping the central view, and one to the right also lapping the central or straight-ahead view.

Camera and Film

The camera is of the fixed-focus, roll-film type and is so mounted as to dampen the vibrations of the plane. The mounting also allows it to be rotated in a plane perpendicular to the camera axis, to be depressed below the horizon, and to be swung both to the right and left of the line of travel. It is provided with a special sight which, when directed to the apparent horizon, gives the camera the required depression, and ensures that the apparent horizon line is recorded on the resulting photograph in a position parallel to the upper limit of the view. Thus, all photographs are taken with a more or less constant depression angle of about 19 degrees given to the camera axis, the object being to eliminate the necessity of making available a large number of grids for use in plotting the resulting oblique views. The camera is equipped with an

Figure No. 12.—Triangulation Control for One-Mile Mapping.
An unusual triangulation station for the control of one-mile mapping in eastern Canada.

interlens shutter for exposures 1/50, 1/100 and 1/150 seconds, and a wide-angled lens of about 8-inch focal length, which covers an exposure area of approximately 7 by 9 inches and works at an aperture of f/6.8.

Similar wide-angled lenses of greater speed are now available which work at an aperture of f/4 and which will probably be preferable for aerial survey work. A roll of film approximately 75 feet long is contained in a magazine which is attached to the camera, and which allows for 110 exposures. The film is coated with hypersensitized panchromatic emulsion, sensitive to all colours, and in order to penetrate the haze and absorb the highly actinic blue light rays, a yellow filter or screen is capped to the camera lens.

During exposure the film is held in contact with a glass plate in the focal register of the camera and as soon as the exposure is made the pressure back is released and the film is automatically wound up preparatory to repeating the operation. Before undertaking any photography the camera is calibrated to determine its principal distance and the position of the principal point. The latter is marked with a small cross etched on the focal plane glass plate and thus appears on each negative and prints therefrom. As soon as a roll is exposed it is shipped to Ottawa for development, and prints on 9 by 11 inch double-weight, semi-matte paper are supplied for plotting purposes.

Ground Control

In order to plot the features shown on the oblique aerial photographs to the proper scale and in their proper positions it is essential to have ground control. An exceptionally good control would consist of continuous traverse surveys crossing the lines of flight at intervals of twenty-five to thirty miles, the purpose of the surveys being to establish the positions of well-defined points which can be identified and marked on the photographs. We thus have, for each flight, central photographs twenty-five to thirty miles apart on which the distances and bearings between certain marked points are known; these data provide a check on the altimeter record and determine the direction of camera pointing at the instant the particular photograph was taken. With this information the azimuth of the line carried through the intermediate photographs of each flight can be determined, the features shown thereon can be plotted and the plot finally adjusted to fit the actual traverses on the ground.

Such ideal conditions as regards control are seldom possible. The lines of ground control must follow routes along which traverse surveys can be run economically, which, in the type of country to which this method is suited usually means the waterways. When there are no waterways suitably situated it is not economical to attempt to establish ground control by continuous traverse surveys. In such cases it is possible to replace a continuous ground survey by a flight line taken across the regular flight lines, the photographs along this line being controlled by astronomical observations for latitude and longitude at selected points along it.

At or near each place of observation the bearing and length of the line joining two well-defined points in the foreground of a photograph are determined, and this information provides a check on the altimeter record and determines the direction of camera pointing at the instant at which that particular photograph was taken. The photographs along the whole flight may then be plotted and the plot adjusted to the plotted positions of the observation points. This plot may then be used to furnish control for the photographs taken on the regular flight lines just as a continuous ground survey would have been used.

For the type of country to which this method is peculiarly suited it is possible to map a complete map sheet without any ground surveys other than the astronomical observations at certain points, the most desirable points being at or near the four corners of the sheet and at or near the midpoints of the north and south boundaries. These astronomical observations need not be elaborate, as the scale of the map will not reveal refinements of less than 200 feet; they may be taken satisfactorily with a small transit or astrolabe of suitable type, a portable radio receiving set, and specially selected chronometers or watches.

During the course of the ground work, whether it consist of continuous traverse surveys or astronomical observations, the surveyor studies the photographs while on the ground, adding such notes as will serve to properly interpret the information shown thereon, either for mapping purposes or other purposes for which the photographs may be used in the future development of the country.

Plotting of Photographs

All the control information, such as traverse surveys, latitude and longitude observations, and features tied to the observation stations, is plotted on a scale of one mile to an inch on a projection or compilation sheet on good quality paper. This provides the framework for plotting the oblique aerial photographs.

Before plotting is commenced the photographs are arranged so that those on which ground control has been marked, as well as those comprising the central views of each set taken on a straight flight joining such controlled photographs, become readily available. The photographs on which ground control is located are then examined, and the information shown on them which is to be transferred to the map is accentuated thereon with white ink or otherwise. This information is then plotted from the photograph by superimposing on it the proper glass grid and noting the particular grid square on which the feature to be plotted lies and drawing it in its relatively correct position in the corresponding square of the plotting paper. Square by square this operation is proceeded with until the plot is completed, when it is then transferred to the projection sheet on which the control is shown.

The glass grid serves as a graphical method of rectifying to the scale of the projection sheet the portion of the photograph represented by the features accentuated thereon. The area covered in an oblique aerial photograph of the mapping type is trapezoidal in shape, having an approximate foreground width of 1.4 miles and diverging sides extending from the foreground to the apparent horizon. Only a small part of the total area, however, namely that which lies towards the foreground, is usable, as the scale becomes very small in the background part of the photograph. If the ground area shown in the plottable part of the photograph were assumed to be divided by two series of equally spaced parallel lines — each spaced ten chains apart — and if one series of such lines were made parallel to the vertical plane containing the camera axis, while the other series intersected the former at right angles to form a system of squares, a true perspective diagram corresponding to such ground squares could be readily constructed for a particular principal distance, depression angle and altitude of air position. By having an intersection of two lines conform with the principal point and marking the apparent horizon in its relatively correct position on such a diagram, the proper orientation of such a diagram on the photograph is facilitated. In this manner the drawing of each grid is carried out to a scale four times its natural size. The drawing, with its markings to designate the factors entering into its construction, is then photographically reduced and prints from the negative obtained are made by contact either on glass or celluloid.

Such positives are referred to as plotting grids. The principal distance used in the construction of the grid is the predevelopment dimensions of the camera's principal distance, or focal length, corrected for film contraction. The depression angle used is derived from the location on the photograph, relative to the upper marginal line, of the apparent horizon for the approximate altitude; for convenience in plotting each grid is marked with the marginal distance of the apparent horizon expressed in tenths of an inch.

These plotting grids are available for use with the cameras on hand and have been constructed for such apparent horizon marginal distances, differing through the range experienced in actual work by intervals of 0.1 inch and for such altitudes differing by intervals of 25 or 50 feet through the zone from which oblique photography is carried out. If an oblique aerial photograph is to be plotted which contains in the foreground two features whose distance apart is known, then the correct grid is selected after first plotting the two features by a trial grid. This latter is selected from those which have been constructed for use with the particular camera employed and with a marginal apparent horizon distance as nearly equal as is available to that of the photograph to be plotted, the altitude for which the grid is constructed being as near as possible the altitude indicated by the altimeter record or the approximate altitude of the plane. With the same marginal apparent horizon distance, the ratio of the true distance between the two features to that obtained in the trial plot, multiplied by the elevation used in the construction of the trial grid, gives the elevation used in the construction of the correct grid. The selection of the correct grid is thus readily made.

After plotting the photographs on which ground control points are marked, the central view of each set of photographs obtained along the flight between such controlled photographs is examined for the purpose of selecting a line which is usually referred to as an "azimuth line." This line should join two image points, one in the distant background and one in the foreground of the first central view, so that along it, or its extension, definite image points can be clearly identified on the consecutively overlapping central views of the succeeding sets from one end of the controlled flight to the other. This common line, when drawn on the plot of each oblique aerial photograph, will serve to orient them on the projection sheet. If the track of the plane were straight and coincided with the direction of camera pointing when the central view of each set was exposed, then the principal line or lines drawn from the principal point normal to the apparent horizon line would, in each photograph, represent the track of the plane. Such ideal conditions, however, are seldom encountered. To avoid the effect of changes in azimuth resulting from unevenness of the ground, the azimuth line should be chosen so as to be as near radial from the photo plumb points as possible.

Clearly defined points on opposite sides of the azimuth line in the overlap common to the right and left side photograph, respectively, and the immediate foreground of each central view of a set, are next chosen and marked in white ink on the photographs. The corresponding image points are also marked in the central part of the preceding central photographs, and the ground controlled points available, preliminary to a trial plotting of the azimuth line. The grids are then selected for plotting the photographs marked with the azimuth line and other selected points by noting, in the absence of other information, the record of altimeter readings provided with the photographs of the flight and choosing the grid constructed for the particular altitude as given.

In the trial plotting of the strip, only the marked-up points and azimuth line receive attention. Consecutive plots of such points in relation to the azimuth line serve as a check in the uniformity of the altimeter readings; and the overall length of the azimuth line as plotted from the photographs, compared with its true length as measured on the projection sheet, indicates the extent of correction, if any, to the elevations as marked on the grids used in the trial plot. The altitude of the correct grids to be used to effect closure in plotting the central strip of photographs is thus found and recorded on each photograph. All the information to be transferred from the photograph is next marked up on it, being careful to note, however, that owing to the overlap of the photographs along the line of

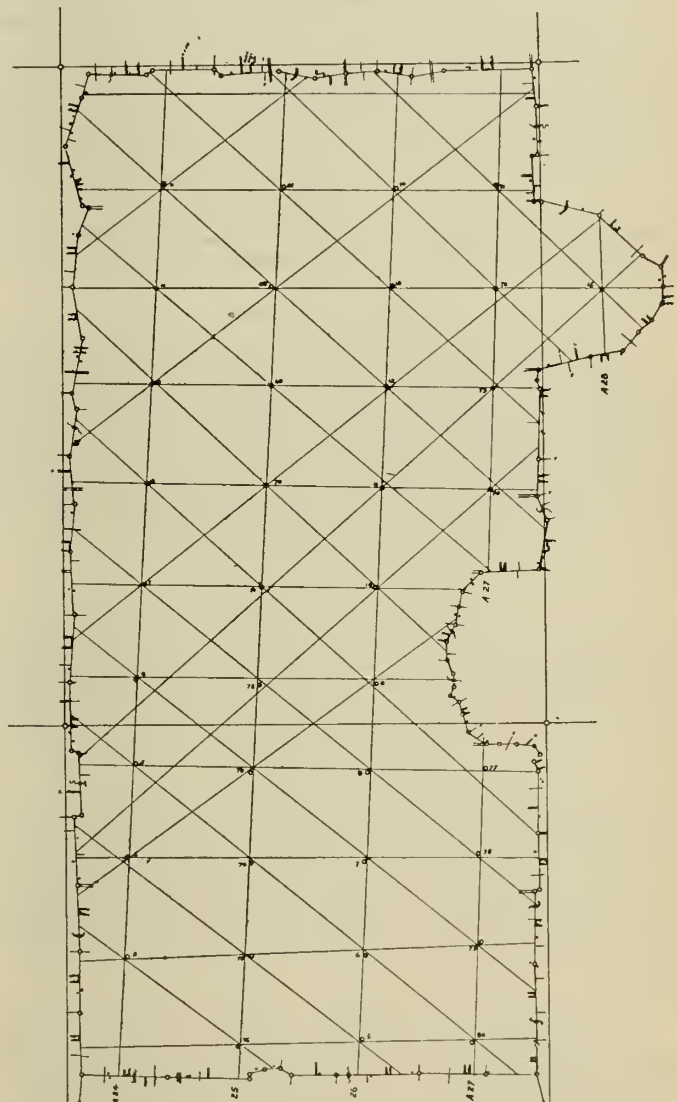

Figure No. 13.—Vertical Photographic Plotting by Straight Line Method—Development of Secondary Control from Ground Traverse.

Diagram showing control lines for vertical photographs as obtained by the straight line prolongation method, in an area the perimeter of which has been controlled on the ground by transit and chain traverses. When straight lines do not pass through the plate plumb points the photographs concerned are viewed stereoscopically and points which appear at about the same elevation are selected for the production of lines. The photo detail is plotted to this photo control by proportional dividers, points which are affected by relief being first fixed by radial intersections. The map graticule shown represent sa quadrilateral of 5′ of latitude and longitude. Details such as fence, stream and road crossing, houses, wood edges, etc., are indicated. This serves to tie in the positions of photo control lines where they cross the traverse.

flight it is not necessary to mark up topography on one photograph much farther from its foreground than a mile beyond its principal point. The individual plots of the central views are then transferred to the projection sheet on which the azimuth line has been drawn; and the plots of the side photographs of each set are traced on the projection sheets by superimposing the plotted positions of the selected side overlap points previously referred to.

When the plots of flights whose terminals have been controlled are fixed on the projection sheets, they serve to furnish control for fixing the plots of intersecting flights. The procedure heretofore outlined is repeated until all the plots of the photographs obtained on the flights over the area have been assembled on the projection sheet. The projection sheet which, as mentioned, has been drawn on the one-mile scale, and in four quarters, is next inked, making slight adjustments to effect continuity of topography where necessary and adding a few names of important topographic features, and the whole is photographically reduced to the two-mile scale. The draughtsman is supplied with prints on the two-mile scale which he assembles and on which he adds the remaining names, title, and any corrections required, and the whole is again photographed. From the negative obtained the photographer makes the zinc plate impression which goes to the printer.

Compiled Maps

The duties carried out by the staff engaged on this work might best be described as the general (or regional) geographic work dealing with Canada, which covers a very wide field. The map-making involved is much more diversified than that normally undertaken by organizations which work directly from information collected by their own field surveyors, under whose immediate direction and supervision the consequent mapping is done.

Sources of Information

As large tracts of Canada are still imperfectly known, it naturally follows that every possible source of information, every thread, official or otherwise, must be investigated and utilized to the utmost possible advantage in order to gradually evolve a more perfect knowledge of the country. As the organization does not maintain or control any field staff, it necessarily relies upon such information as may be collected by others which do employ field staffs. These sources of information, to name a few, are Dominion, Provincial, railway, exploratory and reconnaissance surveys, — development company and other independent surveys — all of which are made use of after a thorough examination has been made to establish their respective values.

General and Specialized Maps

In addition to the regular series of standard maps, based on scientifically fixed points, railway, river, boundary, cadastral surveys, etc., etc., the staff undertakes the compilation and publication of small scale maps of a general nature, railway, physical and political, ethnographical, commercial, historical, industrial, exploration, etc., for the use of the general public.

Other departments and branches as well as the Provincial Governments, requiring a map on which to present some special subject, are given transfers from copper-plates or from original finished drawings to provide the base for their map on which the required special information is added by the department concerned. By this arrangement considerable economy is effected by the avoidance of duplication of work. In addition, many other maps of various sizes and scales, from small sketch maps to large diagrammatic maps measuring 12 by 20 feet, have been prepared for other departments, branches, or individuals for illustrative or lecture purposes.

Methods of Reproduction

On the completion of a manuscript map, the decision is made as to the most advantageous method for reproduction. Should the work be of a more or less permanent nature, recourse is had to copper-plate engraving for subsequent transfer to stone or zinc for printing. In cases where the information available is of such a nature as to lead the geographer to anticipate considerable alteration occasioned by additional field work, the photo-lithographic process is usually adopted. The finished drawing is prepared and is transferred by photography directly to the zinc plate or stone. It has, on occasion, been found necessary to use photo-lithography in many cases where engraving would have been preferable but was not practicable on account of the difficulty of procuring a sufficient number of first class copper-plate engravers. In these cases the results have been exceptionally good.

While the map-printing is not done on the premises, it is closely controlled. All printing, done by contract, must conform to the specifications issued for each individual piece of work. These specifications give detailed instructions for the printers as to the method of reproduction, the stock (paper) to be used, copper-plates from which transfers are to be taken or in the case of a photo-lithographic or photo-zincographic job the correct scales of reduction, etc., the colours with their stipples, rulings and solids and their combination to produce the requisite number of colours with the least possible number of printings.

Method of Making Marine Charts

The nautical, or marine chart, being for navigation purposes, is a map only in the sense that it represents a portion of the earth's surface comprising both land and that unstable element, water, with more particular reference to the latter.

In charting, unlike land operations where everything is visible, one must locate the unseen, against wind and tide. Few mariners, and still fewer landsmen have any knowledge of the operations necessary to produce this indispensable guide to navigation: on the other hand the hydrographic engineer requires a fair knowledge of navigation in order to construct a chart and compile sailing directions for the mariner.

Early Hydrography

Many years ago considerable charting of the waters of Canada was carried out by the British Admiralty. However, owing to the primitive equipment available, using sailing ships and covering large areas, the surveys amounted to little more than a delineation of the coast-line, and few soundings were taken except in the cases of important harbours where an attempt was made to produce a finished chart. These charts were barely adequate to meet the demands of the then existing commerce. Sailing ships never approached the shore except in the vicinity of a harbour, and the saving of time was of little moment.

Present Conditions

Today everything has changed; wood has given place to steel and sail to high-powered steam or motor ships of deep draught and great speed, demanding the best charts that man can produce not only for the safety of the ship but also because in uncharted waters marine underwriters impose prohibitive rates.

The re-charting of the navigable waters of Canada is being carried out by a Canadian service, which was formed for this purpose. The activities of the service are wholly of a marine nature and, although quite separate from the other surveys engaged in the mapping of land, the closest co-operation is always maintained with the latter to avoid duplication of work and effect saving of time and expense.

Equipment

This service employs four steel sea-going steamers on the coastal waters of Canada, with an additional one to be added in the near future. The largest and best equipped of the above fleet is the C. G. S. "Acadia," a single screw high-powered steel steamer of some 1,100 tons displacement, built especially to meet surveying requirements and strengthened to withstand ice. The full establishment of this ship is about forty-five officers and crew, including the hydrographic engineer in charge and six assistants. The officer-in-charge has full responsibility for the upkeep, fitting-out and laying-up of his ship. This ship is equipped with the latest devices to promote efficiency and economy in charting, including the following:—gyroscopic compass; British Admiralty pattern echo sounding machine; usual radio equipment with the most up to date type of radio compass; deep-sea water bottles with thermometers attached, for oceanographical work; chronometers, transits, base-measuring chains, sounding and observing sextants, etc. The gyroscopic compass has proved a great convenience, rendering the true meridian available at all times, which in conjunction with a well-adjusted mariners' compass makes it possible to note magnetic variation as desired. The echo sounding machine is simple to operate and has a range of from 10 to 800 fathoms with, usually, a small operation error of 2 per cent. This method is a great improvement on the old device of line and wire, producing a deep sounding in a few seconds, which formerly would take several minutes to obtain, in addition to the stopping of the ship. Sounding may be carried on continuously at full speed, practically sweeping the bottom, and nothing passed over can escape detection. The ship's equipment includes three gasoline launches and boats fitted with outboard engines, so that several parties may operate at the same time in order to take full advantage of fine weather. The ship is usually fitted out at the port of wintering, and when ready for sea, and the compasses carefully adjusted, proceeds to the field of operations.

Procedure

The production of a coast chart comprises the following: —shore work; establishment of marks; plotting of a field sheet; obtaining of soundings; completion of field sheet; compiling of the fair sheet and printed chart.

On arrival at the scene of operations a location is selected for the installation of a tide gauge for the reduction of soundings to low water datum, and the establishment of a bench mark. Reconnaissance is carried out for the selection of main stations and a suitable place for base measurement, two or three bases being sometimes necessary as a check. If geodetic control points are available, considerable time is saved for devotion to hydrography. Observations are taken for latitude and longitude, usually at two points, and azimuths wherever possible. If the country under consideration proves flat and wooded, necessitating the building of towers and considerable expense of time, ship triangulation is resorted to. In this case stations are built on the coast eight or ten miles apart and the ship being anchored off-shore, a flag at the masthead is "cut in" simultaneously several times by observers ashore at three stations. Starting on a known side obtained from a measured, or geodetic, base very satisfactory results are obtained when the position of the ship has been carefully selected.

The main triangulation stations being built and observed, and the usual computations carried out, the field sheet is plotted, usually on a scale of one and one half inch to one nautical mile for a coast sheet, which would be published on a scale of one inch to one nautical mile. For harbour charts the scale is generally from 400 to 1,500 feet to one inch, according to the locality and circumstances. While the computations and plotting are being proceeded with, parties are employed coast-lining and building intermediate stations for fixing the inshore soundings and, when necessary, building special marks for off-shore work. This class of work is also resorted to during periods when the weather is unsuitable for operations afloat.

Oceanography

During the progress of the off-shore sounding, stations are occasionally observed for the obtaining of water samples at different depths for density and temperature, to be used for the investigation of ocean currents and fisheries. This work is also carried out when the ship is en route from one point to another.

Sounding

Sounding, or depth measurement, is the main object of the season's operations for the purpose of delineating the bottom contours, also the locating of, and obtaining of, the least water over shoals. The mariner having a well-sounded chart is enabled to locate his position off-shore with the use of the lead, or the sailing directions may caution him not to enter shoaler water than a certain depth in a particular locality in fog or at night. Sounding is generally carried out in parallel lines, approximately at right angles to the shore-line, that the area may be well covered. These lines are usually one cable apart to a depth of 10 fathoms and so on, being 10 cables or a mile apart in 100 fathoms of water, frequent sextant angles being taken to objects on shore to locate the soundings. The sounding of shoaler water is carried out in gigs or gasoline launches, two officers in each launch, the depth measurements being taken with a marked line. These soundings are extended off-shore a sufficient distance to ensure an adequate depth for the safe manoeuvering of the ship when connecting with the boat-work.

Examination of Shoals

The most important stage of the season's operations now commences. During the progress of sounding all depths obtained are reduced to low water datum from the tidal records and inked in on the field sheet. These are carefully studied for irregularities or uneven bottom, and every case is carefully examined on the water, and if considered necessary, swept with a wire device to ensure obtaining the least water. Sounding from the ship is carried off-shore as far as possible to fix the ship's position from the masthead. This work has been greatly facilitated by the use of the echo sounding machine by the utilization of which considerably more ground can be covered than by the old method.

Rough or Field Sheet

As the field work progresses it is plotted on the field sheet, and when the season is completed practically all the soundings have been inked in on this sheet. On reaching headquarters the sheet is completed as to the remaining coastline, topography, nomenclature and title.

Fair Sheet

On the completion of the field sheet a Mercator projection is laid down on the scale on which the finished chart is to be published, and all work is transferred from the field sheet to the fair sheet, representative soundings only, including all shoals, being selected, as it would be confusing to transfer every sounding obtained.

Aids to Navigation

As a result of the area being charted, the necessary aids to navigation, lights, buoys, etc., can be determined upon.

Published Chart

The fair sheet having been completed, including nomenclature, title, notes and tidal information, and aids to navigation, the printed chart is produced therefrom, either by transfer from the engraved copper-plate or by photolithography, the latter process being generally resorted to for a first edition if the engravers are fully occupied and delay likely to occur otherwise.

International Map of the World

No paper on maps and mapping would be complete without some reference to the International map of the world. The question of an international map was first raised at the International Geographical Congress at Berne in 1891, but notwithstanding several discussions, nothing tangible resulted until 1909, when the governments of the principal countries of the world sent representatives to a conference at London for the express purpose of discussing the possibilities of the production of a standardized series of maps on a scale of one in a million, which scale is approximately sixteen miles to an inch (15.78 miles to an inch). Canada was represented at this conference.

As a result of the conference the different representatives agreed unanimously on the desirability of adopting definite uniform limits for the map sheets of a map which might eventually cover the whole world and also recommended to the different governments the adoption of a uniform set of symbols and conventional signs.

Advantages of Uniformity

The advantages of such uniformity are obvious. It ensures that all the maps of this international series, no matter what country issues them, can be as easily interpreted as those of one's own country. The study of geography is simplified and encouraged and an added stimulus given to development work and to international commerce. Dealing with the effect upon international relations, the Honourable Sir Charles Hardinge, Under-Secretary of State for Foreign Affairs, said on opening the proceedings of the International Map Committee:

> "The more widely geographical knowledge is disseminated amongst the nations of the world the better will they know each other, and the more fruitful will be the cultivation of feelings towards each other of mutual respect, the forerunner of mutual friendship, and what is more priceless still, of international peace."

Canada's Contribution

Last year Canada's first contribution to this international map was issued in the form of the Regina sheet which conforms to all the requirements of the International Map Committee. The area covered is that between latitudes 48 degrees and 52 degrees and longitudes 102 degrees and 108 degrees. The city of Regina is situated fairly centrally in this area and its name has been adopted for the name of the map sheet. About one quarter of the area covered lies in the United States so that the production of the map necessitated co-operation with the United States map-making organizations, which co-operation was cordially extended. The scale of the map is 1 in 1,000,000, which is approximately sixteen miles to an inch. The area is contoured with 100-metre contours and the relief of the country emphasized by four separate tints of brown. Altogether, in producing the map it was necessary to employ seven separate printings, one for the black, one for the red, two for the blues and three for the browns.

Conclusion

In the descriptions of the several typical maps that have been selected it is largely the field work for which the surveyors and engineers are responsible that has been described. Although in some cases certain of the steps necessary for the office compilation, looking forward to the publication of the finished map, are indicated, no detailed attempt has been made to deal with the very great amount of additional work which has to be completed before the finished map sheet comes off the press. When the field work has been executed it is turned over to others whose occupation keeps them in the office, and to their skill and knowledge as compilers, draughtsmen, photographers, and expert printers is due in a very large measure the excellence of the finished product which goes out to the map-user.

Finally, in bringing this paper to a close the author desires to express his fullest thanks to all those in Ottawa and elsewhere who helped in preparing this paper, by furnishing so freely and generously so much valuable and instructive information for incorporation in it.

The Development of Radio in Canada

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Paper presented at the Annual General Meeting of The Engineering Institute of Canada at Ottawa, Ont., February 13th, 1930.

Canada, as befits a new and great country, has always been prompt to utilize new engineering and scientific developments, and in no field has this been more marked than in the way in which our government and our people have made use of the art of wireless, — or, as it has later become termed, radio communications — and without detracting in the slightest degree from the work of Marconi, in first conceiving the idea of using Hertzian waves for the purpose of communication, and then in developing the apparatus to attain this end, the importance of the contributions to the radio art, of that brilliant Canadian engineer, Reginald A. Fessenden, born at Milton, Ontario, are becoming more appreciated as the years go by, and it is a fitting tribute to Mr. Fessenden that within the last few months he has been chosen by the American Museum of Safety as the recipient of the "Scientific American" Medal for his contributions to the "Safety of Life at Sea."

Canada's first adventure into radio communication took place 29 years ago when in 1901, the late Mr. D. H. Keeley, a member of this Institute and Superintendent of the Government Telegraphs, entered into a contract with Mr. Marconi to establish two stations in the Belle Isle Straits, one at Chateau bay at the terminus of the landline on the mainland, and the other on Belle Isle, thirty miles distant, to replace the submarine cable which was continually going out of commission on account of icebergs.

It is a far cry from the thirty mile station of 1901, to the 10,000 mile station of today, but it was a still farther cry from nothing at all to 30 miles, and the promptitude with which Mr. Keeley seized on this new means of communication, at such an early date, to solve his difficulties, indicates that he, in common with so many of the founders of our Institute, possessed the true spirit of the pioneer. In fact not only did Mr. Keeley make the contract, but he personally contributed to the success of the experiment. In his report of November 1901, he naively states: "This Chateau bay installation was in readiness on Sunday the 20th October, when signals from Chateau bay were received at Belle Isle, but none were received at Chateau bay. The trouble, on investigation, was attributed to defective coherers, and the company's agents proposed abandoning the plant till next year in the absence of a fresh supply. On the 22nd, however, I personally succeeded in establishing communication and was thereby enabled to avert the threatened postponement of operations; and on the 25th, after considerable practice and careful directions, for all that the working of the system as it stands is erratic, I felt confident in leaving our operators in charge, with the explicit instruction as to future action."

While in this experiment, wireless telegraphy demonstrated its utility to replace a cable, it was in an allied field that it made its greatest contribution to progress and to the safety of human life, in providing the first means for communicating with a ship at sea, and accustomed as we are today to a condition where a ship is never out of communication wherever she may be in the world, it is difficult to appreciate, for instance that only a few years prior to the invention of wireless, the S.S. Borussia left Liverpool, with 344 souls aboard, sprang a leak in mid Atlantic and foundered; 160 persons went down on the ship, and 184 took to the boats of whom only 10 were eventually saved. It is of interest to note that the Marconi Company's records show that the first commercial equipment on board a liner was installed in 1901 on the Beaver Liner "Lake Champlain" plying from Liverpool to Montreal.

Those who heard Marconi during his trans-Atlantic broadcast a few weeks ago, will recall that the first trans-Atlantic signals were received at St. John's, Nfld., by means of an aerial supported by a kite on December 12th, 1901, and Sir Wilfrid Laurier, the Canadian Prime Minister, then in power, quick to appreciate the possibilities of wireless, invited the young inventor to proceed to Canada, with the result that a contract was entered into for the establishment of a transatlantic wireless service between Canada and Great Britain, the Canadian Government to pay a subsidy of $80,000 towards the Canadian stations.

Glace Bay, N.S., was selected as the site, and in 1902 the first messages were exchanged between the Earl of Minto, then Governor General of Canada, and His Majesty King Edward VII. After a somewhat prolonged experimental period, the first commercial trans-Atlantic service— in fact the first long distance service in the world — was inaugurated between the station at Glace Bay and one in Clifden, Ireland, in October, 1907, and it might here be added that the inauguration of this service contributed to the fact that we are today paying a toll of only 18 cents per word on our trans-Atlantic messages, as compared with 25 cents per word, the rate previously in effect.

Concurrently with the contract for the establishment of the first Glace Bay trans-Atlantic station, contracts were entered into for the building of a chain of twenty coast stations along the river and Gulf of St. Lawrence, to the Belle Isle Straits and from St. John and Halifax to Cape Race along the east coast. These stations were of comparatively low power and were installed in 1903, 1904 and 1905, and it is a tribute to the quality of the apparatus that at some of these stations in the more isolated points, where they do not cause interference, the major part of the original plant, is still in operation.

In 1907 work was started on a chain of 9 stations to provide communication along the coast of British Columbia, including the Queen Charlotte Islands, and in 1912 a third chain of eight stations was established from Port Arthur to cover the Great Lakes, incidentally linking up with the east coast chain at Montreal.

At all these stations constant watch was maintained, day and night, 365 days a year, or throughout the season of navigation, as the case might be, and from the time a ship was 250 miles from our shores she was in constant touch with one or other of the stations until she reached her final port.

The original stations all carried about the same plant, the prime mover was a 4 h.p. engine and the transmitter was of the spark type rated at 2 k.w. At first coherers, and shortly afterwards magnetic detectors (the latter due to the research work of Dr. Rutherford of McGill University), were used for reception, and the working range of this combination was some 250 miles.

As the art progressed, higher powered and more efficient sets using the same type of transmitter of 5 k.w rating replaced the original outfits, and with the more sensitive crystal type of detector the range of the stations

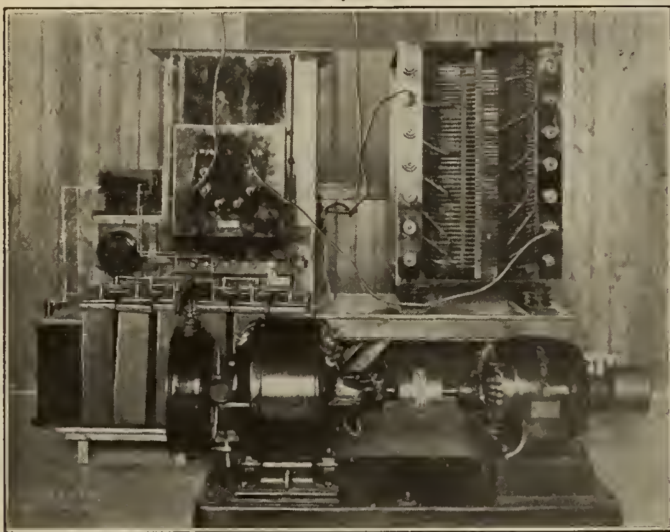

Figure No. 1—Spark Type of Transmitting Apparatus Originally installed at Station on the Great Lakes.

was materially improved. Nevertheless the general design remained fundamentally unchanged, except in minor details, until the year 1918, when transmitters employing the vacuum tube began to be universally adopted.

Prior to this, radio engineers had long recognized that damped Hertzian waves, such as are created by an electric discharge across a spark gap, were by no means ideal for wireless communication. Such transmission occupies a broad band in the ether and its carrying powers are limited.

It is believed that the first practical method of producing a pure continuous wave was due to Dr. Fessenden, when in 1908, he built a high speed alternator making 20,000 revolutions per minute, which gave a frequency of 100,000 cycles. (3000 metres.)

The frequency of an alternator is, of course, a function of the speed, and as there are physical limitations to the latter, it was not found practicable to develop an alternator which would produce electric waves of the frequencies then used for ship to shore communication of the order of 1,000,000 cycles per second. (300 metres.)

For long wave long-range work, however, the alternator was a success, and the General Electric Company developed machines capable of an output of 200 k.w. with frequencies of the order of 30,000 cycles (10,000 metres) which were extensively used for trans-atlantic and other long distance services.

It may be remarked that it was whilst experimenting with these continuous waves that Fessenden contributed his principle of heterodyne reception to the radio art, —a principle simple but eminently effective, and one which is used for reception at all continuous wave radio-telegraph stations today.

Marconi endeavoured to obtain continuous waves by means of a timed spark arrangement, while Poulsen made use of the negative characteristic of an arc in hydrogen. Prior to the war, a large trans-atlantic station of the latter type was built in Canada at Newcastle, N.B., and two or three smaller sets were installed by the Marine Department in coast stations. However, these were all temporary expedients waiting for the development of the vacuum tube, and such of them as are still in existence, will, together with the alternators, ere long be relegated to the historical museum along with the spark sets and be replaced by the three element vacuum tube.

This tube is due to the work of Dr. Lee DeForest of New York, who in 1907, experimenting with the two element vacuum tube detector developed by Fleming, conceived the idea of introducing a third element into the tube, which he called the grid, and thereby he made possible the present phenomenal development in radio, though it is doubtful whether at that time DeForest had the slightest idea of the revolution he was about to inaugurate.

It may perhaps seem strange that this tube can be used both for reception and transmission. However, every one who owns a radio broadcast receiving set probably has a nightly demonstration of the latter, when the owner of a neighbouring one tube regenerative set proceeds to whistle through his concert. He is using his receiving tube as a transmitter and it is made audible to the receiving set through Fessenden's heterodyning effect. In a large transmitting station there is merely a repetition on a large scale of what goes on in the one tube regenerative set. With a vacuum tube transmitter it is possible to produce a pure continuous wave and at the same time to control it when using high power. As compared with a damped wave a continuous wave travels a much greater distance for the same expenditure of energy, occupies a very much narrower band in the ether and when modulated with a microphone it enables us to transmit sounds at voice frequencies.

The large investment in Canada and througout the world in ship-to-shore spark equipments delayed the early adoption of the tube type of transmitter, but insofar as Canada is concerned, the advent of broadcasting rendered such a change urgently desirable in the interest of broadcast listeners, and the Canadian Marconi Co. having, on our behalf, developed a tube transmitter suitable for coast station operation, the government embarked on a programme of replacing all spark sets in its stations, commencing with those in the more populous centres such as Toronto, Montreal, Vancouver, etc., with the result that today, except in one or two isolated points, all our stations are operating on continuous wave.

This transmitter is rated at 1600 watts output and has a frequency range of 500 to 100 kilocycles. For convenience in handling, it is divided into five units, viz., rectifier, oscillator, closed circuit inductance, closed circuit condenser, and aerial tuning inductance. The components of each unit are mounted on angle iron frames which are covered with wire mesh screens to prevent accidental contact with high voltage conductors. All high voltage parts are insulated with porcelain. Power is supplied to the set at 220 volts 60 cycles. This is stepped up to 20,000 volts, and double wave rectification is carried out by two rectifier tubes. The resultant direct current at 10,000 volts, after being passed through a filter, is fed to the anodes of two oscillator tubes operating in parallel in a Hartley circuit. Small transformers of suitable ratio supply current for heating the filaments of the oscillator and rectifier tubes. The condenser in the closed circuit is insulated with porcelain and uses air as the dielectric in order to avoid possible trouble which might result from failure of a solid dielectric such as mica. The aerial tuning inductance is coupled to the closed circuit by means of an aperiodic link and both the closed and aerial tuning units are equipped with selector switches for quickly changing to any one of four predetermined waves. Interrupted continuous wave transmission is obtained by means of a motor driven tonic train wheel and the set is also equipped with a small low voltage motor generator for supplying direct current to operate the keying relay and magnetic send-receive switch.

The keying relay interrupts the primary of the power transformer of the rectifier and also a fraction of a second afterwards a second contact interrupts the grid circuit of the oscillator tubes. This is necessary in order that the morse characters transmitted should be sharply defined.

The transmitter is completely controlled from the operator's desk.

For ships, sets of a smaller and more compact type were developed, and those standardized in Canada are the 500-watt continuous wave and interrupted continuous wave transmitter and the 100-watt continuous wave, interrupted continuous wave and telephone transmitter, short descriptions of which follow:—

The 500-watt ship equipment is a one-unit set delivering 500-watts of high frequency energy to the antenna. It consists of a rigid angle iron frame upon which are assembled the component parts of the oscillatory and control circuits. Continuous wave and tonic train communication are provided over the wave range of the transmitter, and either method of signalling is available by throwing the signal switch mounted on the transmitter panel.

In laying out the transmitter, attention has been paid to the special requirements of ship use. The overall size of the unit is such that it will pass through the ordinary ship's cabin door. All vital parts of this transmitter are clear of the floor.

The transmitter has a wave range of from 600 to 2,400 metres (500 to 125 kilocycles) when used with an aerial having a natural wavelength of 250 metres, and a capacity of .0007 microfarad. Any one of four wavelengths in this range may be selected by a single operation switch. The transmitter is normally wired to permit of two wavelengths in the bands from 600 to 1,300 metres and two in the band from 1,200 to 2,400 metres.

A 2,000 volt d.c. generator, rated at 1,500 watts output and direct connected to a 110-volt d.c. motor, supplies the high tension power for the oscillator valves. This machine is provided with an automatic starter controlled by a push button switch from any convenient place. Provision is also made for opening the generator field circuit when receiving.

A low voltage generator, driven by a 110-volt d.c. motor supplies the heating current for the valve filaments.

The power supply for both motors is drawn from the 110-volt ship's mains. The two machines are independent of the transmitter and may be placed where convenient.

The insulation of the transmitter has been given careful consideration and is designed for an ample safety factor as regards creepage and flash over.

The 100-watt transmitter provides three classes of radio transmission, namely, radiotelephony, continuous wave and interrupted continuous wave telegraphy. It is

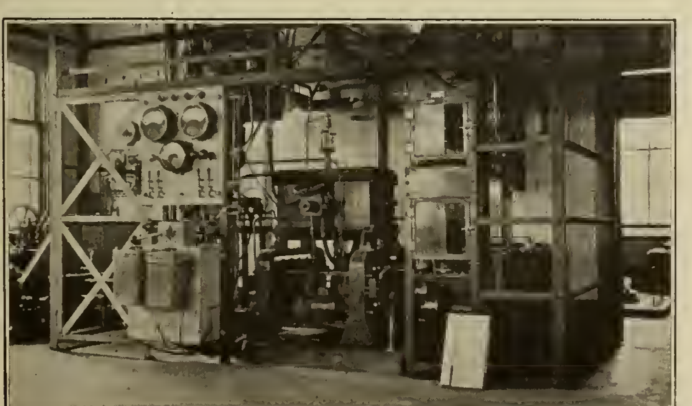

Figure No. 2.—25-Kilowatt Poulsen Arc Transmitter installed at Barrington, N.S.—Now Obsolescent.

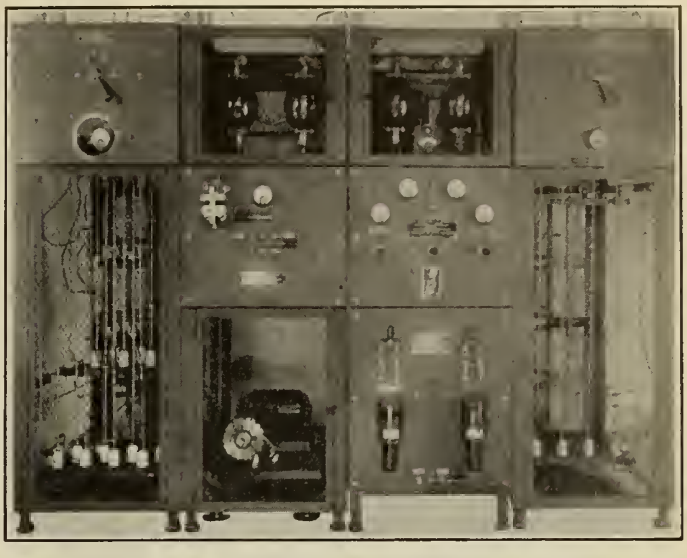

Figure No. 3.—1,600-Watt C.W. and I.C.W. Transmitter used at Canadian Coast Stations.

capable of deliverying 100 watts to the antenna when used for telephony or interrupted continuous wave and 150 watts when used for continuous wave signalling.

The apparatus is ruggedly constructed and is simple to install and operate. Protection to both operator and apparatus is afforded by the necessary screening, fuses, by-pass condensers, etc.

The complete equipment consists of transmitter unit, high and low tension motor-generator unit and associated control rheostat, power control switches, signalling key and microphone equipment.

The power equipment consists of a motor driving a double current generator supplying 1,000 volts d.c. to the valve anodes and 12 volts 12 amperes for the valve filaments and auxiliary equipment such as the tone wheel motor and high tension magnetic switch energizing coil. Switches are provided for the line voltage, and a control rheostat for the regulation of the generator field current.

The wavelength range of the transmitter is between 200 and 800 metres, (1,500 and 375 kilocycles) depending on the aerial dimensions. A wave-change switch is provided which permits the quick selection of any one of three fixed wavelengths within the wavelength band.

The oscillatory circuit is of the Hartley type excited by one *UV-211* Radiotron modulated by a second *UV-211* in the so-called constant current circuit. The microphone circuit is transformer coupled to the modulator valve. For continuous wave communication both valves are used as oscillators, a switching arrangement enabling this to be carried out.

Tonic train transmission is obtained by connecting a small motor and tone wheel with signalling key to the modulation transformer in place of the microphone.

Before being fed to the speech choke, the high tension supply passes through a filter which effectively suppresses the generator commutator ripple.

Modern Tendencies in "Ship to Shore" Traffic

For revenue the ship-to-shore stations look to traffic from ships, and in the early days, when ships could only work some two or three hundred miles, stations such as Cape Race and Belle Isle were of great importance and good revenue producers. For instance, the revenue from

Cape Race for the year 1920 was $82,000.00. Last year, however, the revenue from this same station was only $1,500.00, this being due to the fact that traffic can be much more effectively handled through a central station located at a point with good telegraphic facilities. On the east coast of Canada this service is provided by the Canadian Marconi Company's commercial station at Louisburg, N.S., and on the west coast by the departmental station at Estevan.

Even this arrangement is in a state of flux, as ships are now all turning towards short waves and it may well be that in the near future we will find the traffic going to short wave long distance stations situated at terminal points such as Montreal. Looking towards this end, the Marine Department has just commenced construction on an up-to-date radio station outside of Vancouver, B.C., which, equipped with long waves, intermediate waves and short waves, will be in a position to handle all traffic offering.

The cost and range of this station, as compared with that of the first one on Belle Isle, indicate the growth and change which have taken place. The contract price for Belle Isle complete with buildings was $5,000 and it had a range of about 50 miles. The station at Vancouver will cost $100,000 and on the short wave we expect to be able to take care of traffic from ships as soon as they have left Sydney, Australia, or Singapore, as the case may be.

Radiotelephone Service

An interesting development inaugurated by the Department on the Pacific Coast, in 1924, is a radiotelephone service to and from tug boats and other small vessels plying on the Coast. Radio telephone stations have been established at Vancouver, Merry Island, Cape Lazo, Alert Bay and Digby Island, (see map), and the service has proved of great value to tug owners, some forty-nine tugs being now equipped. This is purely a point-to-point service, and has not as yet been extended to the regular land telephone lines.

The number of paid radio telephone calls handled by these stations last year was 12,540.

Point to Point Communication

The chains of stations established by the government on the east coast, Hudson Straits, etc., whilst established primarily for ship-to-shore communication, serve a second useful purpose in providing facilities for communication with small stations erected at isolated points by private enterprise. On the Pacific coast, for instance, service is given to some 36 local stations located at canneries, pulp mills, etc., which have no access, and, on account of the rugged nature of the country, are not likely to have access to landline facilities for many years to come.

Figure No. 4.

An example recently brought to the public eye was the story of the MacAlpine expedition, which was handled through a small station established by the Dominion Explorers at Bathurst Inlet, communicating with the outside world through the Port Churchill station of our Hudson Bay chain.

Similar communication facilities are available to isolated communities in the interior of Canada through the medium of the radio stations operated by the Royal Canadian Corps of Signals along the McKenzie river in the North West Territories and at several other points across Canada at which that service maintains stations in connection with civil aviation activities.

Point to point communication is also extensively used by public utilities and power companies, for emergency in communication between their power plants and distribution centres in case of interruption of the normal telegraph or telephone communication, and an interesting experiment is being undertaken at this moment by the British Columbia Telephone Co. at Powell river, on the Pacific Coast, looking to the use of radio links in the establishment of regular telephone service to isolated points. If this experiment proves successful, a big development may be anticipated along these lines, there being hundreds of places in Canada to which it is not economical, up to the present, to extend regular telephone service, particularly in the case of plants and communities located on islands.

The use of this phase of radio service by the landline companies of Canada for emergency communication between their important centres in case of interruption of their landlines is also foreshadowed in the immediate future.

Radio Direction Finding

The first use of radio at sea was simply to provide communication, but as years progressed a development of major importance to navigation took place in the application of radio to direction finding, whereby it is possible to determine by means of special antennae and receiving apparatus the direction or bearing of an incoming signal. The principles involved in direction finding had been known for many years, but it required the invention of the vacuum tube with the immensely improved sensitivity of reception secured thereby to make it of utility as an aid to navigation.

Much work was done on this during the war, and the first direction finding stations in Canada were four established on the east coast in 1917, for war purposes. At the close of the war it was decided to continue these stations as an experimental aid to navigation. They were so successful that additional stations were established at Saint John, N.B., St. Paul Island, Yarmouth, N.S., Belle Isle, on the East Coast, and Pachena on the Pacific coast.

The Canadian direction finding stations give approximately 38,000 bearings per annum, and while they are not intended to supersede existing instruments of navigation they act as an accurate check. Fixes are obtained by intersection of the bearings from two or more stations, or a ship can navigate on a line of bearing, as for example, on approaching Saint John up the Bay of Fundy. As an instance of how navigators regard this comparatively new radio instrument, a letter may be quoted from the Captain of a 10,000 ton ship, which arrived in Halifax on December 31st last:—

Figure No. 5.—500-Watt Ship Type Transmitter developed in Canada.

Port of Halifax, N.S.
January 10th, 1930.

Department of Marine and Fisheries,
Radio Branch,
Halifax, N.S.
Dear Sirs:—

In submitting to you a report on D.F. bearings furnished by Chebucto and Canso Stations, the experience narrated hereafter may be of interest.

Being bound from Glasgow to Halifax, and following Track "E" of Atlantic Lane Routes, no position by celestial observation was obtainable after our crossing Longitude 40 West on December 26th, 1929, and recourse was had to W.T.D.F. bearings from Cape Race, first being obtained at a distance of 200 miles. From then onwards bearings were got at intervals and these were checked by ship's D.F. apparatus working on the Newfoundland and Sable Island Stations.

On December 30th a severe Southwesterly storm was encountered, during which steamer had to be hove to, and in six hours was driven 30 miles South-South-east. Bearings from Chebucto and Canso Stations faithfully recorded ship's retrogression.

After storm abated, relying entirely on position obtained by Wireless,—whereabouts by "Dead Reckoning" being merely a guess—a course was set for Halifax Inner

Figure No. 6—General View of the Canadian Direction Finding Station at Saint John, N.B.

Fairway Buoy, at which we duly arrived on the morning of December 31st. Indeed by carrying on long enough we should have collided with the buoy.

I venture to suggest that the W.T.D.F. Stations named could not be given a more severe test than under the circumstances recounted.

Here is a steamer navigated for practically 1,000 miles by W.T.D.F. alone, in a part of which distance and for a period of twelve hours she is exposed to a severe storm and driven far out of her course, various adjustments of courses steered are made as indicated necessary by D.F. bearings, and arrives at her destination not as much as a cable's length in error.

The writer respectfully commends to the attention of the Department the unfailing courtesy, promptitude, zeal and care shown by the Officers operating all Eastern Canadian Stations—D.F.—from Belle Isle to Redhead (Saint John).

Their dutifulness contributes in no small measure to relieve the many anxieties of those "Toilers of the Deep" upon whom devolves the safety of life and property afloat, numbered with the most appreciative of whom is,

Yours faithfully,

....

Master.

Our latest application of direction finding as an aid to navigation is in Hudson Straits and Hudson Bay, where radio may be said to have truly come into its own. There are no lighthouses—there are no fog alarms—and the magnetic compass is sluggish by virtue of proximity to the magnetic pole.

It should not be understood, from the above, that lighthouses or fog alarms have been superseded or will not be installed in these waters in the near future. Nevertheless, it is a tribute to radio direction finding that it was chosen as the most effective way of covering this long stretch of some 1,000 miles as a preliminary measure.

Four stations of the latest type are now in operation at Resolution Island, Hopes Advance, Nottingham Island and Churchill (see map) and have been fully utilized by the ships plying in those waters. The stations are manned the year round and provide a useful service in their weather observations which are of great value to the Meteorological division of the Department of Marine, in making up the daily weather forecasts. Communication with the outside world is maintained by a short wave link from Hopes Advance to Ottawa, by long wave communication between Resolution Island and Father Point or Belle Isle on the St. Lawrence system, and also via Port Churchill and the Canadian National land-line.

Those who are interested in the principle of direction finding will note that when a receiver is connected to an ordinary antenna a polar curve of reception is obtained in the form of a circle, that is to say, the antenna receives with equal intensity from all directions. If however, we substitute a loop antenna and move a transmitter around it through 360 degrees, we find that as the transmitter progresses around the loop, there will be two definite positions 180 degrees apart where the received signal will be of maximum strength, and two other positions 90 degrees from the former where the signal will be at minimum strength.

Similar variations of signal strength will be obtained if the transmitter is stationary and the loop is revolved. If a polar diagram depicting the variation of signal strength in relation to the angular rotation of the loop is drawn as shown in figure No. 9 there will be obtained what is usually referred to as a "figure of eight" diagram, consisting of two circles touching at the origin, minimum strength being obtained when the signals are arriving at right angles to the plane of the loop. Thus if we wish to find the bearing of a ship station we can rotate the loop until we find either the maximum or the minimum signal and we secure a line of bearing. In actual practice the minimum signal is always used, as it is much sharper and better defined than the maximum signal. It is not, however, necessary to rotate the loop, for the Canadian stations use the Marconi-Bellini-Tosi system, which employs two large stationary loops supported with their planes vertical and at right angles to each other. These large loops have much greater receiving power than the comparatively small rotating loop, and since by means of a goniometer arrangement due to Bellini and Tosi there is created in other loops in the receiving apparatus itself a replica of the fields in the large loops, we can secure the bearing by rotating a small search coil carrying a pointer travelling over a graduated scale.

It will be noticed that with a figure of eight diagram, it is impossible to determine on which side the transmitting station is located with reference to the loops. This ambiguity is overcome by combining the type of reception diagram obtained with an ordinary antenna (which as mentioned before is represented by a circle) with that secured with a loop antenna which gives the figure of

Figure No. 7—Interior of the Operating Room at the Canadian Direction Finding Station at Saint John, N.B.

eight. Currents from these two types of antenna, adjusted as to strength and phase, are combined in a common secondary circuit in the receiver, and the resulting polar diagram is a cardioid or heart shaped diagram with only one minimum.

In actual practice the heart shaped diagram is used only to indicate on which side of the station the ship is located, and the actual bearing is taken on the figure of eight, the latter being the more accurate.

The apparatus employed is made in Canada according to the Department's specifications.

Radio Beacons

Following the development of the radio direction finder, for use on shore, came the direction finder for use on board ship. The latter presented special problems in overcoming the effect of funnels, masts, and other large metal objects, which took time to solve, but today the ship's direction finder approaches the accuracy of a similar instrument ashore, and with the important advantage that it is the ship herself who takes the bearings instead of an operator ashore. The importance of this can readily be appreciated.

As a result of this there came into being what are termed radio beacons, which in effect are radio lighthouses, with a range of about 75 miles.

The first series of Canadian beacons were installed at Cape Bauld, Belle Isle straits; Cape Ray, Cabot straits; Seal Island, N.S., and on light ships located off Heath Point (Anticosti), Sambro, and Lurcher shoals.

They consisted of converted sets of the spark type and obtained their power supply from the prime mover of the fog alarm, being worked during fog only. They were operated through a period of useful experiment, and, sufficent data and experience having been secured to form reasonable conclusions, the Department, two years ago, embarked on a regular scheme of installation of an automatic tube type of transmitter. The apparatus was developed in conjunction with the Canadian Marconi Company, and now ten sets are in operation at Lurcher Lightship, Seal island, Cape Whittle, West Point (Anticosti), Pointe des Monts, Main Ducks, Long Point, South East Shoal, Cove island and Michipicoten island, with nine more in course of installation.

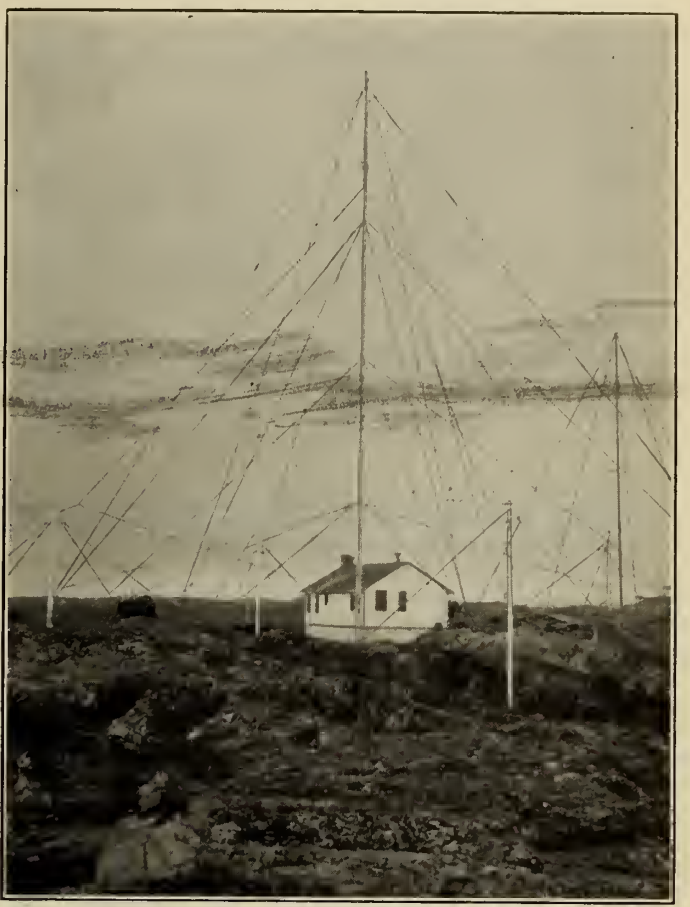

Figure No. 8—Resolution Island 1929—Direction Finding Station showing Combined Operating and Power House with Steel Mast Supporting Loop Aerials.

Our original idea of the beacon was the long distance fog alarm, but as our experience grew, the conclusion was reached that the navigator really desired a 75-mile lighthouse available day and night, 365 days a year, and the new apparatus is designed to attain this end. The transmitter is automatic in all respects. It has as a source of power a gasoline driven electric generator of the automatic start type, and the control of the whole equipment rests

Figure No. 9—Operators' Dwelling at Resolution Island showing Fresh Water Supply in Foreground and Acadia Cove in the Distance.

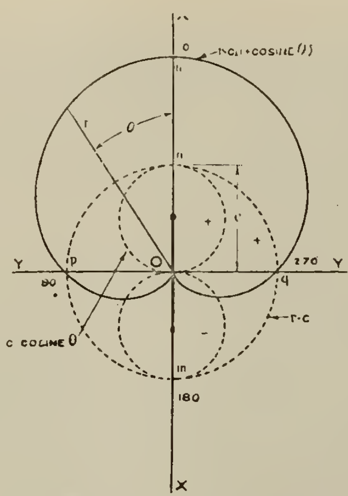

Figure No. 10.—Polar Diagram showing Types of Reception obtained with An Ordinary Aerial and a Loop Which Combine to Form the "Heart Shaped" Diagram with One Minimum.

in a master clock. Each beacon is given a characteristic, whereby it may be identified. In fine weather the clock automatically starts the engine once an hour and automatically puts the transmitter on the air for one minute and off for two, for a period of five minutes, when the clock automatically shuts the whole plant down. In foggy or hazy weather the lightkeeper throws what is called the fog switch and the beacon then functions automatically one minute on, two off, until the lightkeeper throws the switch back to fine weather schedule.

Details of the beacon transmitter may be of interest.

Four transmitting tubes are used, each rated at 50 watts output, arranged to work in what is generally called a back to back self rectifying circuit. The high tension for the anodes of the tubes is obtained from a 500-cycle alternator driven by a 110-volt d.c. motor. This alternator supplies current at 110 volts to the primary of a transformer which raises it to 1,500 volts. The secondary of this transformer is centre tapped and its outside terminals are connected to the anodes of two tubes operating in parallel.

This arrangement gives a note modulated at 1,000 cycles which is distinctive and can be read on a non-oscillating receiver. In addition it has the advantage of avoiding the necessity of using a thermionic rectifier or high voltage d.c. generator for supplying the high tension necessary for the tube anodes and the necessity of providing auxiliary modulating equipment.

Figure No. 11.—Radio Beacon at East End of Cape Whittle.

In order to obtain good regulation of the filament-heating current it is supplied at 60 cycles from a separate small converter.

A hinged gate at the front of the unit gives access to the tubes and is equipped with an automatic safety gate switch which interrupts the a.c. supply and renders the set dead when the gate is opened.

The brains of the equipment rest in a clock controlled time switch. The clock is a high grade eight day spring driven movement with balance wheel escapement suitable for use either ashore or afloat.

The usual hands are replaced by a disc which makes a complete revolution once an hour. This disc carries a series of pins or studs mounted on its face, which engage two light contacts possessing quick make and break features, called clock contact No. 1, and clock contact No. 2. No. 1 controls the starting and stopping of the engine-driven generator and No. 2 the duration of the transmission and silent periods.

Figure No. 14 illustrates the general appearance of the control clock, which is mounted in a water and dust proof metal case.

The source of power for the beacon transmitter is a 2-k.w., 110-volt d.c. generator, driven by and directly connected to a four cylinder gasoline engine rated at four horse power. This unit is automatically started from a 32-volt storage battery when a load equivalent to a 75-watt lamp is switched on across its output terminals.

This initial load is provided by a 150 ohm resistance connected in parallel with the energizing solenoid of a 110-volt shunt relay and is switched on and off by the No. 1 contacts of the control clock.

As soon as the circuit is closed by the No. 1 contact the engine driven generating unit starts and when it has built up to its full voltage of 110 volts, which it will do in approximately ten seconds, the shunt relay will begin to operate to close the remote control contacts on the solenoid operated starter of the motor alternator. This starter is of the progressive contact type and is adjusted, by means of an oil filled dashpot, to bring the motor alternator up to speed in twenty seconds.

The motor which drives the character disc is started at the same time and through the same operation.

Actual transmission is controlled by the second set of contacts on the time switch, and these are timed relatively to the No. 1 contacts so that transmission does not begin until one minute and forty-five seconds after the engine has been started in order to ensure that it will be running evenly and will drive the motor alternator at uniform speed under load.

The No. 2 contact on the clock energizes a relay to close or interrupt the primary circuit of the 500-cycle transformer, which supplies high tension to the anodes of the transmitting tubes. This circuit is closed for a one minute and fifteen seconds transmission period and then opened for a one minute and forty-five seconds silent period. This sequence is transmitted twice at the beginning of each hour day and night during clear weather and is repeated continuously during fog.

The character disc through a keying relay makes and breaks the same circuit to form the signals of the beacon characteristic.

When the clear weather hourly operating period of six minutes is over the clock opens the energizing circuit of the main starting relay which, in turn, drops out and opens the remote control circuit of the solenoid operated motor starter. This results in every output circuit of the generator being open and the engine shuts down.

Figure No. 12.—Combined Lighthouse, Fog Alarm and Radio Beacon Station erected on South East Shoal, Lake Erie, by the Canadian Government.

For continuous operating during fog, a single pole switch, located on the main control panel above the starting relay, is closed, short circuiting the No. 1 contacts on the clock. This takes the control of starting and stopping away from the clock and the generating plant will continue to run so long as the engine is supplied with fuel. The transmission and silent periods are still controlled by the No. 2 contacts of the clock.

In order to draw the attention of the attendant in case of overload or if the filament of a transmitting tube should burn out, an alarm bell operated through an auxiliary relay is provided. This auxiliary relay is energized from the 110-volt d.c. circuit in series with the overload trip coil of the circuit breaker and also through a differential relay in the filament circuit. Of the four filaments, two are connected in each side of the differential relay and under normal conditions the two sides are balanced and the relay is inoperative, but if one tube burns out the two sides of the relay become unbalanced and it will operate to energize the auxiliary relay and through it close the bell circuit. After the auxiliary relay has been tripped by the operation of either the overload or the differential relay the alarm bell will continue to ring until the auxiliary relay is reset by hand.

All beacons are provided with duplicate equipment throughout, and a transfer panel mounted between the two transmitters permits of using either engine with either transmitter and either control clock. (See figure No. 15.)

In connection with radio beacon installations, methods have been developed for synchronizing transmission of the radio signal with that either of a local fog horn or a submarine oscillator, in order to provide means for determining the distance intervening between a ship and the beacon. This is done by observing the time which elapses between the reception of the radio signal and the sound signal of the fog horn or submarine oscillator and by a simple calculation, based on the rate of travel of sound in air or water, as the case may be, a navigator can determine the distance with a fair degree of accuracy.

Long Distance Communication by Means of the Marconi Short-Wave Beam System

Canada's pioneer work in the matter of trans-Atlantic communication did not end with Glace Bay, and it is interesting to note that the first commercial long distance beam short-wave radio service was that established by the Canadian Marconi Co. between their station at Drummondville, near Montreal, and a station at Bodmin, England, which was put in commission on October 25th, 1926. Today hundreds of long distance short-wave stations are in operation in practically every country of the world, and, as a consequence, one of the biggest problems with which those charged with the administration of radio are confronted is to fit them all into the radio spectrum. A station in Montreal interfering with a station in Toronto is a simple matter to sort out, but a station in the Dutch East Indies interfering with a station in London which communicates with Montreal is a much more complicated affair.

Prior to the advent of the beam in 1926, long distance communication was usually carried on on long waves of from 8,000 to 20,000 metres, with frequencies of 37,500 to 15,000 cycles, but since that date there has been a complete revolution in this phase of the art, and while today there are a few long wave stations left, all new development is along short wave lines. Canada has two international short-wave circuits, the one to England above mentioned, and one to Australia opened by the Canadian Marconi Company in June 1928. The frequencies used on the British circuit are 18,180 kilocycles day and 9,330 kilocycles night, and on the Australian circuit the same frequency is used both day and night, but at night signals are shot around the world the other way. In addition there is an experimental short-wave voice telephone circuit between Montreal and London which we look forward to seeing in commercial operation in the not too distant future.

Those who listened in on the speeches given at the inaugural session of the Disarmament Conference had an opportunity of testing the quality of this particular short-wave circuit, over which the signals were brought to Montreal, where they were put on the telephone wires and distributed to the Canadian broadcasting stations from coast to coast.

Telephone communication with Australia has also proved entirely practicable, but it is doubtful if there is sufficient commercial demand for such a circuit to warrant placing it in operation in the immediate future.

The Canadian Marconi Company's beam transmitting station in Canada is situated at Drummondville, thirty miles east of Montreal, and the receiving station at Yamachiche, twenty-five miles north of Drummondville. These stations are linked up by land line to the central office of the Company at Montreal, from which the transmitter is automatically operated.

The moment the operator in Montreal presses his key or feeds his message tape into a high speed telegraph instrument, the signals he is sending are instantaneously recorded at the distant terminal office of the circuit, whether it be 3,000 miles away, in London or the longer distance to Melbourne.

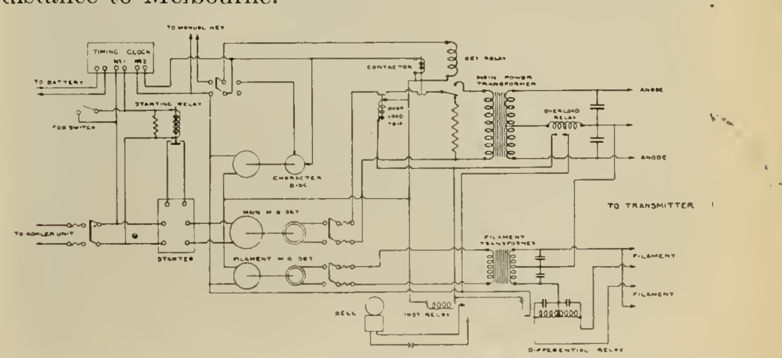

Figure No. 13.—100-200 Watt Radio Beacon Schematic Diagram of Automatic Controls.

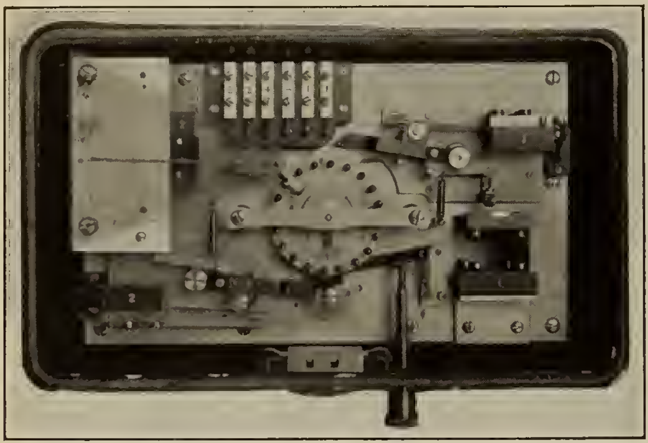

Figure No. 14.—Clock Operated Time Switch which controls the Automatic Transmissions of the Canadian Government Radio Beacon Stations.

Incoming signals from the corresponding stations are received at Yamachiche, and after being heterodyned to a lower frequency, amplified, and filtered, are conducted by landlines, consisting of open wire lines and cables, to the office in Montreal where they are automatically recorded and are transcribed for delivery to the addressee.

For convenience in briefly describing the beam system its distinctive features may be divided in the following four parts:—

(*1*) The aerial and reflector.
(*2*) The aerial feeder system.
(*3*) The transmitter.
(*4*) The receiver.

(*1*) The aerial systems at the transmitting and receiving stations are identical and are supported on guyed steel lattice masts, the exact height depending to some extent on the wavelength used. The usual height is about 277 feet with cross arms at the top measuring 90 feet from end to end.

The design of the masts and aerials is peculiar to the short-wave beam system and is entirely different from the design previously used in commercial radio stations. In the ordinary radio station the aerial consists of a series of horizontal wires suspended at a height on a line of masts and connected with the transmitting apparatus by a vertical or oblique section. With the beam system, the aerials consist of a number of vertical conductors forming a wire curtain suspended from horizontal supporting steel cables attached to the ends of the cross arms at the top of the masts. The aerial system is on one side of the masts facing the distant station and the reflector system similarly constructed is suspended on the opposite side.

There are usually five masts for each service erected in a straight line and aligned so that the great circle bearing on the distant station is at right angles to the line of the masts.

The usual spacing between the masts is 650 feet making the total length of each line of five masts about 3,150 feet.

The beam leaves the aerial system at right angles to the plane of the masts and follows the shortest or great circle track in the direction of the corresponding station and this station, being in the centre line of the beam, receives the maximum strength of signal.

Each service usually employs two waves and therefore two aerial systems, one for day and one for night working.

It may be interesting to note here that in the case of the England to Australia circuit, only one wave length is used projected alternatively in opposite directions. This is accomplished by arranging two similar aerials with one reflector between them, the transmitter being switched from one to the other as conditions require. This simplification was decided upon following the discovery during preliminary tests of this circuit, in 1924, that the position and altitude of the sun had an effect upon the transmission of signals, and that during the morning period the waves travelled from England to Australia starting in a westerly direction across the Atlantic and Pacific Oceans, following the great circle along the longest route, approximately 12,000 miles, but during the evening period they travel in an easterly direction over Europe and Asia, following the shortest route which is about 9,000 miles.

Each aerial occupies two bays between the masts and in radio parlance may be said to consist of a sheet of parallel elements made up of a number of vertical doublets linked by phasing coils.

The aerial wires are spaced about one quarter wavelength from a screen composed of twice as many reflector wires.

The aerial arrangement is such that the currents fed into the parallel wires of the aerial are all in phase. Under this condition the energy radiated from the individual wires cancels out in the plane of the wires, but adds in the direction at right angles to this plane.

The effect of the reflector is to cut off the back radiation from the aerial and to strengthen it in front, the total result being a strong beam of radiation confined almost entirely to one direction and spread over an angle determined by the dimensions of the aerial.

The calculated directional effect of aerials of different widths is indicated below:—

Width of aerial in wave lengths	1	4	20
Approximate horizontal angle within which practically all the energy is confined.....	180 deg.	30 deg.	6 deg.

The greatest energy concentration by directional effect for a given area of aerial, and therefore for a given cost, is obtained by having equal areas at the transmitter and receiver. Thus an aerial of 20 square wavelengths at the transmitter or the receiver may give a concentration equal to 200, but if divided into two aerials one at the transmitter and one at the receiver, each of 10 square wavelengths, the resulting concentration will be equal to 10,000.

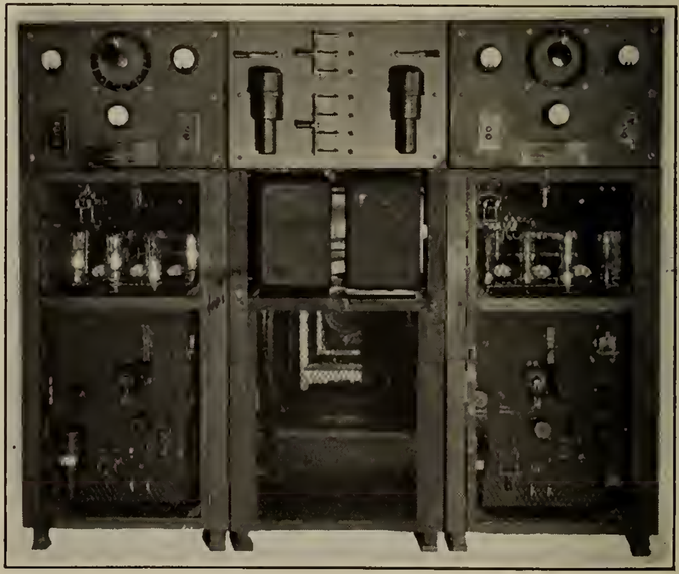

Figure No. 15.—Type of Transmitter installed at Canadian Government Radio Beacon Stations showing Duplicate Units and Transfer Panel.

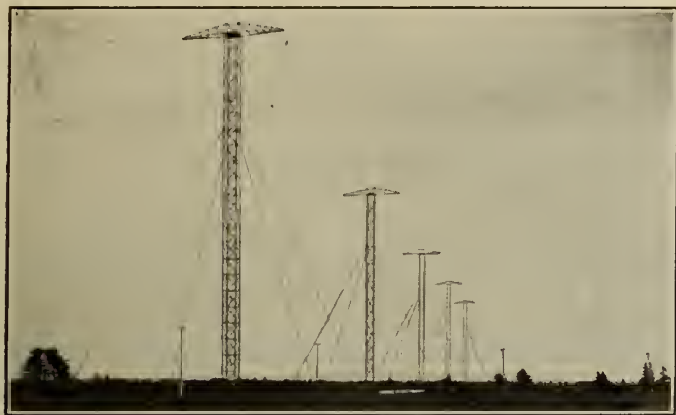

Figure No. 16.—Short-Wave Beam Receiving Station at Yamachiche showing Masts Supporting Reflector Aerial for Receiving from England.

(*2*) The feeder system by means of which energy is transferred from the transmitter to the aerial consists of concentric copper tubes, the outer one of which is earthed and the inner tube insulated from it by means of a special porcelain insulator. This feeder system is so arranged that the length of feeder to each individual aerial element is exactly the same, which ensures that the currents in all the aerial wires are in phase.

(*3*) The transmitter is specially designed to give great stability of wavelength, a point of the utmost importance in dealing with short waves; 20 k.w. is supplied to the anodes of tubes in the final amplifier stage, from which ample energy is fed through the feeder system to the aerial to permit of high speed working.

Stability of wavelength is obtained by means of a master oscillator which controls the frequency of the succeeding amplifer stages and also by careful arrangement and screening of the components. Stability of the emitted wave is further assured by diverting the high tension supply through resistances during the spacing periods and so keeping a constant load on the generators.

In order to deal with the high frequencies encountered in short-wave working, special transmitting tubes are used. These are oil cooled and operate at high efficiencies.

(*4*) The receiver is coupled to the reflecting aerial system by means of a feeder arrangement similar to that employed at the transmitting station, and consists of nine carefully screened units conveniently mounted on a vertical rack.

The signal in passing through the receiver, in addition to being amplified, has its frequency lowered by being heterodyned to a suitable value for efficient transmission over landline to the central office.

The receiver has incorporated in it band pass filters, which allow only certain narrow bands of desired frequencies to pass through, and the intensity of the signal finally transferred to the landline is automatically prevented from exceeding a certain maximum value by being passed through a limiting tube which has its grid so biased as to accomplish this end.

By employing circuits analogous to those extensively used in carrier current telegraphy for superimposing several communication channels on one physical wire circuit, each beam aerial can be efficiently utilized for the simultaneous transmission of telephonic and telegraphic messages or for the simultaneous transmission of telephonic or telegraphic messages without there being any mutual interference between these services.

Facsimile transmission can also be employed with the beam system over practically any distance.

It may be interesting to note here that the carrier current systems of telegraphy now being extensively installed by both the Canadian Pacific and Canadian National Telegraphs on their long heavily loaded landlines for greatly increasing their traffic handling capacity employ apparatus made possible by the use of thermionic tubes, first developed by the radio industry.

With regard to the relative advantages of the beam as compared with the older systems of long wave radio communication, the following may be cited:—

1st Less capital expenditure required.

2nd Less electrical power required to operate the transmitters.

3rd Greater speed of transmission possible. At present this is limited only by the mechanical limitations of the keying and recording instruments.

4th Due to the restriction of the radiation to a narrow beam, to the screening effect of the reflector at the receiving station and to the large number of wave-bands available, a greater number of services can be carried on.

5th Due to the screening effect of the receiving reflector the signal-to-interference ratio is increased, and consequently the traffic capacity is increased, because the possible sources of interference are reduced in proportion to the narrowness of the arc of reception.

The competition of the beam stations has introduced a new factor in international communication and as a consequence a merger has been formed in England to unite the British cable and radio telegraph systems into one.

One advantage enjoyed by the beam system over the cables is the fact that two beam stations capable of communicating half way round the world may be built for approximately half a million dollars whereas the cost of laying a permalloy loaded cable capable of working at similar speed is many times as great and increases in proportion to the distance separating the terminal stations.

In this regard it is interesting to note that a cable of this type laid between New York and the Azores, a distance of 2,328 miles, is reported to have cost four million dollars.

Radio Broadcasting

The extraordinary development of broadcasting is familiar, but it is not generally known that Canada is also a pioneer in this phase of the radio art. The Canadian Marconi Company commenced their first regular weekly

Figure No. 17.—Short-Wave Beam Transmitter at Drummondville, P.Q.

broadcasts from their station "XWA" at Montreal in December, 1920, on a wavelength of 1,100 meters, and they challenge the honour which Westinghouse, Pittsburgh, claims to hold. In protecting the interests of the broadcast listener Canada has been prominent. No other country in the world attempts any such service to broadcast listeners as we endeavour to give, in the matter of clearing up ship interference. In this Canada led the way by making treaties with ten countries, as early as 1925, arranging to have their ships stop the use of any wave in the broadcast band when ships flying their flag were on this side of the Atlantic, or the Pacific.

All spark transmitters on government stations at points where they could cause interference were scrapped and replaced by tube sets, and at the International Radio Convention at Washington in 1927, at which seventy-six administrations were represented, the policy of the Canadian Government was given international effect, and rules were drawn up making international the regulations and arrangements which previously had been in effect in Canada and the United States.

There are today in Canada upwards of half a million radio receiving sets and sixty-six broadcasting stations. The future of the latter is still to be decided. A Royal Commission on broadcasting was appointed to enquire into this matter a year ago, and its report will be dealt with by Parliament during the coming session.

Whereas many of the original stations employed transmitters rated at from 50 to 250 watts output, there are now several stations in Canada equipped with transmitters rated at 5,000 watts.

Our neighbours to the South are employing many broadcast transmitters rated at 50,000 watts, and transmitters of four times this power have been successfully operated in experimental tests, so that it is reasonable to expect to see transmitters employed in Canada of considerably higher rating than those at present in use.

Improvements have been incorporated in the design of amplifying and modulating equipment which now permit the carrier wave to be practically 100 per cent modulated, with the result that the effectiveness of the equipment is quadrupled as compared with the older type of transmitter which was capable of being modulated to only 50 per cent.

In order to prevent stations occupying adjacent frequency channels, which are only 10 kilocycles wide, from deviating from their allotted frequencies and so interfering with each other, crystal control of the carrier frequency has come into prominence. A piezo crystal consisting of a small quartz plate about one inch square is used to control a master oscillating circuit. The faces of the crystal are accurately paralleled and ground to a thickness associated with the frequency of mechanical vibration required. In order to insure frequency stability the crystal is mounted in a heat insulated chamber, the temperature of which is held to very close limits by the use of a sensitive thermostat controlling a heating element.

Tests of this method of control have shown that it is possible with ordinary supervision on the part of the operating staff to maintain the carrier frequency well within 100 cycles of the assigned frequency. When it is recalled that the carrier frequency may be as high as one and one half million cycles per second, control to within 100 cycles is a truly remarkable precision.

With broadcasting stations as originally constituted it was necessary that the programme to be broadcast should originate in a studio located in the same building as the transmitter. However, by the development of portable pick-up and amplifying equipment for use with the local telephone lines, and by improved methods of compensating the latter to give substantially uniform transmission of the frequencies involved, the possible separation of the point of origin of the programme from the transmitter was gradually extended.

The successful application of the thermionic tube to act as a repeater in long distance telephone communication circuits has had a marked effect on the extension of the distances over which such lines can be successfully operated, and in consequence, it is now possible to link up many widely separated broadcasting stations by means of wire lines, in order that a programme of general interest originating at one point may be simultaneously broadcast.

Two of the outstanding uses to which some form of thermionic tube has recently been put are in the development of television and in the production of sound motion pictures. The sound motion picture art has progressed with great rapidity during 1929, and the public reaction is one of increasing acceptance and patronage. The adaptation of radio broadcasting technique to this newest division of electrical engineering is an interesting example of scientific evolution and adaptation.

A few years ago the thermiomic tube was of interest primarily in radio and in landline telephony and telegraphy. Today it is a vital factor in a dozen industries and is of increasing significance in a score of others.

Even in this age of wonders the rapid progress made by radio stands out as phenomenal, and if we pause to consider its future possibilities, there is no doubt that, intelligently employed, it may become one of the most potent factors in bringing about mutual understanding among all peoples and the promotion of an irresistible sentiment in favour of universal peace.

The St. Hubert Airship Mooring Tower

R. de B. Corriveau, M.E.I.C.,
Assistant Chief Engineer, Department of Public Works, Ottawa.

Paper presented at the Annual General Meeting of The Engineering Institute of Canada, at Ottawa, Ont., February 14th, 1930.

Canada's share in airship development, determined at the Imperial Conference, was to provide, as one of the overseas terminals, a mooring tower. The Montreal airport, at St. Hubert, on this side of the Atlantic, selected in 1927 by representatives of the Air Ministry and the Department of National Defence, was placed under the jurisdiction of the Department of Public Works for construction purposes.

The airport, 615 acres in area, is a triangular plot, 90 feet above sea level, bounded by the Canadian National Railway, the Chambly highway and La Savane road, situated on the south shore of the St. Lawrence, seven miles from Montreal, in open country, free from smoke and other flying hazards. The Canadian National Railway and the Victoria bridge, with the new South Shore bridge and improved highways, provide connecting routes with the city.

Provision has been made for railway siding, water, electric power, telephone, hydrogen gas and gasoline fuel supply service to airships and aeroplanes. The Department of National Defence has established radio, wireless and meteorological services.

Airships are built and housed in huge hangars. Several hundred men have to be kept on duty to walk the airship in and out of the hangar in favourable weather. This can be arranged at military bases only. The British were the first to develop the mooring tower, and the mast—so called—at Cardington is the type of structure which the Air Ministry desired to have duplicated in this country.

Following the visit of Major G. H. Scott of the Airship Development Directorate, and Mr. A. R. Gibbs of the Directorate of Works and Buildings, we were supplied with complete plans of the Cardington mast, and the Air Ministry in co-operation with Messrs. Babcock and Wilcox, of London, further improved the design of the mooring head, which was later fabricated in England and shipped here for erection.

In adapting the plans for the steel structure, slightly heavier sections had to be used and certain changes were made to meet conditions in this country.

The Canadian mooring tower is a self-contained structure, anchored to concrete footings.

At the base of the tower is a two-storey building, cruciform in shape, to house the mooring winches, heating plant, etc., and to provide lobby entrance, retiring rooms and offices.

Fairleads for side cables to yaw winches are located 250 feet from the centre of tower. There are 24 concrete blocks, spaced at fifteen degree intervals, on the circumference of a circle of 750 feet radius. These are for anchoring the 25-ton snatch blocks through which the yaw cables pass from nose of ship to fairleads.

The tower is an octagonal structure 171 feet high, surmounted by a steel plate turret 25 feet in diameter, from the top of which projects a telescopic mooring arm to which the nose of the airship is attached. The total height of the tower to the top of the mooring arm is 205 feet, and the arm can be extended 7½ feet.

This telescopic arm, weighing 15 tons, is mounted on gimbal bearings and counterweighted, through a system of cables and pulleys, to swing thirty degrees from the vertical and in any position of the compass. It is operated by compressed air. When the ship's cone is cupped, the arm is contracted, brought back to its vertical position and locked so as to permit the ship swinging with the wind.

The tower proper is made of steel and is composed of eight posts on a base 69 feet 2 inches in diameter, and drawn in to a diameter of 25 feet 8-1/16 inches at the passenger platform level, 171 feet high. The posts are braced diagonally between levels of horizontal bracing, which occur at intervals of 28 feet 4 inches. In addition to this regular system of horizontal bracing, there is a heavy network of I-beams 19 feet above ground to support the reinforced concrete floor, and another 29 feet above ground for the reinforced concrete roof of the building at the base of tower. There are horizontal struts supporting the searchlight platform, and heavy girders covered with checkered plate floors at the elevator landing and passenger platform. In the centre of the tower, there is an elevator and stair shaft 16 feet square. Four columns are placed at the corners of the elevator stair shaft, from ground to roof of base building, to support the floor and roof loads.

To support the Duntile wall enclosing the stair shaft, two additional columns made of 6 by 6 by ⅜ inch angles were riveted to the horizontal bracing on each of the four sides of the shaft.

The searchlight platform, 142 feet 6 inches above ground, is equipped with searchlights which are used to spot the anchorages on the ground, and, generally, to facilitate airship moorings at night.

A movable platform landing stage is provided on the passenger platform, connecting over the guard rail with the airship's gangway. Passengers descend a stairway inside the turret to the elevator landing, 14 feet 2 inches below, and then proceed by elevator to the lobby on the ground floor, 156 feet 10 inches below.

The elevator has a capacity of 3,000 pounds, travels at a speed of 150 feet per minute, and is operated by electric motor taking three phase, 60-cycle alternating current at 550 volts.

The stairway, 3 feet 3¼ inches wide of checkered plates, ascends around the elevator well, and the combined shaft, 16 feet square, is of framed steel braced on all four sides and completely covered in with Duntile hollow cement blocks. The interior is insulated with Ten-test fibre board one inch thick nailed to wooden furring. The insulating material, weighing 14 pounds per cubic foot, was manufactured to have an insulating value of 0.34 B.t.u. per square foot per inch of thickness per degree difference in temperature.

The low pressure steam heating plant installed on the ground floor consists of a 35 h.p. Spencer boiler, with direct driven automatic boiler feed and vacuum pumps, and was designed to heat the two-storey building to a temperature of 70° and the elevator stair shaft to a temperature of 50° F. in severe weather. Cast iron radiators were installed in the lobby, machinery house and rest rooms, as well as in the mooring head. In the elevator shaft, special fin-type radiators had to be used to fit the confined space. The heating plant is fired with oil and includes a jacket-heater and a 1,000-gallon oil tank.

Messrs. Canadian Vickers Limited, of Montreal, were awarded the contract to fabricate and erect the steel tower—645,000 pounds of steel, and to erect the mooring head—87 tons of steel and equipment. The unusual nature of this structural steel job called for special care in the preparation of detail drawings and fabrication, and every member was erected without the necessity of reaming. The mooring arm, 26 feet long with gimbal bearing, the whole weighing about 17 tons, was raised up the elevator well before erecting the stairway.

In the design of the airship mooring tower the contractors provided for a pull at tower head of 90,000 pounds with maximum stresses in the structure within the elastic limit, and a factor of safety against uplift of 1.325. The C.E.S.A. Standard Specification for Steel Structures for Buildings, No. A16—1924, was used. The calculated deflection at top of tower, due to 30 pounds per square foot wind pressure and pull of airship, is 0.995 inch.

The Cardington mast when tested by applying a pull of 67,200 pounds at the top deflected 1¾ inches and went back to the vertical.

The R-101 exerted a maximum pull of 33,600 pounds when riding a gale at the top of the Cardington mast. This dirigible was also reported to have veered over ninety degrees in less than one minute, without any serious strain to ship or mast at Cardington.

In connection with the swinging arm, there is a vertical two-stage air compressor direct coupled to motor at ground level. The compressor charges the air receiver at base of tower to a pressure of 400 pounds per square inch. It is reduced down to 150 pounds per square inch from this receiver and is supplied at that pressure to the receiver on the passenger platform by a 2-inch diameter flanged pipe line.

Air at 150 pounds per square inch is used for the locking cylinder, top and bottom, and for bringing in the ram against the resistance of the ship and the centreing gear.

The air is again reduced to 25 pounds per square inch pressure to the recoil receiver, which is slung underneath the passenger platform. This air is used for pushing out the ram and holding it out until the bucket or cone on the nose of the ship enters the cup on the swinging arm. A recoil gauge graduated in tons is fitted in the control cabinet to show the pressure under the piston in the cylinder of the swinging arm when the ram is hauled down by the main haul winch against the pressure of 25 pounds per square inch.

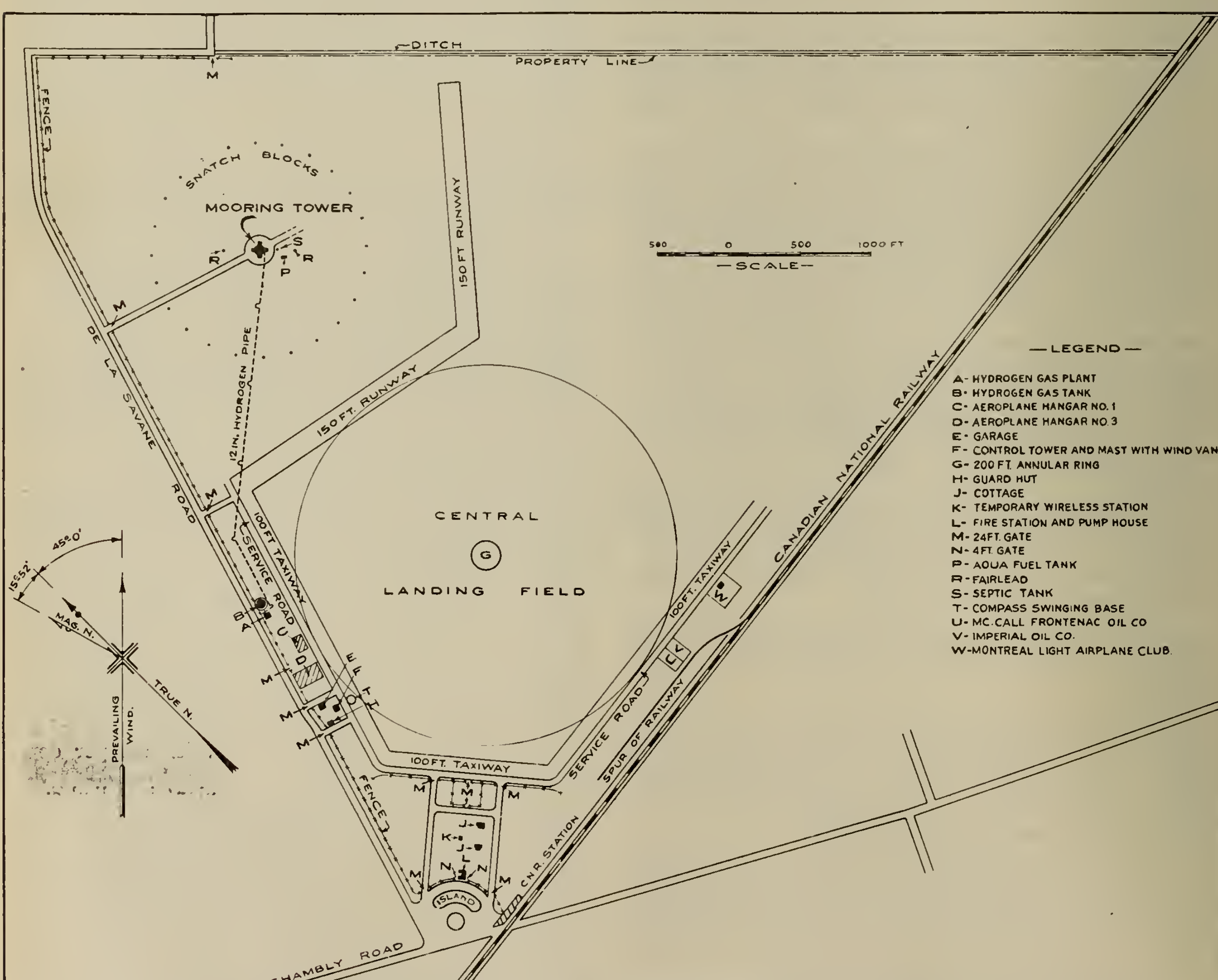

Figure No. 1.—Location Plan of Montreal Air Harbour at St. Hubert, P.Q.

The 400 pounds per square inch and 150 pounds per square inch air receivers are fitted with lock-up safety valves. The 25 pounds per square inch recoil receiver and the reducing valves are fitted with adjustable relief valves.

Each of the eight tower posts rests upon a concrete base 11 feet by 13 feet 6 inches by 9 feet 6 inches deep. These bases act as counterweights to prevent any uplift due to combined wind pressure on the tower and pull of the airship at the top tending to overturn the structure. Each post is anchored with four 2½-inch diameter bolts, 6 feet 3 inches long, which in turn are held in place by four 8-inch I-beams 5 feet 3 inches below the top of concrete footing. The weight of each base is approximately 105 tons.

The possible error in surfacing the concrete footing was 1/16 of an inch. In laying out the 32 anchorage bolts in the eight footings and on either side of a circle of 34 feet 7 inches radius, the resident engineer made use of wooden templets and so thoroughly checked up the locations that the bolts after being fully set in the concrete were found to fit exactly the base plates of the steel posts, which are rigidly connected together, and this facilitated erection of the steel structure.

The base building consists of 12-inch tile walls with stucco exterior, tile partitions and plaster finish inside, reinforced concrete floor and roof finished with copper flashings, metal doors and window sash, chimney, with all necessary plumbing and lavatory fixtures. The building contract also included the curtain walls of Duntile cement block and insulation of the elevator stair shaft.

The whole structure, except the building at the base, which is gray stucco, is painted black and chrome orange; these colours were combined to develop maximum visibility from the approaching airship.

All machinery in the tower is electrically operated; the power cable is carried underground a distance of 2,100 feet; two transformers step down the 2,200 voltage to 550 for machinery, and another transformer to 110 volts for lighting. There is a motor-generator set for charging the airship batteries, and a complete installation of motors and switchboard for all power and lighting services. The tower is flood lighted below the passenger platform, and the mooring head above has obstruction and operating lights. The electrical installation was carried out under the regulations of the Quebec Inspection Bureau.

To develop an adequate water supply for the airport, an arrangement was made with the Canadian National Railways to use St. Lawrence river water from the twin railway tanks at Southwark, 2½ miles from St. Lambert, where there is a hydrant pressure of 25 pounds.

A main of 8-inch class B pipe was laid along the Canadian National Railway right of way, a distance of two miles to the pump house on the airport property. The distribution pipes are 8-inch class D for high pressure raw water to the mooring tower, one mile distant, and 6-inch class C for high pressure raw water to serve hydrants, hangars, etc., located in another direction. To distribute domestic water, 4-inch class B pipe was laid in the same trenches as the high pressure pipes.

The pumps, filter, tanks, etc., are housed in a solid brick building, adjacent to which are located the raw water reservoir of 50,000 gallons capacity, valve chamber and fire station. The reservoir is of reinforced concrete and the roof and exposed side are banked with earth. The reservoir and valve chamber were built for enlargement to double capacity, when necessary.

Under the floor of the pumping station there is a clear water well of 12,000 gallons capacity. Coagulation and alum tanks, and filters, of reinforced concrete, are provided.

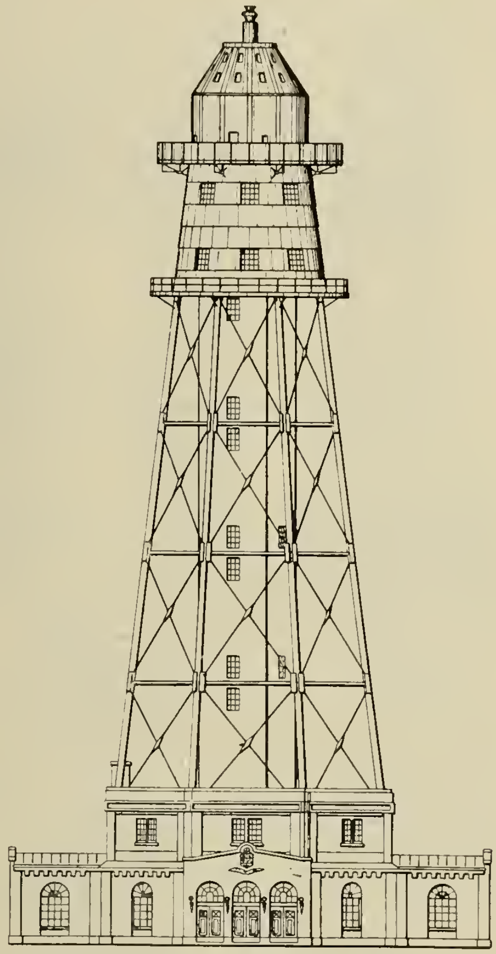

Figure No. 2.—Elevation of Mooring Tower, Montreal Air Harbour at St. Hubert, P.Q.

For raw water there is a centrifugal pump with a capacity of 250 gallons per minute against a head of 260 feet, direct connected to electric motor, and an auxiliary pump operated by gasoline engine. For domestic water distribution, there is an enclosed self oiling power pump of the duplex piston type, with a capacity of 100 gallons per minute against 150 feet head. This pump is automatic, stopping at 70 pounds pressure and starting at 50 pounds pressure. The water is pumped through a Tweed pressure tank of 1,500 gallons capacity. The auxiliary pump is of the centrifugal double suction type.

There is also a centrifugal high rate wash water pump in the pumping station. Booster pumps are installed at the base of the mooring tower to force the water up to total heads of 400 feet, for fuelling and ballasting the airship.

The water supply from Southwark is metered. A recent test showed the filtered water to be of high quality. The whole system was designed by Mr. F. C. Laberge, M.E.I.C., consulting engineer.

To deliver gasoline or Diesel oil to the fuel tanks of the airship, the Aqua flotation system was selected. This makes use of the principle that water and gasoline do not mix, and that the lightest and best gasoline always floats on top. The installation includes a 10,000-gallon pressure storage tank, placed underground and connected to the domestic water service. The water enters the tank under pressure and displaces the gasoline, which is forced up the tower through a 2-inch pipe. There are automatic valves with an auxiliary tank installed at the base of

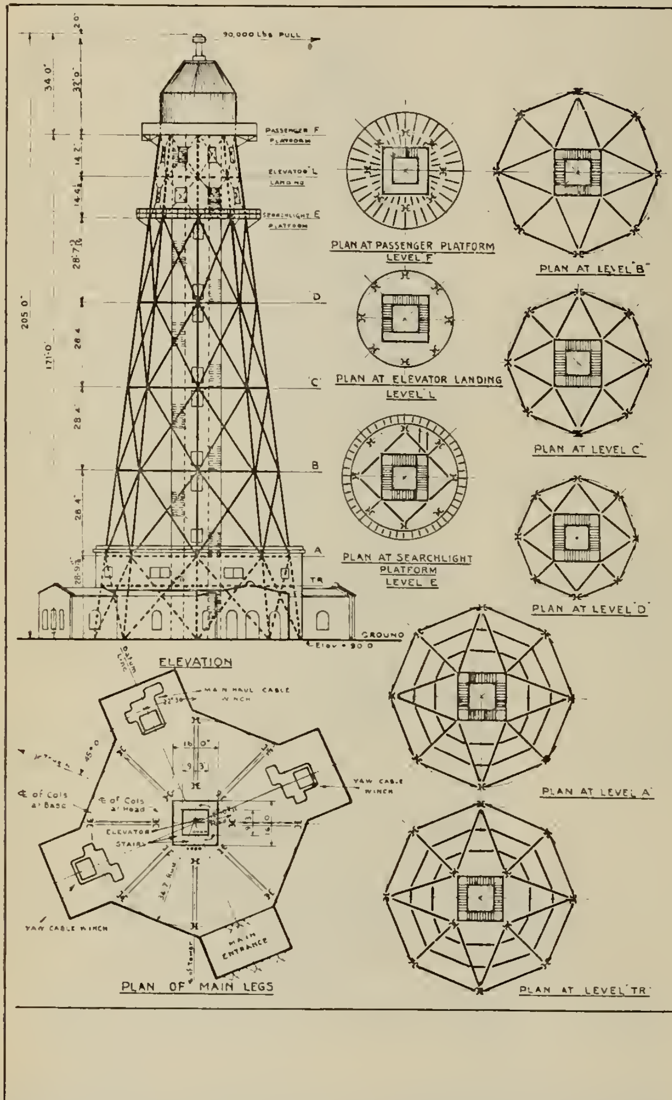

Figure No. 3.—Diagrams showing Elevation and Sections of Mooring Tower at Montreal Air Harbour, St. Hubert, P.Q.

the tower to prevent the water going above ground level and to control the gasoline supply. A sump pit and electric pump are provided to drain the water from the storage tank to field underdrains when gasoline is being stored into the tank. This sump pit is so located that it also takes care of the water seepage along the hydrogen main. The storage tank is equipped with a spray blending header, so that water under pressure can be used for blending fuel oil to any desired degree.

The R-100 requires 5,000,000 cubic feet of hydrogen to fill her gas bags. It is estimated that one-tenth of this supply has to be replenished after a trans-Atlantic trip. To meet this demand a Silicol hydrogen plant of 40,000 cubic feet per hour capacity and a gas holder of 50,000 cubic feet have been provided at St. Hubert.

There are two generating units each of 20,000 cubic feet capacity installed in a special building alongside the gas holder 2,500 feet away from the mooring tower, both being connected to a twelve inch low pressure hydrogen main. Ferro silicon and caustic soda are used to generate the hydrogen. The gas holder operates on a pressure of 5-inch water gauge and facilitates the movement of hydrogen by differential pressure in the gas main.

At the top of the tower the pressure is reduced through a regulator valve to 30 millimeters water gauge, and the hydrogen is then metered before it reaches the airship supply pipes in the mooring head. As the plants can operate above their rated capacity, provision has been made to meter up to 60,000 cubic feet of hydrogen per hour. All connections are electrically welded.

At the base of the tower, on the ground floor of the machinery house, are three variable speed electro-hydraulic winches; two for the yaw cables and one for the main haul cable. These winches are of the spur gear type, each operated by an electric motor through a Waterbury hydraulic transmission, and capable of handling a load of 33,600 pounds at 50 feet per minute and a light line at 150 feet per minute. When the airship's cone is being drawn into the cup of the mooring arm, the speed of the winches will be reduced to a minimum, as for inching heavy loads. Each motor is an a.c. 85 h.p. constant speed motor, 550 volts, three-phase, 60 cycles, 430 r.p.m., and is equipped with a hand starting compensator.

The drums are designed to hold 5,000 feet of ¾-inch diameter special mooring cable coiled in five layers. This is to provide for the larger airships of the future. For mooring the 5,000,000 cubic foot airships, 2,000 feet of cable has been provided for the main haul winch, and 3,000 feet each for the yaw winches. There is an automatic spooling device on each drum, and the main haul cable is guided by a fleeting sheave, 40 inches in diameter, and set 25 feet away from the main winch.

The base plates of the winches provide for the future installation of gasoline engine auxiliary power.

The drums are arranged to be disconnected from the transmission and act as free drums controlled by operator at mooring platform. Valves at control stand permit the flow of compressed air from the reservoir to brake cylinders at drums. The control of braking effect on the three winches can be directed from either of two positions.

There is a klaxon annunciator system for drum release at main haul cable winch and yaw cable winches.

The winches are further controlled from the operating platform by Selsyn-servo-motor remote control apparatus, consisting of transmitter servo-motors at remote control stands, electrically connected to receiver servo-motors mounted on top of the hydraulic transmission of each winch. There is also a cable tension meter for indicating the pull of the main cable.

To prepare for mooring, the main haul cable is let down to the ground through the mooring arm, and hauled to leeward 800 feet; the yaw cables are led through the fairleads and snatch blocks on either side.

The airship approaches slowly up wind and is brought down gradually to 900 feet, paying out its main cable through the mooring cone from a winch in the bow. The speed of the ship is eased off a little more, and the two cables are connected by snatch-coupling, the ground crew signalling to the ship and tower head. Ballast is dropped from the bow. The main cable tautens. The ship is then adjusted for trim and equilibrium, and signals the tower she is ready to haul down. The yaw guys are paid out from the ship's bow winches and connected up by snatch-couplings to the yaw winch cables from the tower. The guys are hauled taut and the main winch then continues to haul until the ship's cone engages in the mooring arm cup. The telescopic arm is contracted, centralized and locked. The ship cables are then unrove from the tower winches and reeled up on the bow winches. When ready to cast off the ship slips a pendant through the mooring arm.

In carrying out the construction of the mooring tower and providing the services connected therewith, the Department of Public Works had the active co-operation of the Department of National Defence through Mr. J. A.

Wilson, A.M.E.I.C., controller of civil aviation, and Group Captain E. W. Stedman, M.E.I.C., chief aeronautical engineer. Through the Department of National Defence, also, the necessary funds were provided, and consultation was had with the Air Ministry. Messrs. Babcock and Wilcox were represented by Mr. F. E. Williams, of their staff, on the erection of the mooring head by Canadian Vickers Limited.

The general plans and specifications for the tower and base building were prepared by Mr. F. G. Smith, A.M.E.I.C., bridge and structural engineer, and Mr. T. D. Rankin, architect. Mr. J. H. Ralph, A.M.E.I.C., electrical engineer, advised on electrical installation, and Mr. F. O. Hamel on matters of heating. Mr. J. A. L. Dansereau, A.M.E.I.C., district engineer in Montreal, and Mr. J. A. Adam, A.M.E.I.C. resident engineer at St. Hubert, had active charge of construction, under the general direction of Mr. K. M. Cameron, M.E.I.C., chief engineer, and the author.

Discussion of Paper on Rigid Airships by Group-Captain E. W. Stedman, M.E.I.C.(1)

MAJOR-GEN. A. G. L. MCNAUGHTON, M.E.I.C.(2)

General McNaughton remarked that the information which the author had given to The Institute was particularly apt at the present time when the great experience in the lighter-than-air field which was initiated in Great Britain in 1924 had reached the point where the new airships were completed and were undergoing their air trials. To engineers this project would be of particular interest because it was an excellent example of the application of scientific methods to the solution of a major problem.

In hearing Group-Captain Stedman's paper he had been struck with the fact that the early development of the airship was rather haphazard and that experience had been bought at the cost of some rather tragic failures. On reviewing the history of these failures it seemed evident that empirical methods of design had persisted long after the other branches of aeronautical engineering had been placed on a thoroughly sound scientific basis.

To the Air Ministry, acting on the advice of the Committee which had investigated the loss of the R.38, belonged the credit for changing all this. Fundamental research on air resistance, the distribution of the air loads and on the stresses induced in the various parts of the frame were undertaken, and, as a result, a design had been evolved in which the air resistance was less than half that of a ship of the same displacement built to the previous conventional form, while all redundant members were eliminated from the structure. This work was necessarily highly confidential and the first intimation received in Canada was from the advance copies of the documents prepared for the Imperial Conference of 1926.

All the Canadian officers who had the privilege of reading those reports were much impressed, perhaps not so much with the projected designs, which they were not in a position to appreciate, as with the thoroughly scientific manner in which the whole proposition had been developed, and also the fact that at last a type of design had been produced which was calculable in relation to the static stress in all members; also this design permitted the greater and far more important dynamic loads developed during manoeuvering to be predetermined with considerable accuracy. It was this that inspired confidence, and, with the able exposition at the Conference by the Secretary of State for Air, led to the notable offer of support by the Prime Minister of Canada. He said "the Canadian Government will only too readily co-operate with the British Government . . . by immediately taking steps to see that mooring masts to secure the landing places for airships in Canada are erected; also that the work of meteorological organization is commenced forthwith," and from that declaration, coming at a time when others hesitated, resulted the continuance of this great experiment and the satisfactory position in the matter which was evident to-day. In fact, it had been stated by Air Ministry and other officials in London that without that promise of support from Canada, implemented as it had been by the construction of an airship mast at St. Hubert, near Montreal, and by the organization of our Meteorological Service, a matter of the highest importance to air navigation, the work would reluctantly have had to be placed in abeyance. Initial steps for the organization of the required meteorological service in Canada were taken within a few hours following the announcement of our Prime Minister in London, and the St. Hubert mooring mast was erected just as quickly as designs could be got out and the material fabricated.

Thus Canada had a particular interest and pride in the achievements of these new ships, and all were deeply indebted to Group-Captain Stedman for placing the facts before Canadian engineers so that the final stages of the experiment could be followed with intelligent interest in the results used to guide our future development.

J. A. WILSON, A.M.E.I.C.(3)

Mr. Wilson had listened with a great deal of interest to Group-Captain Stedman's paper and the discussion contributed by General McNaughton.

Following the decision of Canada to participate in the experiment of developing airships for inter-Empire communications, Major Scott, who had commanded the R.34 on her trans-Atlantic flights in 1919, had visited Canada and made a thorough examination of many sites for airship bases from the Atlantic coast to Western Ontario. The location finally chosen was at St. Hubert, near Montreal. Immediate steps were taken to purchase the site and prepare a base for the reception of rigid airships, by the installation of a mooring mast, a hydrogen plant and refuelling facilities.

The work had been proceeding steadily for the past two years, and the engineering work has been in charge of members of The Engineering Institute of Canada in Ottawa and in Montreal. He desired to place on record his appreciation of the assistance rendered by the members of the staff of the chief engineer, Department of Public Works, on this novel project. They had had most valuable assistance from the Air Ministry, who had placed freely

(1) This paper was presented at the Annual General Meeting of The Institute, Ottawa, Ont., February 13th, 1930, and published in February 1930 Journal.

(2) Department of National Defence, Ottawa, Ont.

(3) Controller of Civil Aviation, Department of National Defence, Ottawa, Ont.

at their disposal the experience gained, not only in Great Britain, but in other parts of the Empire. The United States Navy Department had also been most generous in contributing valuable information.

With the benefit of all this experience they had tried to incorporate the best features from each country, so that the installation at St. Hubert was probably the most advanced of its kind in the world. The whole work was practically complete and they were now looking forward to the first visit to Canada of the R.100 in May of this year.

The trials of the R.100 and R.101 had confounded their critics. Previous to their launching, there had been a great deal of adverse criticism, but the results of the two ships' experimental flights had shown that they had come fully up to their specifications and the expectations of their designers. There was every reason for confidence that the whole venture would be an unqualified success.

It should be kept in mind that these two ships were not designed for passenger carrying on the trans-Atlantic route. The intention of the British Government in building them was to construct two experimental ships to fly to Egypt and India, in which would be incorporated all the fruits of the patient and careful research carried out before they were built. The results of their trials had shown that they are a great advance over any rigid airships ever constructed. Their success indicated the wonderful future which lies in the development of rigid airship construction.

Another gratifying feature was that we had our own men now under training during the trials of the two ships. The reports received from them had been more than satisfactory. One of our officers accompanied R.100 on a 53 hour trip recently made, under most adverse weather conditions, with fog and storm. The ship returned safely to her base, after a trying journey, in good condition, and her crew showed no sign of distress after their experience.

Mr. Wilson was of opinion that a great stride had already been made towards the solution of trans-Atlantic flying by airship.

Major-Gen. J. H. MacBrien[4]

General MacBrien enquired whether any advance had been made in dealing with ice formation on the covers of airships, and had provision been made for travelling in tropical climates. Further was there any hope of these ships being equipped with Diesel engines? The author had dealt with the design and construction of rigid airships in a most informative and interesting way.

J. H. Parkin, m.e.i.c.[5]

Mr. Parkin observed that up to the present time Canadians had had very little experience with regard to airships, and in view of the coming visit of R.100 to Canada this paper had been timely and would serve as a preparation for more intimate contact with aircraft of this type.

One part of the paper which had impressed him was that relating to the design of the transverse frames used in the construction of these two modern ships, the R.100 and R.101. In previous ships the transverse frames had been in direct contact with the outer envelope, and as a result the envelope had a series of transverse ridges which added a great deal to the air resistance.

In these two ships, however, the transverse ridges had been eliminated, since the transverse frames were not in contact with the envelope. This should much improve their performance.

(4) President, Aviation League of Canada.
(5) Asst. Director in Division of Pure and Applied Physics, in charge of Aeronautical Research, Ottawa, Ont.

Group-Captain E. W. Stedman, m.e.i.c.[6]

Group-Captain Stedman replied that the question of ice formation on the covers of airships was at present engaging the attention of all those interested in the work of air navigation. He pointed out that the initial flight of an airship to Canada was purposely to be carried out at a period when ice troubles were not likely to be encountered.

In early airships practically no provision had been made for heating the passenger compartments, but in the two British rigids the radiators from some of the engines were placed so that they could be put into the inlet of the ventilating air, and so provide heat for the passengers accommodation.

In reply to General MacBrien's question upon the engines to be used, the author said that this was a matter of great importance, and that in designing the R.101 the use of a heavy oil engine had been considered as one of the most important features.

With the R.100 it was decided, however, that the ship could not wait for the design of a suitable heavy oil engine, and, therefore, gasoline engines were used. These gasoline engines could always be replaced by heavy oil engines when such were available.

The airship R.101 was at the present time being enlarged by adding a central section which would increase the gas capacity by 500,000 cubic feet.

Mr. Parkin had raised a very interesting question as to the fabric cover of the new rigid airships. The cover of the airship R.101 was the subject of considerable criticism in England. This criticism seemed to have been due mainly to lack of sufficient information, because from the accounts of the trials it appeared that very little difficulty had been encountered in this respect.

With the R.100 the method of attachment of the fabric was different, in that wire rings passed right around the ship, and the fabric was attached to these wires. Some slight difficulties had been encountered with this method of attachment of the fabric, but these had apparently since been overcome.

At the time of the preparation of his paper very little information had been released upon the construction of the R.100, and, therefore, this information could not be included in the paper. The trials of the two ships had taken place since the paper was first written. The author would have liked to have completed the paper by giving more details of the R.100 and also accounts of these trials, but so much information is now available on these matters that another paper would be required to do justice to the subject.

(6) Group-Captain, R.C.A.F., Chief Aeronautical Engineer, Dept. of National Defence, Ottawa, Ont.

Discussion of Paper on the Engineer's Work in Surveying and Mapping by F. H. Peters, M.E.I.C.[1]

Dr. J. L. Morris, M.E.I.C.[2]

Dr. Morris desired to congratulate the author on his instructive paper, and also to compliment the government mapping services on the splendid work they had done and were now doing. He had used not long ago a map prepared by the Department of National Defence on the scale of two miles to the inch, in connection with an area of 32 square miles bordering the Detroit river, and in no place in checking up the scale was there found an error of more than 100 feet. This represented an accuracy of a very high order. He had made use of the plans prepared from this map and had distributed them to the surveyors and engineers in that part of the province of Ontario. That was only a part of the valuable work being done by the surveying and mapping services, and now with the co-operation of the Royal Canadian Air Force large areas were being covered in other portions of Ontario and in the hinterland bordering the provinces of Quebec and Manitoba.

W. H. Connell[3]

Mr. Connell observed that in the United States there had been a steady increase in the accuracy of surveying and mapping required for carrying out engineering projects, and he believed that, in the very near future, the accuracy of the surveying done for the location of highways and railways would be much greater than had hitherto been the case.

The modern demand for quickly-read, light and compact surveying instruments had resulted in some striking departures from conventional designs; for example, British manufacturers had made substantial progress with the production of transits in which circles of about three inches diameter might be read direct to one second of arc. This had necessitated the working out of an entirely new technique in the production of divided circles, since the ordinary method of engraving divisions on a strip of inlaid silver failed to meet the new requirements, and it had been found necessary to use circles of glass.

Speaking generally, the best modern transits and levels represented a saving in weight and bulk of about one-third, as compared with pre-war practice, but in achieving these considerable economies, the makers had been very careful not to impair the reputation which British-made instruments had so long enjoyed in regard to their robust construction and ability to stand up to the rough usage incidental to field work and transport. He knew of at least one firm which submitted its instruments to a thorough bumping test before issue—just as used to be the case with dial sights for the artillery during the war.

In designing surveying apparatus it was necessary to keep in view the very important question of repairs to damaged instruments in places far removed from workshop facilities, and hence, whilst introducing well-tried time and labour saving devices, undue complication should be avoided in ordinary field instruments.

(1) This paper was presented at the Annual General Meeting of The Institute, Ottawa, Ont., February 13th, 1930, and published in this issue of the Journal.

(2) Departments of Lands and Forests, Toronto, Ont.

(3) Managing Director, Cooke, Troughton & Sims, London, Eng.

Professor James Weir, A.M.E.I.C.[4]

Professor Weir remarked that the paper deserved the widest publicity, for in it the chief trustee in the matter of graphic description of the Dominion, the Surveyor-General, had given an account that appealed to all. Its non-technical treatment was an advantage.

Nowhere had there been a better illustration of plane-tabling and its concomitant operations.

He would particularly draw attention to the remarkable progress of oblique aerial photography in Canada. Few Canadians realized that in this matter during the past decade Canada had led the world. The factors explaining this were, the crying need of our vast hinterland for inventory, its worth while possibilities, the suitability of the terrain for this method of mapping, the impracticability of any other, the great war's lessons in aerial photography, the personnel available, and finally, the vision of the past and present workers in photographic surveying in Canada. The pioneer work in photogrammetry of the late Dr. E. Deville, and his basic development leading to present methods, should receive whatever tribute present successes might offer.

Professor Weir considered that the topographic maps prepared from oblique photographs were not mere "reconnaissance maps" as somewhere stated. They were complete, and amply accurate for the four-mile scale. In fact, such maps were the inevitable medium for a terrain such as the flat pre-Cambrian peneplain, whose unbroken horizons presented such obstacles to ground work that ten flying hours could bring home as much detail for mapping as ten seasons of ground work.

The author, modestly, had omitted any account of the enormous office labour such a mass of topographic detail required before the map appeared. In comparison with older methods the economy of time would alone be sufficient to justify the adoption of this method. The principles of linear perspective had never before been used to such an extent, nor had their application ever been so simple. The grid method was most ingenious.

A pleasing inference from the paper was the effective co-operation of the various departments of the federal government in advancing the work, and it was to be hoped that each provincial government would realize the paramount advantage of consistency in methods and results so vital in map production.

The necessity, in such a wide area, of mapping years ahead of possible geodetic control, however energetically the geodetic survey was being pushed, might cause some speculation as to the ultimate consistency of these sheets. Their standard was, however, not so absolute, and astronomic positions spaced at intervals of fifty miles or so would, for the present purpose, appear ample. A few hundred feet station-error on a four-mile map could cause but little concern. It was the present feasibility of a radio check on longitude that allowed him to venture on such a statement.

The author had given a most timely compilation and explanation of unique methods, derived from the experiences of very competent technical staffs to meet an urgent need.

(4) Assistant Professor of Geodesy, McGill University.

Discussion of Paper on the Aeronautical Laboratories of the National Research Council of Canada by J. H. Parkin, M.E.I.C.[1]

ARTHUR S. SUDDES[2]

Mr. Suddes considered that the acquisition of aeronautical laboratories in Canada would prove of inestimable value in research and development.

Being connected with aircraft engine assembly work in Canada, he realized the importance of having suitable equipment to carry out power tests for present and future type engines.

In connection with air-cooled engines considerable assistance could be given in investigations on the correct cooling of engines of this type. At the present time the majority of large powered air-cooled engines were of the radial type, but several makes of *in-line* air-cooled engines were being developed and doubtless it would be essential to have a testing equipment suitable for experimenting with these, and recording their cylinder temperatures at given power and air speeds. At the present time no such facilities were available in Canada and in his opinion the future prospects of aviation in this country certainly warranted the acquisition of aeronautical laboratories.

FLIGHT LIEUTENANT ALLAN FERRIER, A.M.E.I.C., R.C.A.F.[3]

Flight Lieutenant Ferrier inquired as to the velocity attained by the air, with the tunnel working at full speed, in the passages just before entering the open mouth of the nozzle. He would also ask whether it would not be worth while to fill in the corners in the wind tunnel and whether there was any particular reason for reducing the pressure in the experimental chamber below that of the atmosphere. Mr. Parkin had mentioned that this might be done.

With reference to the water channels it seemed to him that the results always obtained by constant velocity tests would not be exactly what was wanted; that is, the maximum resistances obtained after steady conditions had been reached would not be the same as the maximum resistances occurring in actual practice, where the conditions were changing. The velocity would be increasing all the time, and it would seem that a continuous record of the resistances from the beginning of acceleration until the time of "taking off speed," would be of great value.

The AUTHOR replied that the air would reach its lowest velocity in its circuit of the tunnel at the entrance to the nozzle where the cross sectional area of the tunnel is greatest. The cross section at this point would be 17 feet square, giving an area of 289 sq. ft., and the area of the 9 ft. diameter jet would be about 63.6 sq. ft. For a jet velocity of 150 miles per hour the velocity at the entrance to the nozzle would be $\frac{63.6}{289} \times 150$, or about 33 miles per hour, say 48 feet per second. Under these conditions there would be a pressure difference between interior and exterior of tunnel at the entrance to the nozzle of about 50 lbs. per sq. ft.

Flight Lieutenant Ferrier remarked that as the air was turning around a fairly sharp corner, and there was a corner on the outside which was absolutely rectangular according to the plans, it seemed to him that a few guide vanes could be omitted and the corner filled in.

The AUTHOR stated that in tunnels of this general type two constructions were employed for the bends in the air passages. In one the bend was of large radius and two or three large intermediate guide vanes were used. With this arrangement the air tended to crowd to the outside of the bend and the velocity distribution in the passage after the bend, therefore, lacked uniformity. In the other construction—that to be employed in the Ottawa tunnel—the bend was angular, of practically zero radius, and a large number of small vanes were placed along the diagonal of the bend. These vanes would break the air stream up into a number of small streams, each of which was turned separately.

The two methods were comparable, in the one case to a squad of soldiers wheeling as a whole, and in the other to the manoeuvre in which the change of direction was effected by each soldier pivoting on himself.

It was the aim to make the flow around the bends as nearly as possible laminar flow, which would result in the most nearly uniform velocity distribution in the stream. There would thus be very little corner to be filled in; the corner outside the last guide vane would, however, be filled in.

In respect to the pressure as previously stated, at maximum operating speed there would be a pressure difference between inside and outside of tunnel, at the entrance to the nozzle, of about 50 lbs. per sq. ft.; that is, if the experimental room through which the jet flows at 150 miles per hour were at atmospheric pressure, the pressure at the entrance to the nozzle (where the velocity is 33 miles per hour) would be 50 lbs. per sq. ft. above atmospheric pressure. It was expected that the experimental room would be maintained at atmospheric pressure for convenience of operation, ventilation, etc.

It might be necessary to adjust the pressure in the experimental room to some other value, if as had been considered, it were desired to bleed air from the tunnel at one point in the circuit and draw fresh air into the tunnel at another point, in order to prevent excessive rise of temperature of the air in the tunnel.

In tunnels of the Eiffel type, the pressure in the experimental room was below atmospheric, because with open return the pressure in the low speed part of the circuit would be atmospheric.

The question regarding the speed in the testing tank touched on a more or less fundamental principle. They started out by providing ideal conditions both in the wind tunnel and in the test tank, because they could not adequately define or control actual or non-ideal conditions. If a drive could be arranged so that constant speed over the test part of the run would be secured, then it would not be difficult to insert a variable control so that variable speed test runs could be made.

Flight Lieutenant Ferrier observed that reports of that nature were seldom seen.

The AUTHOR agreed as to the desirability of such tests, and said that with the system now in mind records could, if necessary, be made, starting at the beginning of the acceleration and covering the whole run, including acceleration, constant speed and deceleration. Even for the constant speed tests they were planning to start the recording drum some time before the constant speed part of the run commenced.

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(1) This paper was presented at the Annual General Meeting of the Institute, Ottawa, Ont., February 13th, 1930, and published in the February 1930 Journal.

(2) Chief Engineer and Works Manager, Canadian Wright Ltd., Montreal.

(3) Aeronautical Engineer for Research, Dept. of National Defence, Ottawa.

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THE
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The Past-Presidents' Prize 1929-1930

The subject selected by Council for the competition closing June 30th, 1930, is "The Engineering of Aviation." This subject may be taken as including any or all of the phases of engineering involved in aeronautical activities, and authors are expected to deal with broad features rather than with details.

It is recommended that in preparing papers the following directions be adhered to as far as possible:

Manuscript: Copy should be typed double space or triple space, preferably the latter, on one side of the sheet. Authors should retain carbon copies of their papers.

Illustrations: All illustrations and diagrams should be numbered, and a concise descriptive caption written on the back of each photograph or drawing. Photographic prints should be of glossy finish clear and distinct, unmounted, and in no case folded, as the cracks thus caused will show in the reproduction. Line drawings should be in black ink on white paper or tracing cloth. Blue prints and photostats cannot be reproduced. Working drawings do not reproduce satisfactorily, for when reduced photographically to the necessary size the lettering is so small as to be illegible, and details cannot be seen clearly. As far as possible, curves or diagrams should be drawn with the base line about 7 inches ong and with cross rulings spaced not closer than 3/16 inch. Such diagrams should be carefully drawn in black ink on white paper for tracing cloth.

The Council desires to leave the competitors the fullest latitude as to their treatment of the subject. It is suggested, however, that detailed descriptions should be avoided, and that papers should not exceed ten thousand words in length.

Rules Governing Award

(1) The prize shall be awarded for the best contribution submitted to the Council of The Institute by a member of The Institute of any grade on a subject to be selected and announced by the Council at the beginning of the prize year, which shall be July first to June thirtieth.

(2) In deciding on the subject to be specified, the Council shall confer with the Branches, and use its discretion, with the object of selecting a subject which may appear desirable in order to facilitate the acquirement and the interchange of professional knowledge among the members of The Institute.

(3) The papers entered for the competition shall be judged by a committee of five, to be called the Past-Presidents' Prize Committee, which shall be appointed by the Council as soon after the Annual Meeting of The Institute as practicable. Members and Honorary Members only shall be eligible to act on this committee.

It shall be within the discretion of the committee to refuse an award if they consider no paper of sufficient merit.

(4) The prize shall consist of a cash donation of the amount of one hundred dollars, or the winner may select books or instruments of no more than that value when suitably bound and printed, or engraved, as the case may be.

(5) All papers eligible for the competition must be the bona fide work of the contributors and must not have been made public before submission to The Institute.

(6) All papers to be entered for the competition must be received during the prize year by the General Secretary of The Institute, either direct from the author or through a local Branch.

(7) The award shall be announced in The Engineering Journal and at the Annual Meeting, and, if possible, the presentation shall take place at that meeting.

The Scientific Study of Fire Hazards

In the past our fire record in Canada, as judged from the losses paid by insurance companies, has been an uncurable one, although during the past few years there has been a progressive improvement. In 1922 the total loss of insurable property was over fifty-four million dollars; in 1928 it was still over thirty-six millions. It is notable that this reduction has not been accompanied by a diminution of the number of individual fires, of which in 1928 Canada had thirty-two thousand. The lessened property loss however has been reflected in the average insurance rate, which has fallen from over one dollar in 1922 per one hundred dollars of property at risk, to eighty-seven cents in 1928. These results, encouraging as far as they go, have been largely due to such causes as the wider use of improved fire appliances, better quality of building construction, and the use of more reliable electrical and heating equipment in buildings. But they have been greatly aided by the close technical study given to the subject by the under writers and by such bodies as the Dominion Fire Prevention Association, all of whose constituent bodies are greatly interested in the protection of life and property against fire.

Some striking instances of the benefit to be derived from scientific study of this subject are given in a paper recently published by that Association on "Unseen Hazards in Hospitals, Clinics and Other Institutions," a question which was brought very prominently to the public view after the disaster which occurred in Cleveland on May 15th, 1929, when over one hundred people were killed as a result of a fire in the X-ray department of a clinic.

Real progress as regards a matter of this kind can only result from a complete investigation of the causes of such events, and the publication just named affords an excellent example of work of this kind. To begin with, a study had to be made of the properties of X-ray films, of which, as is well known, there are two kinds; those in which the photographic emulsion coats a film of nitro-cellulose, and others in which the film is composed of cellulose acetate. Both these materials are inflammable, but the former not only ignites at a comparatively low temperature but burns with almost explosive violence and gives out a mixture of poisonous gases including carbon monoxide, nitric oxide and nitrogen dioxide. On the other hand, the acetate film when burning has combustible properties which render it not much more dangerous than ordinary paper.

Investigation of the Cleveland disaster drew attention to the great dangers arising from nitro-cellulose film, particularly when stored in large quantities as is the case in the X-ray departments of large hospitals. The recommendations which have been made to render impossible the recurrence of such a deplorable event are all based on careful study covering not only the inflammable natures of the films and their keeping qualities, but their suitability as regards photographic exposure, development, and fixation. There seems no reason to doubt that the supply of cellulose acetate films is now assured in such quantities as to render unnecessary any further use of film of the more dangerous type in hospitals. Many of the more important hospitals in Canada have adopted the use of acetate X-ray film, and in some places in the United States the use of nitrate film in hospitals has been prohibited by law. Attention has been paid to the vaults or rooms where films are stored, and proper methods of arrangement and construction have been prescribed.

An example of another type of special fire hazard which can only be controlled as a result of intensive scientific study is that arising from explosions of anaesthetic gases in operating rooms. These gases, such as ether vapour, ethylene, nitric oxide, and others may be used in such proportions as render the mixture liable to explosion, and it has been necessary to develop a special series of devices, which, if embodied in the equipment of the hospital, will prevent danger from this source. It is evidently necessary to avoid the occurrence of any sparks due to static electricity or to the operation of switches or electrical equipment. Precautions necessary are the effective grounding of all operating room equipment, the ready identification of the contents of compressed-gas cylinders, adequate ventilation, provision for proper humidity of the air, proper construction and installation of all electric light and power cables, outlets and fittings, and precautions regarding electric bell and telephone apparatus, which in some cases has been found liable to produce dangerous sparks.

In the installation of proper equipment for fire protection and prevention the instruction of all employees regarding its purpose and use is of primary importance. Work of this kind is just as necessary as technical improvement in equipment and construction methods.

The public and governmental authorities are gradually realizing how much can be accomplished by adherence to proper standards for safety. The action of those provincial governments who have adopted and are enforcing the use of the Canadian Electrical Code or equivalent regulations, is a case in point. Such policies play an important part in the safety movement which has already resulted in a great lessening of fire hazard, and whose progress will be watched with interest by all engineers.

Report of the Royal Commission on Technical and Professional Services

This report was recently made public by presentation to Parliament, and while there has scarcely been time to judge of its findings as applied to all branches of the Civil Service, there seems a general opinion that its provisions if adopted would mark a distinct advance in the Service's organization. The situation has been clarified by the Commission's definition of what constitutes a technical and professional position, and the report will be of benefit by giving the Government and public generally a knowledge of what professional and scientific service really means.

It is certainly to be hoped that Parliament will take action during the present session on the basis of this well-considered and carefully thought-out document. It is too much to expect that its provisions will not be criticised, but it provides many admirable features and few which have aroused any serious objection. The report simplifies the classification of the technical and professional members of the Civil Service, it recommends what would appear to be a most desirable alteration in the Superannuation Act, and provides a reasonable likelihood of future advancement for the lower grades in the Service.

The immediate salary benefits indicated would largely be in connection with the higher grades, but future benefits would accrue to practically all coming under professional classification.

Since so many of the Civil Servants affected by this report are engineers, it is natural that members of The Institute should be interested in the Royal Commission's remarks as to what constitutes a professional and technical position, a point which has considerable bearing upon the qualifications for membership in The Engineering Institute of Canada and the several Associations of Professional Engineers.

The Commission remarks in part:—

> "The use of the word technical in our terms of reference is obviously beset with difficulty. There is a sense in which an artisan who has served a term of apprenticeship, and become qualified as a journeyman, may fairly be described as a technical man. Yet it is obvious that no line of demarcation drawn for our present purpose, could include such a worker . . . it is the scientific character of so large a part of the work of the Civil Service upon which our attention has been directed.". . .
>
> "A working definition should have reference both to the previous training of the incumbent of a position, and to the duties which he is called upon to perform in that position.". . .
>
> "For a position to be considered as technical or professional, we believe that it should as a rule be

necessary that the holder possess the degree of a recognized university, with specialization in a branch of knowledge generally now regarded as belonging to the professions—as pure and applied science (including forestry), law, statistics, or actuarial science."...

"No definition could permanently be satisfactory, if its application were so rigid as to preclude the admission of occasional special cases."...

"We regard it as essential that the position ... should be such as to demand the use of the technical, scientific or professional knowledge which the incumbent has already acquired by special studies, as distinguished from the practice of a technique which can be learned in the course of employment."...

In these findings it will be observed the Commission deals very clearly not only with the previous training of a technical and professional employee but also with the effect of his professional work upon his status. It is pleasing to note that the report includes in one of its appendices, a resumé of the information furnished at the Commission's request, by the special committee appointed by the Council of The Institute for that purpose.

Publications of Other Engineering Societies

From time to time announcements have appeared in The Engineering Journal regarding the exchange arrangements which exist between The Engineering Institute of Canada and the founder engineering societies of the United States, whereby members of The Institute may secure the publications of the American societies at the same rate as charged to members of those societies. A list of these publications, with the amounts charged, is given below and subscriptions may either be sent direct to New York or through headquarters of The Institute.

	Rate to Members	*Rate to Non-Members*
American Institute of Electrical Engineers		
Journal, single copies	$0.50	$ 1.00
" per year	5.50	10.50
Transactions, per year:—		
Paper	5.00	10.00
Cloth	5.00	10.00
Year Book	1.00	2.00
Pamphlets	.25	.50
American Institute of Mining and Metallurgical Engineers		
Magazine, single copies	0.50	1.00
" per year	5.00	10.00
Transactions, per volume, with pamphlets, paper	2.50	5.00
(Other publications, same rate E.I.C. members as to A.I.M.M.E. members.)		
American Society of Civil Engineers		
Proceedings, single copies	0.50	1.00
" per year	4.00	8.00*
Transactions, per year	6.00	12.00†
Year Book	1.00	2.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
American Society of Mechanical Engineers		
Journal, single copies	0.50	0.60
" per year	4.00	5.00
Transactions, per year	6.00	8.00
Year Book	1.00	2.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		

**If subscription is received before January 1st, otherwise $10.00.*

†*If received before February 1st, otherwise price $16.00.*

Meeting of Council

A meeting of Council was held on Friday, March 7th, 1930, at eight o'clock p.m., with President A. J. Grant in the chair, and fifteen other members of Council present.

The minutes of the meetings held on February 4th and 12th, 1930, were taken as read and confirmed.

The membership of the following committees were approved:

Finance Committee
Library and House Committee
Legislation Committee
Publication Committee.

The Special Committee on the Publications of The Institute presented an interim report, making certain recommendations, in which the importance of securing more and better papers for The Institute was urged as being a matter which required immediate consideration. The recommendations were considered, but it was felt that before taking action it would be necessary to ascertain the expense involved.

On the nomination of the Executive Committee of the Saint John Branch, it was unanimously resolved that W. J. Johnston, A.M.E.I.C., be appointed councillor for the Saint John Branch to replace the late Mr. E. A. Thomas until the next annual election.

The following committees were re-appointed for the year 1930 with the same membership as last year:

Committee on Policy
Committee on Publicity
Board of Examiners and Education
Honour Roll and War Trophies
Committee on Biographies
Committee on International Co-operation

The Treasurer asked for Council's guidance in preparing the budget for 1930 for submission to Council, pointing out that if provision were made for the same activities as had taken place during 1929 a considerable deficit was likely. After considerable discussion the Finance Committee was asked to submit a draft budget including an allowance for the Plenary Meeting of Council and for the work of certain committees, but omitting certain other activities on the score of economy.

The Secretary submitted a letter to the President from the Hon. Charles Stewart, Minister of the Interior, Honorary Chairman of the Canadian Honorary World Power Conference Committee, which had been presented to the Annual General Meeting, and reported that the necessary publicity had been given to the announcement of this Conference in The Journal, and he was directed to reply to Mr. Stewart that the President would be happy to serve on the committee.

An address to be presented to The American Society of Mechanical Engineers on the occasion of their Fiftieth Anniversary was approved.

Twenty resignations were accepted, and one special case was considered.

A number of applications for admission and for transfer were considered, and the following elections and transfers were effected:

Elections		Transfers	
Members	1	Assoc. Member to Member	1
Associate Members	4	Junior to Assoc. Member	4
Juniors	7	Student to Assoc. Member	3
Students admitted	11	Student to Junior	6

The Council rose at twelve fifty a.m.

OBITUARIES

Edward Prout Girdwood, M.E.I.C.

Deep regret is expressed in recording the death of Edward Prout Girdwood, M.E.I.C., which occurred at Vancouver, B.C. on March 10th, 1930.

Mr. Girdwood was born at Montreal, Que. on September 5th, 1875, and received his education at the Montreal High School and McGill University.

In 1898 Mr. Girdwood was an apprentice in the Canadian Pacific Railway shops at Victoria, B.C. and from December 1898 to January 31st, 1899, was assistant on construction with the same railway, being located at Montreal. He was later for a short time with the Columbia and Western Railway at Brooklyn, B.C., and was for several years on the staff of the British Columbia Telephone Company at Vancouver. Mr. Girdwood went to South Africa with the Canadian Mounted Rifles, and was later located at Pretoria with the South African Constabulary. In 1903-1905 he was with the Durban Municipality Works, Durban, S. A. Returning to Canada, he was on the staff of the Transcontinental Railway for four years, as rodman, topographer, leveller, and instrumentman at Quebec, and as resident engineer at La Tuque, Que. For a short time Mr. Girdwood practised as a consulting engineer in Montreal, and then became resident engineer for the Canadian Northern Pacific Railway at Metchosin, B.C. In 1912 he was resident engineer for the same railway at Duncans, B.C. In 1913 and 1914 Mr. Girdwood was district engineer for the Public Works Department for the districts of Kamloops, Okanagan and Similkameen, in charge of bridges and roads, and was located at Vernon, B.C. From 1915 to 1918 he was overseas with the 48th Battalion, Canadian Expeditionary Forces.

On June 1st, 1918, Mr. Girdwood joined the Water Rights Branch at Victoria, B.C., as engineer, being assistant to the meteorological engineer, dealing with temperature and precipitation and snow fall drainage for the province of British Columbia.

Mr. Girdwood joined The Institute as a Student on April 19th, 1906, was transferred to the class of Associate Member on December 12th, 1907, and became a full Member on November 17th, 1914.

Charles Arthur Millican, A.M.E.I.C.

Members will learn with regret of the death of Charles Arthur Millican, A.M.E.I.C., which occurred on January 23rd, 1930, at St. James, Man.

Mr. Millican was born at Alston, Cumberland, England, on November 23rd, 1861.

From January 1875 to February 1882 he was a pupil with the late Adam Walton, mining engineer. From March 1882 to March 1883 Mr. Millican was assistant to the city engineer of Winnipeg, being in charge of street improvements etc., and in 1883-1884 he was in the office of the Argyle Gold Mining Company Ltd. From June to December 1884 he was assistant to the city engineer of Winnipeg, in charge of street improvements and drainage. For six months in 1886 Mr. Millican was a leveller on location on the Manitoba and Northwestern Railway, and to September 1887 he was assistant engineer in charge of construction on the Red River Valley Railway. In 1887-1888 Mr. Millican was assistant engineer on location and in charge of construction on the Great Northwest Central Railway, and from August to December 1888 he was again on the Red River Valley Railway, this time in charge of construction as assistant engineer on the Portage extension. From December 1888 to December 1889, Mr. Millican was assistant engineer on location and in charge of construction on the Northern Pacific and Manitoba Railway, later entering private practice as a consulting engineer. He served overseas during the war, enlisting in the 90th Battalion, Canadian Expeditionary Force. He was transferred to 3-C Labour Battalion in France and in November 1917 joined the 11th Battalion, Canadian Railway Troops. While in this last battalion, Mr. Millican was in turn private, lieutenant and captain, returning to Canada in December 1918 with the last named rank.

Mr. Millican joined the Canadian Society of Civil Engineers as an Associate Member on January 29th, 1891.

Charles Cesar Leluau, M.E.I.C.

It is with deep regret that we record the death of Charles Cesar Leluau, M.E.I.C., which occurred at Montreal on March 10th, 1930.

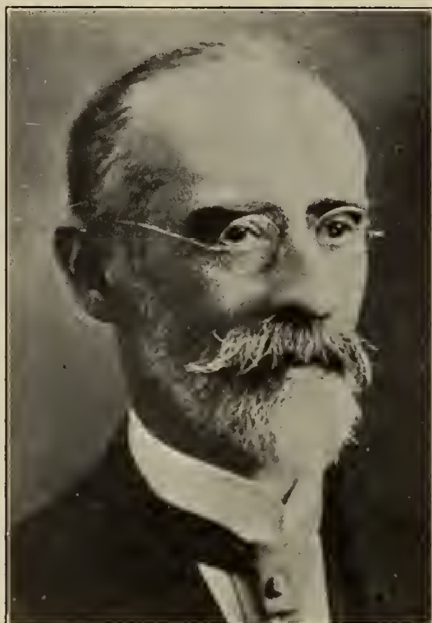
Professor Leluau was born at Hazebrouck, France, on March 8th, 1849. He was a graduate of the Ecole Centrale des Arts et Manufactures, Paris, and before coming to Canada he was engaged for a time as engineer in the French Company Chemin de Fer du Nord, and from August 1880 to July 1895 he was head of an important department in the same company.

Professor Leluau saw active service during the Franco-Prussian war of 1870-1871, being seriously wounded in action, and was awarded the decoration of Chevalier de la Légion d'Honneur for gallantry on the battlefield. The Association des Anciens Elèves de l'Ecole Polytechnique unanimously appointed him an honorary member of their association. The French Government in recognition of his excellent work as a professor bestowed upon him the title of "Officier d'Académie."

He became a professor at the University of Montreal (then Laval University) in 1899, and remained on the university's staff for more than twenty-five years, lecturing on many important subjects, but particularly in physics and hydraulics. He was also secretary-treasurer of the General Railway Signal Company of Canada.

Professor Leluau became a Member of the Canadian Society of Civil Engineers on December 18th, 1903, and was placed on the Life Membership list of The Institute on December 18th, 1928.

CHARLES CESAR LELUAU, M.E.I.C.



HENRY IRWIN, M.E.I.C.

Henry Irwin, M.E.I.C.

The death of Henry Irwin, M.E.I.C., which occurred at Montreal on March 3rd, 1930, removes from the list of The Institute one of its oldest members.

Mr. Irwin was born at Newgrove, county Down, Ireland, on October 27th, 1847. He attended the engineering school of Trinity College, Dublin, from 1866 to 1869, graduating in engineering in the spring of 1870, and receiving two special certificates out of three possible, only one other member of the class also receiving two. These special certificates correspond to honours of other universities. Mr. Irwin was apprenticed to the chief engineer of the Midland Great Western Railway of Ireland from about May 1870 to May 1871, and was assistant to the county surveyor of Antrim county, Ireland, from August 1872 to August 1874.

Coming to Canada in 1874, Mr. Irwin settled in Montreal, and became assistant to Joseph Rielle, a well-known provincial land surveyor. He remained with Mr. Rielle for some years, acquiring much experience in assisting in the planning and laying out of many sections of what are now thickly populated parts of Montreal.

In 1887 Mr. Irwin joined the Canadian Pacific Railway Company as a surveyor in the chief engineer's office in Montreal, becoming assistant engineer in that department in 1901. In 1914 he was appointed right-of-way agent, continuing in that position until 1922, when, although due for retirement, he was retained by the Canadian Pacific as consulting right-of-way agent, holding that position up to the time of his death. Mr. Irwin was a member of the Dominion Land Surveyors and Quebec Land Surveyors. He was also a member of the Civic Improvement League of Montreal.

Mr. Irwin joined the Canadian Society of Civil Engineers as an Associate Member on January 20th, 1887, and was transferred to the grade of Member on May 20th, 1892. Mr. Irwin was always interested in Institute affairs, and represented the Montreal Branch on the Council during the years 1896 and 1897.

PERSONALS

W. E. Seely, S.E.I.C., who was formerly with the MacLaren Dam Company at High Falls, Que., is now in the employ of the Dominion Bridge Company, Ltd., at Lachine, Que.

L. Sosinsky, S.E.I.C., is now on the staff of the Northern Electric Company, at Montreal, Que. Mr. Sosinsky graduated from the University of Manitoba with the degree of B.Sc. in 1929.

M. Sinclair, A.M.E.I.C., has resigned from the position of acting city engineer of Moose Jaw, Sask., to become city engineer of Yorkton, Sask. Mr. Sinclair had been with the city of Moose Jaw's engineering service for eleven years.

Cameron Doberer, S.E.I.C., who graduated from McGill University in 1929 with the degree of B.Sc., and was for a time with the Canada Power and Paper Company at Shawinigan Falls, Que., is now in the employ of Canadian Explosives Ltd. and is located at McMasterville, Que.

M. J. Holm, A.M.E.I.C., who is a member of the staff of the Atlas Construction Company, has been transferred by that firm to West Saint John, N.B. Mr. Holm is a graduate of Copenhagen University, having secured the degree of B.Sc. in 1918.

W. L. Ball, A.M.E.I.C., has accepted the position of resident engineer on the Sunny Brae-Guysboro railway for Canadian National Railways. Since 1926 Mr. Ball has been with Dexter P. Cooper, at Welchpool, Campobelle Island, Charlotte City, N.B.

E. W. Neelands, A.M.E.I.C., has been appointed high-road engineer with the Highroads Commission, St. John's, Newfoundland. Mr. Neelands was formerly with the Department of Lands and Forests, Northern Development Branch, at New Liskeard, Ont.

W. E. Hall, A.M.E.I.C., has severed direct connection with the Avon River Power Company, Ltd., with which concern he has been engaged as construction engineer since 1929, in order to devote his entire time to contracting and private engineering at Windsor, N.S. Mr. Hall was at one time on the staff of the Anticosti Corporation at Three Rivers, Que.

F. T. Boutilier, S.E.I.C., is now on the mechanical staff of the Aluminum Company of Canada, and is located at Arvida, Que. Mr. Boutilier, who graduated from the Nova Scotia Technical College in 1928 with the degree of B.Sc., was for a year and a half in the engineering department of the Dominion Iron and Steel Company Ltd., at Sydney, N.S.

H. B. Brehaut, A.M.E.I.C., is now with the Manitoba Bridge and Iron Works, Ltd., having opened a branch office for that company at Saskatoon, Sask., and being in charge of its interests in that city, adjacent territory and the northern part of Saskatchewan. Mr. Brehaut graduated from the University of Saskatchewan in 1927 with the degree of B.Sc., and subsequently joined the staff of the Canadian National Railways, with which he has remained until the present time.

G. R. Adams, S.E.I.C., has returned to South America, where he is on the staff of the Tropical Oil Company at El Centro, Barranca Bermejo, Colombia. Mr. Adams graduated from Queen's University with the degree of B.Sc. in 1927, and following graduation became connected with Price Bros. and Company, Ltd. at Riverbend, Que. In November of that year he went to Colombia as a member of the staff of the Tropical Oil Company. He returned to Canada in 1929, and has been located at Woodstock, Ont.

Major Alan B. McEwen, D.S.O., A.M.E.I.C., is now in charge of civil engineering work with Canadian Industries Ltd., Montreal. Major McEwen, who was formerly connected with W. I. Bishop Ltd., Montreal, is a graduate of the Royal Military College, Kingston, Ont., and of McGill University, from which institution he obtained the degree of B.Sc., In 1920 he was with Canadian Explosives Ltd., Montreal, and prior to that he was principal assistant to R. S. and W. S. Lea, consulting engineers, Montreal.

M. H. Jones, A.M.E.I.C. who was appointed to the engineering staff of the Ontario Paper Company, Ltd., at Montreal in 1929, has been transferred to Thorold, Ont., as assistant chief engineer. Mr. Jones is a graduate of the Technical College at Cardiff, Wales, of the year 1912. In 1924 he was assistant engineer, pulp and paper machinery, with the Port Arthur Ship Building Company, and in 1928 was resident engineer at the Fort William mill of the Great Lakes Pulp and Paper Company, Ltd., for Backus Brooks Company, Ltd.

W. H. Stuart, A.M.E.I.C., formerly supervisor of hotel grounds and buildings for the Canadian National Railways, Montreal, has been appointed superintendent of facilities, with jurisdiction over buildings and mechanical equipment, and other duties to be assigned from time to time. The appointment covers the sleeping, dining and parlour car department and hotel department, and dates from January 1st, 1930. Mr. Stuart was at one time resident engineer on hydraulics for the Western Region, Canadian National Railways.

H. G. Cochrane, A.M.E.I.C., of the Power Corporation of Canada Ltd., is now located at the Seven Sisters power development at Whitemouth, Man. Mr. Cochrane, who is a graduate of the Royal Military College, Kingston, Ont., was at one time engineer in charge of design and construction of the structural work for the Lethbridge Northern Irrigation District under H. B. Muckleston, M.E.I.C. In 1923 Mr. Cochrane was with the Quebec Development Company, Ltd. at St. Joseph d'Alma, Que. Mr. Cochrane was a member of the executive committee of the Lethbridge Branch for the year 1922-23.

Duncan Kennedy, A.M.E.I.C., is now senior sectional engineer with Rendel, Palmer and Tritton, consulting engineers, in London, England. On coming to Canada in 1924, Mr. Kennedy became engaged on the hydro-electric project at Isle Maligne, Que., with the Quebec Development Company. He later was connected with Messrs. Monsarrat and Pratley on the substructure work of the Montreal South Shore Bridge, and later acted as resident engineer for Robert White and Partners of Westminister, England, on the construction of wharves and jetties at Bharnagar, Para, Kathiawar, India.

J. A. Burnett, M.E.I.C., consulting and appraisal engineer, Montreal, was appointed to make a physical appraisal of the manufacturing plants in the town limits of Lasalle, Montreal, at a recent meeting of the municipal council. In 1922 Mr. Burnett took over the office of M. A. Sammett, A.M.E.I.C. He has had a wide experience with the Royal Electric Company, Canadian General Electric Company, the construction of a large substation for the Montreal Light, Heat and Power Company, the construction of the Montreal and Southern Counties Railway, and the appraisal of all the electrical equipment on the Grand Trunk System for the Government arbitration.

A. S. Williams, A.M.E.I.C., has become electrical designer with the Northwestern Power Company, Ltd. at St. James, Man. Mr. Williams graduated from the University of Manitoba, with the degree of B.Sc., in 1921, and following graduation was demonstrator in physics at that university during 1921-1922. During 1922-1923 he was with the Canadian General Electric Company at Peterborough, Ont. and in 1923-1924 was draughtsman on electrical layouts with the Hydro-Electric Power Commission of Ontario. From April 1924 to the present time he has been chief operator at the Great Falls generating station of the Manitoba Power Company, Ltd.

Victor Stanley Chesnut, A.M.E.I.C., has been appointed assistant engineer of the Saint John Harbour Commissioners, Saint John, N.B. Mr. Chesnut graduated from the University of Toronto with the degree of B.A.Sc. in 1909, and took a post graduate course in 1912. From 1913 to 1917 Mr. Chesnut was assistant resident engineer on the Welland ship canal and in 1917 was for six months assistant engineer on the Bloor street viaduct, Toronto, for Quinlan and Robertson. Later in the same year he was engineer on bridges and culverts for the Munro Construction Company. In 1919 Mr. Chesnut became assistant engineer with McFarlane, Pratt, Hanley Ltd., on concrete grain elevator work, and in 1919 was appointed assistant engineer of the Saint John Drydock and Shipbuilding Company. In 1928 he returned to Messrs. McFarlane, Pratt, Hanley Ltd. at St. Catharines, Ont. as engineer.

Engineer Commander Angus D. M. Curry, M.E.I.C., has taken over the duties of consulting engineer of H.M.C. Dockyard, Halifax, N.S. Commander Curry was born at Newcastle-on-Tyne, England, and received his professional training at the Royal Naval Engineering College, Keyham, England. He came to Canada in 1910, and was commissioned engineer sub-lieutenant in the Royal Canadian Navy, with which his service has been continuous ever since. He was promoted to engineer-lieutenant in 1912 and to engineer lieutenant-commander in 1920. From February 1924 to April 1925 he was in charge of refitting light cruisers and destroyers at H.M. Dockyard, Chatham, England. Subsequently he was assistant to the consulting naval engineer, Department of National Defence (Naval Service), Ottawa, Ont. In 1927 Commander Curry was appointed consulting engineer at H. M. C. Dockyard, Esquimalt, B.C.

J. A. Beauchemin, A.M.E.I.C., has resigned the town managership of Dolbeau, Que., which position he has held since 1927, and is now connected with the Port Alfred Pulp and Paper Corporation at Port Alfred, Que., in charge of the company's municipal affairs, properties and employment. Mr. Beauchemin graduated from the University of Montreal in 1911 and was assistant engineer in the hydraulic division of the Department of Public Works, Ottawa, from 1911 to 1918, when he joined the staff of the Riordon Pulp Corporation, Ltd., at Temiskaming, Que., as assistant to the chief engineer in charge of hydro-electric power investigations. In 1920 he resigned from the Riordon Corporation and became associated with the Donnacona Paper Company, later becoming mill engineer for this company and remaining in that position until 1926. He was then appointed mill engineer on maintenance and construction with the Port Alfred Pulp and Paper Corporation at Port Alfred, to which company he has lately returned.

F. Y. Harcourt, M.E.I.C., who has been district engineer of the Port Arthur and Fort William district for the Department of Public Works, Canada, since 1921, has been transferred by the Department to London where he is to be in charge of the district. Mr. Harcourt obtained the degree of B.A. from the University of Toronto in 1900, and graduated from the School of Practical Science in 1903. In 1903-1905 he was rodman and instrumentman and chief of field

R. de L. French, M.E.I.C.

party with the Ontario Power Company at Niagara Falls, Ont. In 1905-1907 Mr. Harcourt was on the Georgian Bay canal survey as instrumentman. In 1907 he entered the service of the Department of Public Works, Canada, as senior assistant engineer of the Port Arthur district. In 1911-1915 he was district engineer of the same district, and from 1915 to 1919 Mr. Harcourt served overseas, returning to the same position at the end of the war. From 1921 to date he has been district engineer for the Department of Public Works of Canada, of the Port Arthur and Fort William districts. Mr. Harcourt joined The Institute as a Member on May 22nd, 1922, and has taken a keen interest in Institute affairs. He was elected Councillor representing the Lakehead Branch on the ballot which was reported on at the Annual Meeting on February 12th, 1930, and it is most unfortunate that owing to his present move he has been compelled to resign from the Council.

R. de L. French, M.E.I.C., has been appointed engineer for Lucerne-in-Quebec. Thus this vast recreation resort, newly established in the vicinity of Montebello, Que., secures the services of one of Canada's well-known engineers and at the same time retains those of Prof. C. B. Breed, of Boston, as the Community Association's consulting engineer.

Professor French was educated at the Worcester Polytechnic Institute, Worcester, Mass., receiving the degree of B.Sc. in 1905 and that of C.E. in 1908. From April to September 1906 Professor French was associated with the late Malverd A. Howe, a well-known authority on the design and construction of arch bridges. From June 1908 to January 1910, he was assistant engineer with the Commissioners of Sewerage of Louisville, Kentucky, on the design and construction of sixty-five miles of sewers, and from January 1910 to August 1911 he was assistant engineer with the National Concrete Construction Company, Louisville, designing, estimating and constructing reinforced concrete and steel structures, principally buildings.

Coming to Montreal in 1911, Professor French became principal assistant engineer with Messrs. R. S. and W. S. Lea, consulting engineers, and was engaged mainly in connection with water supply, sewerage, and other municipal projects for Montreal, Ottawa, Quebec and other large cities.

Professor French was engineer of the commission appointed by the Dominion Government to devise methods of making the low-grade coals of Saskatchewan available as a domestic fuel, and for three years was a member of the Committee on the Fire Resistance of Roofing Materials of the Dominion Fire Prevention Association, and he has served for some time on the Metropolitan Town Planning Board of Montreal.

Professor French was appointed lecturer in civil and municipal engineering at McGill University in 1911, and was made professor of highway and municipal engineering in 1920.

Professor French is a member of the Corporation of Professional Engineers of the Province of Quebec, the American Society of Civil Engineers and the Canadian Good Roads Association. He joined The Institute in 1918 as a Member and in 1920 was awarded the Gzowski Medal for his paper on "The Design and Construction of Reinforced Concrete Covered Reservoirs."

R. A. C. Henry, M.E.I.C., former Deputy Minister of Railways and Canals, has resigned from that office to become vice-president and general manager of the Beauharnois Light, Heat and Power Company. Mr. Henry graduated from McGill University with the degrees of B.A. and B.Sc., receiving the latter in 1912. Following graduation he entered the service of the Department of Railways and Canals as inspecting engineer, and in December 1913 he was made assistant engineer, which position he held until 1923, when, following the reorganization of the Canadian National Railways, he joined their staff in Montreal as director of the newly established Bureau of Economics, which was set up for the study of railway problems connected with the consolidation and co-ordination of the various lines of railway making up the Canadian National system. In February 1929, following the unexpected death of the former Deputy Minister of Railways and Canals, Major Graham A. Bell, Mr. Henry consented to become Deputy Minister, and he has held that position since that time. Mr. Henry has achieved a reputation throughout Canada and also in the United States as an authority on Canadian railway problems. His work has made him familiar with matters pertaining to canals and water powers, and he is recognized as an authority on water terminal problems.

R. A. C. Henry, M.E.I.C.

ELECTIONS AND TRANSFERS

At the meeting of Council held on March 7th, 1930, the following elections and transfers were effected:

Member

BRIDGES, Frederick, Supt., Government Shipyard, Sorel, Que.

Associate Members

FELLOWS, Howard, B.Sc., (McGill Univ.), asst. chief engr., The Nova Scotia Power Commission, Halifax, N.S.
LeBOURVEAU, Homer Benjamin, B.A., B.Sc., (Univ. of Alta.), asst. engr., Calgary Power Company, Ltd., Calgary, Alta.
LEE, William States, Jr., C.E., (Princeton Univ.), vice-president, W. S. Lee Engineering Corpn., New York, N.Y.
MENGES, Edwin A. H., chief engr., Disher Steel Construction Co. Ltd., Toronto 2, Ont.
STUEWE, William Lafayette, E.M., (Montana Sch. Mines), mech'l. supt. of coal mines, British Empire Steel Corpn., Sydney, N.S.

Juniors

ANDERSON, George Douglas Elphinstone, B.Sc., (N.S.T.C.), elect'l. engr., N.S. Light & Power Company, Halifax, N.S.
BENT, Edgar Delap, B.Sc., (Acadia Univ.), cable engr., cable engrg. lab., Northern Electric Co. Ltd., Montreal, Que.
CLARKE, Thomas Gerard, B.Sc., (N.S.T.C.), professor of engineering, St. Francis Xavier University, Antigonish, N.S.
D'AOUST, Joseph Gilbert, B.A.Sc., (Univ. of B.C.), junior engr., B.C. Pulp & Paper Co. Ltd., Port Alice, B.C.
DAVIDSON, John Knox, B.Sc., (Univ. of St. Andrews), asst. engr., Dominion Bridge Co. Ltd., Montreal, Que.
McDOUGALL, James Lyle, mech'l. engr. and dftsman., Price Bros. & Co. Ltd., Kenogami, Que.
REGAN, Francis Edward, (City and Guilds of London), engr. for Prov. of Quebec, Lancashire Dynamo & Motor Co. of Canada, Montreal, Que.

Transferred from the class of Associate Member to that of Member

McCANNEL, Donald Alexander Roy, B.Sc., (Queen's Univ.), City Commissioner, City of Regina, Sask.

Transferred from the class of Junior to that of Associate Member

INGS, Jasper Harold, B.A.Sc., (Univ. of Toronto), engr., Gatineau Power Company, Ottawa, Ont.
KNAPP, Edward Winslow, B.Sc., (McGill Univ.), elect'l. engr., operation dept., Shawinigan Water & Power Company, Montreal, Que.
VON ABO, Cecil Vivian, B.Sc., M.A., (Univ. of Cape Town), Ph.D., (McGill Univ.), research engr. and district engr., bridges, chief civil engr's. dept., South African Railways and Harbours, Johannesburg, S.A.
WATERHOUSE, George Kerby, B.Sc., (Queen's Univ.), asst. purchasing agent, Aluminum Company of Canada, Ltd., Montreal, Que.

Transferred from the class of Student to that of Associate Member

FINLAYSON, Archie Wallace, B.Sc., (McGill Univ.), squad leader in charge of Falls River power development, B.C., for Power Corporation of Canada, Ltd., Montreal, Que.
MITCHELL, Wallace Murray, B.Sc., (McGill Univ.), constrn. engr., Fraser Brace Engineering Company, Ltd., Sudbury, Ont.
NICHOLL, Henry Lloyd, B.Sc., (Univ. of Man.), sales engr. for Sask., Canadian Westinghouse Company, Ltd., Regina, Sask.

Transferred from the class of Student to that of Junior

BAIN, Archibald Marcus, B.Sc., (Univ. of Man.), M.Sc., (McGill Univ.), struct'l. designer, Dominion Bridge Co. Ltd., Montreal, Que.
COLLINS, George Edward, B.Sc., (Univ. of Man.), res. engr., Good Roads Board, Belmont, Man.
HOLDEN, John Hastie, B.Sc., (McGill Univ.), estimator and designer, Geo. W. Reed & Co. Ltd., Montreal, Que.
KINGSTON, George Harold, B.Sc., (McGill Univ.), elec'l. designer, Alcoa Power Company, Arvida, Que.
MACKAY, Leslie, B.Sc., (Univ. of Man.), asst. res. engr., power development at Slave Falls, Man., for Winnipeg Hydro-Electric System.
ORR, William Winston, B.Sc., (Queen's Univ.), transformer design engr., Canadian General Electric Company, Toronto, Ont.

Students Admitted

CHISHOLM, Donald Alexander, B.Sc., (St. Francis Xavier Univ.), dftsman., C.N.R., Monckton, N.B.
COURTNEY, Alexander Gordon, undergrad., Univ. of Man., 262 Balmoral St., Winnipeg, Man.
EHLY, Lucas Joseph, rodman, Alberta Main Highways, 9327-107a Avenue, Edmonton, Alta.
FORD, Albert Frederick Brome, undergrad., Univ. of Man., 535 Sherburn St., Winnipeg, Man.
HARRIGAN, Mayo Arthur Perrin, undergrad., Dalhousie Univ., P.O. Box 567, Halifax, N.S.
HOOD, George Leslie, undergrad., Univ. of Man., Manitoba College, Winnipeg, Man.
SAVAGE, Palmer Ernest, undergrad., McGill Univ., 154 Ballentyne Ave. No., Montreal West, Que.
SCOTT, Lloyd George, undergrad., Univ. of Man., Manitoba College, Winnipeg, Man.
SMITH, Eugene Lloyd, undergrad., Univ. of Alta., University of Alberta, Edmonton, Alta.
THORN, Richard, mech'l. dftsman., with E. A. Ryan, M.E.I.C., 1188 Phillips Place, Montreal, Que.
WEBSTER, William Beverley, undergrad., Univ. of Toronto, 36 Thorne Crescent, Toronto 10, Ont.

The following Students were admitted at the meeting of Council held on February 4th, 1930.

BARBOUR, Clarence Allen, undergrad., Univ. of N.B., 255 Regent St., Fredericton, N.B.
BLANCHET, Paul Maurice, Grad., R.M.C., undergrad., McGill University, Montreal, Que.
FRASER, Norman Innes, Grad., R.M.C., undergrad., McGill Univ., 470 Prince Arthur St. West, Montreal, Que.
GINGRAS, Francis Percival, undergrad., Univ. of Man., 271 Furby St., Winnipeg, Man.
HAWLEY, Eric Farwell, undergrad., McGill Univ., Ormstown, Que.
LEVERIN, Harald Liecester, Grad., R.M.C., undergrad., McGill Univ., 2044 Metcalfe St., Montreal, Que.
McLEOD, Wilson Churchill, undergrad., N.S. Tech. Coll., 72 South St., Halifax, N.S.
McMORDIE, Robert Campbell, undergrad., Univ. of Toronto, 94 Wright Ave., Toronto 3, Ont.
NATION, Frederick Spencer, undergrad., McGill Univ., 3637 University Street, Montreal, Que.
NELSON, H., dftsman., Vulcan Iron Works, Ltd., Winnipeg, Man.
RODGER, Norman Elliot, Grad., R.M.C., undergrad., McGill Univ., 2044 Metcalfe St., Montreal, Que.
TAIT, Gordon Ewing, undergrad., McGill Univ., 632 Grosvenor Ave., Westmount, Que.
WIEBE, Victor, undergrad., Univ. of Sask., Herbert, Sask.
WILLIAMS, Richard Louis, undergrad., McGill Univ., 159-24th Ave., Lachine, Que.

BOOK REVIEWS

Canadian Trade Index, 1930

Compiled and published by Canadian Manufacturers' Association Inc., Toronto, 1930. Cloth, $6\frac{1}{2}$ x $10\frac{1}{2}$ in., 884 pp., tables, \$6.00.

This is the sixth annual issue of the Canadian Trade Index. The special feature of the 1930 edition is the inclusion of a 54-page special export section, provided by the Department of Trade and Commerce of the Dominion Government, and comprising a summary statement of Canadian progress in commerce, with data designed to aid in the further development of export trade.

The present edition contains an alphabetical and classified list of over 10,000 Canadian manufacturers and their products; a produce section giving the names of producers of a variety of agricultural products; a complete survey of Canadian export trade, besides indicating those firms interested in and prepared to do export trade.

This work is very valuable as a reference aid, and is the only comprehensive book of its kind published in Canada.

Practical Railway Painting and Lacquering (Practical Finishing Series, Vol. 4)

By H. Hengeveld, C. P. Disney and W. J. Miskella. Finishing Research Laboratories, Inc., Chicago, 1929, leatherette, 6¼ x 9¼ in., 242 pp., illus., figs., tables, $3.50.

This book is described as a handbook for railroad men. It is principally concerned with description of mechanical devices which have lately been adopted by the painting trade and is profusely illustrated.

It describes, in a general way, the spray gun and its accessories, sand blasting equipment, mechanical scalers and polishers, etc. The greater part of the book is concerned with the use of the spray gun. With the aid of photographs, the particular forms of equipment best suited for painting and lacquering locomotives, passenger and freight cars, bridges, buildings, etc., are described.

This book should prove valuable to a master painter who wishes to keep up to date in modern painting methods. There are some sections dealing with primers, paints and lacquers but these are not discussed with much detail. One of the authors is a director of a consulting laboratory and a chapter is devoted to describing the tests which this laboratory is prepared to make on paint samples submitted.

S. G. Lipsett, Ph.D.,
Research Chemist,
J. T. Donald & Co., Ltd.,
Montreal.

The Rayon Industry

By Mois H. Avram. D. Van Nostrand Company, New York, second edition, 1929, buckram, 6½ x 8½ in., 893 pp., illus., figs., tables, charts, $12.00.

This book is well named. The accent throughout is on the broad industrial aspects of rayon rather than on the finer technical points of process. The volume is just what is needed for those who wish to familiarize themselves with a general picture of this young prodigy among industries. There is particularly sound and pertinent information for any industrialist who is considering venturing into the field of rayon production, possibly lured into this position by a cursory review of the phenomenal successes of a few of the pioneer rayon producers. Not that the writing is pessimistic in any sense, but it gets down to bedrock on the problems of the industry and its varied and exacting demands.

The book contains an imposing array of statistical information covering all phases of the growth of rayon, production and consumption trends, interrelationship of the various rayons between themselves and other textiles, world wide ramifications of the great producing groups, costs, exports and imports of leading countries, tariffs, etc. Business and industrial organization and economic background are particularly well covered.

As might be expected, the book is written from an engineering viewpoint, and as a result the details of the chemical processes are merely sketched. There is little here for those interested solely in rayon-process technology—a common fault of books and periodicals dealing with rayon.

One wonders why the section on "Control Tests" of the processes was included at all, since the descriptions of methods are so incomplete. Thus in "Determination of Alpha, Beta and Gamma Cellulose" we find the surprising statement: "Alpha cellulose is that modification of cellulose which takes part in the Rayon process," and "Alpha cellulose soluble in caustic solution, but beta cellulose is precipitated by acetic acid, while gamma cellulose remains dissolved." The entire information given on the control of the acid coagulating or neutralizing bath in the viscose process reads as follows: "The strength of the coagulating bath is checked with the hydrometer. The sugar content is determined as follows: The caustic soda is determined by titrating a measured or weighed quantity with normal acid solution using phenolphthalein as an indicator. The amount of sugar present is determined by boiling a measured sample with an excess of standard potassium permanganate solution. The sugar is titrated with oxalic acid." It is perhaps unfair to quote passages which are a contrast to much that is worth while in preceding chapters.

The new edition under review follows two years after the first, and contains a considerable amount of new material, although some of the statistical data is still carried only up to the year 1925, and such promising developments as the Lilienfeld viscose process and the cellulose ether process by the same investigator are conspicuously absent.

The book is recommended as a broad, but in places not too deep, survey of the rayon industry.

H. S. Hill, Ph.D.,
Research Department,
Price Bros. & Co., Ltd.,
Quebec, Que.

Recent Additions to the Library

Proceedings, Transactions, etc.

PRESENTED BY THE SOCIETIES:

American Society for Testing Materials: Proceedings of the Thirty-Second Annual Meeting, June 24-28, 1929, Vol. 29: Part 1: Committee Reports, New and Revised Tentative Standards Part 2: Technical Papers.

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CORRESPONDENCE

The Editor of The Engineering Journal

Dear Sir,

Two or three years ago I formed the opinion, which I have strongly held ever since, that the reinforcing of concrete had reached the "Fad" stage. This, I claim, is abundantly shown on innumerable plans, diagrams, sections, descriptions, etc., of works of all kinds shown in the engineering periodical literature of Canada and the United States.

Here is a simple case. A cylindrical column 20 feet high and 2 feet in diameter, of concrete, with the usual amount and style of reinforcing; the cubical contents of such a column is 63 cubic feet. The weight of the reinforcing would be about 600 pounds which at 5 cents per pound amounts to $30.00 or the cost of a yard and one-half or 40 cubic feet of concrete.

If we added this 40 cubic feet of concrete to the column under discussion we could make its diameter about 2 feet 6 inches, and I contend that a concrete column 20 feet high and 2 feet 6 inches in diameter without any reinforcing is a stronger and better column than one 2 feet in diameter with reinforcing.

On page 328 of "Engineering News Record" for February 20th, 1930, there is an interesting case in point; a concrete viaduct in Seattle; columns are 53 feet in maximum height: 3 feet in diameter. The reinforcing, amounting to about 1,000 pounds would cost $50.00, which is the cost of 2½ cubic yards of concrete. If this quantity of concrete be added to the column and the reforcing omitted we should have a column about 3 feet 3 inches in diameter, and I contend that that extra 3 inches in the diameter of such a spindly column is worth far more than the reinforcing.

On page 2 of the advertising section of "Engineering News Record" for February 20th, 1930, there is also a very striking exhibit. The illustration shows "a bulkhead wall ready to receive cast-in-place wall section." That is to say the concrete in this case is subject to either direct vertical compressive strain, or the impact of waves, in either of which cases I firmly believe the very heavy reinforcing shown in the illustration is an absolute waste of money and that a very much stronger piece of work would result from putting the cost of that reinforcing into an enlarged section of concrete.

If the reinforcing in concrete could be so disposed as to take direct or indirect tensible or transverse stress, as in floor timbers or girders, it would be a wise precaution to use it, but this is only possible in one case in five to ten.

Used as it is so freely to-day in retaining walls, dams, piers, abutments, foundations, etc., it is, in my opinion, a sheer waste of money. In these cases the reinforcing either takes no stress at all or a very indeterminate one.

The true inwardness of the matter, I believe, is that the steel interests have "put it over" the engineers all over Canada and the United States. If the makers of steel and the people that handled it commercially can prevail upon an engineer to bury a few tons of it in concrete, where, if it does no good it will do no harm, that is a matter of business, and I am convinced that for every ton of steel that is doing good work as reinforcing in concrete there are a score of tons that are doing no good at all.

Yours very truly,

"CONCRETE"

BRANCH NEWS

Calgary Branch

A. W. P. Lowrie, A.M.E.I.C., Secretary-Treasurer.
H. R. Carscallen, A.M.E.I.C., Branch News Editor.

Things We See

On January 16th, Mr. H. J. McLeod, M.Sc., M.A., Ph.D., professor of electrical engineering, University of Alberta, addressed the Calgary Branch at the Board of Trade rooms on "Things We See," the nineteenth century view of the universe and the new outlook upon nature in the light of twentieth century science. The address was an unusual one for an Engineering Institute meeting, and was very interesting and enjoyable. It is summarized below in some detail.

"The conception of the universe held by scientists toward the end of the nineteenth century is now known to be much more superficial than was thought at that time. Present day research has gone far beyond it and undermined many of its downright certainties.

"In order to understand its position we must recollect that that idea of things was the gradual development from Greek philosophy which had covered the whole range of thought; from Roman law which had organized administration of society; and the Christian religion which contributed the ideal of the universal family.

"Behind the Greek and Roman states had been the desire for security. Greece had achieved it by a policy of isolation, Rome by uniform religious and civil law. The Christian ideal was impossible under the old idea of progress. The Christian church after the fall of Rome abandoned the idea of its founder and fell back on the old pagan ways of accepting truth on authority. They looked back unquestioningly on the fathers who had taught that the world they saw and lived in was a finite universe—a world contained in a finite circumference and ordered on a systematic plan, part of which had been revealed. Salvation was its chief aim.

"The Christian church has been mainly responsible for the new society; but the tenth and eleventh centuries were the golden age of Mohammedanism which spread a civilized stability from China to Spain. And in the twelfth century Latin translations of Arab literature came back to Europe and sowed the seed of the Renaissance.

"Aristotle was still cited as the chief authority in all realms of knowledge. But in the fifteenth and sixteenth centuries progress came to the fore again and thinkers began to look forward instead of back. The new learning was a considerable impetus to this new movement but its chief impulse came from the many voyages of discovery which forced philosophers to take a new view of the universe. Gradually, and against strenuous opposition, the idea began to prevail of an infinite universe instead of a finite. At last Aristotle was laid aside and the new motto prevailed 'Prove all things; hold fast that which is true.'

"In the research which followed, science with mathematics gradually unveiled the mechanism of the universe and gave rise to the stream of inventions which characterized the nineteenth century. Materialism arose as the characteristic philosophy. The predictions which science was able to make were taken as proofs of science and man's mastery seemed secure.

"The system was not yet complete, however. Living things had not been explained nor the mind of man. The purpose of things seemed obscure. But Darwin apparently removed these objections by his discovery that variations may be transmitted and his theory of natural selection of variations. At the beginning of the nineteenth century life was chemical. At the end the living cell was a machine of which biochemistry was well on the way to a solution.

"It was thus the universe appeared in the 1880's. It floated in absolute space and in absolute time, consisted of a definite number of atoms and was pervaded by a strange ether which transmitted stresses and carried light vibrations. Only the details remained to be filled in, so the materialists thought.

"The first of these details to be investigated, however, started the crash of the whole philosophy. Professor Michelson investigated the velocity of the ether with most accurate apparatus. No motion was found. Rutherford and others also opened up a new door by their experiments with radioactivity.

"It took an Einstein, however, to show that the scientific philosophers had been looking for something that did not exist. They felt the world slipping through their fingers, for the old basis of materialism had been quite undermined by the rapid and successive discovery of x-rays, radio, the electron, the quantum theory, relativity, and the structure of the atom. It was, however, the beginning of a clearer understanding of the world out of which will be reconstructed a new philosophy.

"These discoveries all related matter to a series of electrical waves. The idea of this can be seen when a beam of light passes through a prism. It is broken up into a spectrum in which are seen different lines each of which corresponds to a definite wave length of vibration. The beam was not the simple thing it appeared to be but was made up of many of these, each with a different wave length of vibration. A line at the violet end of the spectrum had a frequency twice that of one at the red end.

"Similar characteristics pertain to the phenomena of sound. Middle C has a frequency of 256 per second. Its octaves downward have 128, 64, 32 and 16 vibrations per second respectively. The last is the lowest audible to the human ear. About 30,000 is the highest audible frequency. That is, the ear can hear about 10 octaves, of which the piano comprises the second to the eighth.

"The research of the past fifty years has determined, however, that in regard to light frequencies the scale covers some seventy octaves, of which we know that the spectrum of humanly visible light is the 45th and the x-ray the 65th. Below the 45th are the infra-red rays.

"And thus the conception has arisen that all these phenomena pertain to one enormous scale of 70 octaves, the keyboard of the universe, but so far science gives us no indication of the existence of time or space. We are still unable to prove the reality of the things we see. What a change in our outlook in fifty years! The world is not so simple now; it is no longer one vast machine, and we no longer believe that nature is limited to what we know.

"Science does not tell us the origin of nature or the purpose of the reality behind its laws and symbols. The material has dissolved into the non-material and the sharp distinction between them fades.

"A new civilization lies before us whose philosophy, religion, and art must blend with this background of science. In the panorama of this world we have lived in, we see in the beginning perhaps that a great star swung close to our sun which created a great wave upon it that splashed fire-foam into space and created our earth. The great bulk of matter is still in a firy state.

"By comparison we infer that we live in the dawn of a day just breaking, a day which is to extend to unthinkable length. We ask the meaning and purpose of it. Is life (so rare) merely the accidental outcome of matter and motion, or is it the climax of millions of millions of years of evolution which has also created the suns and systems we see? The answer may be found perhaps in the noon of that day that is breaking. The people of that time will see us in the morning of the world gradually groping our way out of ignorance and superstition toward the truth."

Town Planning

The Branch was given an address on "Town Planning" on January 30th at the Board of Brade rooms, by J. H. Doughty-Davies, A.M.T.P.I.C.

The speaker defined town planning as the scientific and orderly disposition of land and buildings in use and development with a view to obviating congestion and securing economic and social efficiency, health and well being; that is, it is an engineering problem requiring the ability to analyze and elicit basic facts before any definite solution can be reached.

It was brought out that generally a town plan is designed with particular reference to arterial highways and major street requirements, rapid transit, transportation, zoning, public recreation and civic art.

Regarding arterial highways and major streets it was pointed out that in planning these the governing factor is traffic origin based upon development both within and without the city limits. The density of population can be estimated from the topographic conditions in different areas. In deciding on a major street plan a traffic count is made from which the flow of traffic is determined, its maximum density, entrance into downtown districts, and other information. By-pass streets and relief thoroughfares can then be planned and the necessary width of streets determined. A major street should be so located that it is not interrupted by jogs or lack of continuity and should not have excessive grades or sharp curves.

The speaker then took up the subject of rapid transit and showed how by a study of the present street railway system, population, growth, and areas of probable densest population the future needs can be determined and any immediate extensions can be made with the final development in mind, thus causing an immense saving to the citizens.

In discussing "public recreation" which deals with playgrounds for children of elementary school age, larger playing fields for children of high school age, neighbourhood parks, large parks, and park drives, it was pointed out that as a result of many discussions between teachers, play supervisors and other specialists certain standards had been determined. For example, it has been decided that playgrounds for small children should not be more than a half a mile apart. Using the standards decided on for playgrounds, parks, etc., it is possible to reserve sufficient areas for these purposes at a time when land is comparatively cheap.

Under the heading "zoning" the speaker stated that the requirements of the city in its commercial and industrial development are thoroughly investigated and the location of major streets and park drives, street capacities and many other details are carefully considered. Upon these data the boundaries of districts are determined together with the regulations specially applicable to those districts. In regulating the height of buildings in any district, this is limited by the width of streets in that district, experience showing that the bulk of a building is very closely associated with the automobile traffic on the street serving it.

The lecture was followed by considerable discussion as the matter of town planning, especially that part of it dealing with the limiting height for buildings, is a very live issue in Calgary at the present time.

Construction of the Ghost Water Power Dam

H. J. McLean, A.M.E.I.C., production superintendent of the Calgary Power Company, addressed the Branch on "The Construction of the Ghost Water Power Dam," at the Board of Trade rooms on February 13th.

This dam was recently completed for the Calgary Power Company, Ltd., by the Foundation Company of Canada, Ltd. It is situated just below the confluence of the Bow and Ghost rivers about 34 miles west of Calgary.

The speaker described the dam in some detail but in brief the Bow river section is a concrete gravity dam with the power house built on the downstream batter of the dam. The length of this section is 928 feet and the volume of concrete in this and the south sluices and spillway dam is 129,900 cubic yards. The south semi-hydraulic fill dam is 1,140 feet long and contains 800,000 cubic yards. Near the south end of this fill is incorporated the south sluices and spillway dam above mentioned. The north fill dam was placed partly by hydraulic sluicing but mostly by gravel fill with a rolled clay core and contains 300,000 cubic yards.

The maximum head is 108 feet, the effective storage depth is 35 feet, and the net regulated storage 73,700 ac. feet. The dam has created a lake (Gaherty lake) extending 8 miles up the Bow river and about 3 miles up the Ghost river. It has a surface area of 2,855 acres and with the adjacent area will probably be made into a park for use as a summer resort.

The initial installation consists of two 18,000-h.p. vertical Dominion Engineering turbines, one 1,450-h.p. vertical Dominion Engineering station service unit, two 15,000-kv.a. Westinghouse generators and one 1,000-kv.a. Westinghouse station service generator. Provision has been made in the intake dam, and the penstock placed, for a third 18,000-h.p. unit which will be installed later.

The sluice and spillway capacity provided amounts to 150,000 cubic feet per second, giving an ample safety capacity according to the speaker, who estimated the combined maximum discharge of the Bow and Ghost rivers for the past twenty years as 39,000 c.f.s.

The progress of the construction work was explained in detail, being illustrated by an excellent series of lantern slides. The stripping of the site for the south earth fill dam was started on September 7th, 1928, and the whole construction work completed on November 30th, 1929. The first 18,000-h.p. unit was turned over on October 30th, 1929, and power has been generated from October 23rd, 1929.

The lecture and slides were followed with great interest and a large number of questions answered by Mr. McLean afterwards.

The Toronto Waterworks System

The Branch was fortunate enough to be able to persuade Wm. Gore, M.I.C.E., M.E.I.C., to deliver a lecture on "The Toronto Waterworks System" during his brief visit to Calgary recently. Mr. Gore is the senior member of the Toronto firm Messrs. Gore, Nasmith and Storrie, consulting engineers, which has been engaged by the city of Calgary in connection with the waterworks project to be started in the very near future. The meeting was held at the Public Library on the February 20th.

The speaker displayed a large number of very fine lantern slides, which, together with his explanatory remarks, gave his hearers a clear idea of the make-up of the extensive waterworks system of the city of Toronto. The filtration of the supply and the methods used in purifying it to eliminate pollution were described in great detail. Proposed extensions to the system were also detailed.

The lecture proved most interesting, especially in view of the new waterworks system about to be installed by the city of Calgary.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.
J. R. Dunbar, A.M.E.I.C., Branch News Editor.

(Reported by J. A. M. Galilee, Affil. E.I.C.)

Engineering in Europe

The regular monthly meeting of the Hamilton Branch of The Institute, preceded by a dinner at the Wentworth Arms hotel, was held on Friday, February 21st. The speaker of the evening, Professor R. W. Angus, M.E.I.C., of Toronto University, was introduced by E. H. Darling, M.E.I.C. The subject chosen by the speaker was "Engineering in Europe," which was illustrated by lantern slides.

Owing to ill health two years ago, Professor Angus was granted a year's leave of absence. He spent that time travelling in Europe taking more or less a "busman's holiday." Half of the time was spent on the continent and the other half in Great Britain. It was chiefly the continent which claimed the Professor's attention. The object of the tour was to gain some impressions regarding the comparison of European and American engineering practice. The speaker gave high praise to all the engineers of the different countries wherever he visited, for their hospitality and for their anxiety to show him everything that he wanted to see, as well as to show him some things about which he had not even heard.

The first country to be visited was Holland. This, in the Professor's opinion, was not a country where he might expect much engineering activity, but he was surprised to see at Delft some remarkable experiments being carried out in water channels. The construction of artificial canals and rivers there, on a small scale, is providing the answer to many of the problems which are peculiar to that country.

In Germany, the Professor found many large industrial plants rivalling in size the largest that this country can show. At the A.E.G. works is to be found a bursting pit for turbines, one of the few that are in existence.

In Berlin the Kleinberg power station is quite remarkable. This station generates 300,000-k.w., using pulverized fuel. It consists of three 80,000-k.w. machines and three 10,000 k.w. machines.

At Dresden there is a remarkable peak load storage system. For pumping purposes here there are eight 30,000-h.p. pumps. The pumps are supplied with moveable vanes, resulting in greater efficiency at variable heads.

At Munich there is a famous museum, the Von Dueller Museum, where there is a complete industrial exhibit. The youth of the country is given an opportunity to see the entire processes a product undergoes from the time the raw material is taken from the mine to the packaged article. All kinds of factory processes are explained by working models and diagrams, making an exhibit of the greatest possible value to industrialists.

Many views of hydro-electric undertakings were shown both in Germany and Switzerland. The chief point about these developments was that a relatively small head was utilized and in all these were large collecting dams for peak load use. As well as that arrangements are made for pumping back water during the off peak load. Only the economic conditions of a country could warrant such a procedure.

Both in Continental Europe and in Great Britain the Professor noted that very elaborate experiments are in progress to determine the best practice in any engineering project. For an expenditure of something like $5,000.00 a saving eventually through correct design of very many times that value is thereby saved, and the Professor thought that some such methods might very well be employed in this country.

L. W. Gill, principal of the Hamilton Technical School, in moving a hearty vote of thanks to Professor Angus for his lecture, heartily concurred with the speaker's statement, saying that Europe was now at a position where economics decide the engineering projects and that we in this country, through our wilful waste of natural resources and power, are rapidly coming to the time when we shall be in the same unfortunate position.

Kingston Branch

L. F. Grant, M.E.I.C., Secretary-Treasurer.

On Thursday, February 20th, Mr. C. D. Howe of C. D. Howe and Company, consulting engineers, Port Arthur, gave a very interesting and informative address to the members of the Kingston Branch, on "Grain Marketing and Grain Elevators."

Mr. Howe began by pointing out that the production and marketing of grain constitutes the biggest business in Canada to-day, and indicated the effect of a poor grain crop or of poor prices on the general economic prosperity of the country. The largest competitors of Canada in this commodity are Australia, United States, and the Argentine.

Until 1915 the marketing of grain generally, and of wheat in particular, was entirely in the hands of private dealers. The farmer took his wheat to the nearest one of the numerous small elevators some 7,000 of which are scattered through the Prairie provinces. Here the wheat was weighed, and a price offered by the buyer, this price being based on that quoted in the grain exchanges. Disputes as to weighing or grading could be referred to the government inspection office in Winnipeg. The dealer then sold the wheat. As dealers were, in the main, firms unwilling to carry indefinitely at their own risk all the wheat they purchased, they were obliged to sell wheat at once for future delivery at the Lakehead ports, the buyers being exporters or millers, Canadian or English. At the Lakehead the wheat was finally graded and reached tidewater by Port Colborne, Buffalo, or the Georgian bay ports.

In 1915 the requirements of the allied powers led to an arrangement under which all wheat was purchased by a representative of the Imperial government, who set the price. Two years later this system in turn gave way to the Canadian Wheat Board, which lasted until 1921. While this body operated, the farmer was given an initial payment on delivery of his wheat at the local elevator, and in addition he received a "participation certificate" entitling him to further payments should the ultimate selling price of his wheat warrant it. Originally regarded as worthless by many farmers, these certificates in some cases netted as much as 80 cents a bushel. Indeed the whole operation of the Wheat Board could be considered successful from the farmer's point of view, but the practice of government marketing was not considered sound except under war or other abnormal conditions.

Accordingly, when in the deflation period of 1922 agitation arose for a revival of the Wheat Board, the suggestion was made that co-operative marketing should be substituted, and in spite of some opposition and adverse opinion the Alberta Wheat Pool was formed in 1923, the other provinces joining in 1924. The wheat handled by the pool has grown from 20 per cent of the total crop in 1923 to 52 per cent in 1929. The farmer signs a voluntary contract for five years to sell through the pool all wheat he may grow or otherwise acquire.

The objects of the pool are, first to eliminate the middleman; to curb speculation in wheat and to market the wheat in an orderly manner. Under the system prior to 1915 lack of credit often led to what was virtually dumping. The wheat is sold directly to Liverpool or other buyers and for the first five years of its existence the pool was very successful.

In 1928 every wheat producing country in the world had a big crop, and in view of the probable fall in prices, the pool made an initial payment to producers of only 75 cents a bushel instead of $1.00 as in previous years. Not only the pool but private marketing bodies held wheat, as dumping would undoubtedly have depressed the price below the cost of production. Consequently the world in general and Canada in particular entered 1929 with a much larger carryover than usual. On the other hand reports from other countries indicated poor crops, and the management of the pool felt justified in raising the initial payment again to $1.00. The Argentine crop however turned out to be much better than anticipated, both in quantity and quality. Indeed so high was the grade that the usual admixture of a proportion of Canadian wheat was not needed, making the situation still worse from our point of view. It had been estimated that the Argentine crop would be exhausted in November, but shipments of about 6,000,000 bushels a week are still being made.

Consequently Canadian shipments have been at an alarmingly low figure during the past autumn and winter. Instead of a normal flow of 7,000,000 bushels a week, only about 2,000,000 a week have been shipped, and at the present time that is more wheat in the country than was grown in 1929, some of the previous year's crop still being unsold. The new Argentine crop will be on the market early in April, but reports indicate that the yield will be low.

The question arises as to whether the pool deliberately held up wheat with the object of inflating prices. Due to lack of storage capacity, wheat producing countries other than North America are obliged to market their wheat almost as fast as it is produced, a process which, in times of a large world supply, becomes dumping. Had the pool decided to market all its wheat during the past autumn it would not have been a case of shading the Argentine price, but of entering a price war against a forced seller, which would probably have produced calamitous results.

The situation is unprecedented in Canada because heretofore wheat has been regarded as practically as good as cash, but at the present time the banks have some $250,000,000 invested in a commodity which is not readily marketable. Further, whatever may be the merits or demerits of the Winnipeg Grain Exchange, it proved a ready market for wheat at all times. The operation of the pool has diminished the power of the exchange greatly and it is no longer in a position to dispose of as much wheat as in the past. The situation was aggravated during the past autumn by the existence of a heavy speculative interest, chiefly located in United States, which suffered from the stock market collapse, and which was obliged to sell a large amount of grain with the result of depressing the price further.

Turning to the geography of wheat movement Mr. Howe pointed out the new routes through which wheat finds its way to the consumer. In 1921 the first grain was shipped to Liverpool via Vancouver and the Panama canal. In 1928-29, 100,000,000 bushels went via the Pacific. The opening of the Welland ship canal will undoubtedly result in a saving to the shipper, though the amount cannot be definitely stated yet. The effect of the Hudson Bay Railway will be most interesting to watch.

Concluding his address Mr. Howe dealt with some features of elevator construction.

The number of questions which Mr. Howe was called upon to answer indicated the interest with which his audience has followed his remarks.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

The Lethbridge Branch held its usual fortnightly meeting at the Marquis hotel on February 22nd, when C. G. Childe, A.M.E.I.C., gave a talk on "Highways and Byways of the National Parks."

The popular nature of the address made a splendid opportunity for having a ladies night, and the executive's efforts were well rewarded for about ninety people were present for the dinner. During the dinner, orchestra selections were rendered by A. Morgan's orchestra and afterwards pianoforte solos by Miss F. A. Soar and vocal solos by F. G. Teague were appreciatively received.

Mr. Childe in his address discussed the development of the Park roads from the primitive game trails up to the present motor highways, and then led us into the byways by means of motion pictures and beautifully coloured slides, showing many of the wonderful natural beauty spots that have made our National Parks so famous.

Following this an informal dance was held, the music being supplied by Mr. Morgan's orchestra.

MEETING OF MARCH 8TH

The Lethbridge Branch held its regular meeting at the Marquis hotel on March 8th, when the speaker of the evening was Dr. R. Neidig of the Consolidated Mining & Smelting Co., Trail, B.C.

The meeting was preceded by a dinner and musical programme composed of selections by Mr. Morgan's orchestra and vocal solos by Mrs. W. Meldrum and Mr. E. Rannard.

Dr. Neidig, who is connected with the phosphate fertilizer work being undertaken by the Consolidated Mining & Smelting Co., gave a general talk on "fertilizers," outlining the development of ideas in regard to soils and fertilizers from ancient times up till today, when we consider the soil from an agricultural point of view as a dynamic thing in which chemical and bacteriological action is continually going on, varied by climate and tillage conditions.

Modern science has produced fertilizers in much more concentrated forms than were previously known, and much new research has to be done to establish their full utility.

Dr. Neidig outlined the different treatments in use in various parts of the world, showing the great variety of conditions, of soils and climates which determine what fertilizers are most valuable and how they are to be applied. Different applications may be used to promote different qualities such as disease resistance, high yield, high protein content, or quick growth.

In western Canada, fertilization of the wheat growing areas is a comparatively new idea, though it is well established in Australia. The idea is not to replenish an impoverished soil, but to promote more economic production generally.

The Consolidated Mining & Smelting Company has sent out shipments of phosphate fertilizers and in co-operation with the Canadian Pacific Railway, various implement companies and provincial and federal governments, has been carrying out field tests, to provide data for large scale production and application. The results have so far been very encouraging and a large plant is being erected at Trail for the commercial production of highly concentrated fertilizers. Large deposits of phosphate rock are being developed near Fernie, B.C., and the material is shipped to Trail where it is treated. The principal reagent is sulphuric acid obtained from the sulphur dioxide given off in the smelting of sulphide ores. This treatment produces a very concentrated fertilizer known as triple super phosphate.

A large ammonia plant is also being erected for the production of nitrogen fertilizers. Hydrogen is obtained from the electrolysis of water, the oxygen being used for metallurgical purposes. Distillation of liquid air provides the nitrogen supply. Thus with large amounts of phosphate, ammonia and sulphuric acid available, there is scope for a great development in fertilizer production, which will undoubtedly enhance the prosperity of western agriculture, and consequently enrich the whole nation.

It was gratifying to note that the meeting was attended by a large number of technical agriculturalists from various parts of Alberta, who were anxious to hear the first public discussion of the fertilizer question.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

P. B. Motley, M.E.I.C., presented a paper before the Montreal Branch on Thursday, February 20th, dealing with the reinforcing of the Stoney Creek arch bridge of the Canadian Pacific Railway in British Columbia. This paper will be published in full in a later issue of the Journal. Mr. P. L. Pratley, M.E.I.C., occupied the chair.

TRANSFORMER LOAD RATIO CONTROL

On February 27th, C. E. Sisson, M.E.I.C., Canadian General Electric Co., Toronto, presented a paper to the Montreal Branch on "Transformer Load Ratio Control." There are considerably over 100 of these transformers installed, total capacity 5,000,000 kv.a. or more. These transformers are used for interconnecting power systems, allowing generating stations to run with reduced responsibility in regard to voltage regulation. Also phase angle may be shifted by changing ratio. Some of these transformers thave been in use for 5 years, changing taps as frequently as 7 times daily. In general the principal involved is 2 contacts, one of which is closed to the proposed ratio tap, shorting a section of winding through an impedance to limit the current, the first tap then being removed and transferred to the new tap. Operations are carried out in sequence by a motor-driven mechanism. This mechanism may be operated by a hand crank if auxiliary power fails. The largest of these load ratio tap changers is connected externally to the transformer bank by bringing the grounded neutral connection through the tap changer. These ratio changers then operate in series with the main transformer, and may be excited from any local synchronous source of power.

In the discussion the rate of speed involved in changing taps was shown to be approximately 2 minutes per tap, or to work from one end of the ratio change device to the other would involve possibly 20 minutes. Pilot lights indicate position of tap. Mechanism is enclosed in an oil tank external to the main transformer tank. The question of using load ratio change on long lines where independent generators are used was brought up, and it was considered that generator field control is satisfactory in such a case.

J. H. Trimingham, A.M.E.I.C., A. D. Allen, S. B. Brown, A. Gall, John Morse, M.E.I.C., and C. R. Reid took part in the discussion.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

C. G. Moon, A.M.E.I.C., Branch News Editor.

On February 26th, the Niagara Peninsula Branch held a dinner meeting at St. Catharines to celebrate its tenth birthday and to do honour to Alex. J. Grant, M.E.I.C., who was recently elected to the presidency of The Engineering Institute of Canada.

Many out of town members were present and messages of regret were received from others who were unable to be present.

R. J. Durley, M.E.I.C., and J. M. R. Fairbairn, M.E.I.C., represented Montreal at the head table and spoke briefly, bringing congratulations from Headquarters. Mr. Fairbairn presented the President with the gold badge of The Institute.

E. G. Cameron, A.M.E.I.C., presided and mentioned that the Branch was honoured in having had two Members elected to the presidency within the last ten years—Mr. Grant and Colonel R. W. Leonard, M.E.I.C., Colonel Arthur L. Bishop, A.M.E.I.C., said that he wished to represent Colonel Leonard who, although not well enough to be present, took a great interest in this meeting and desired his congratulations to be conveyed to Mr. Grant.

Alex. Milne, M.E.I.C., and Mr. Gordon Sherk, president of the Rotary Club, welcomed the visitors to St. Catharines, and W. D. Black, M.E.I.C., of Hamilton, responded.

Mr. Grant spoke of the strides which The Engineering Institute had made and the part which it had played in the progress of the Dominion. He referred to the Welland ship canal, with which he has been so intimately connected, and gave praise to the staff for the able assistance which had been given during the construction. The canal would be opened during the coming year and although the cost was greater than the original estimate yet there was reason for it. The index of commodity prices had about doubled since 1913 when the estimate was made and many improvements, not originally contemplated, had been added. When finished it would be a modern waterway in every sense of the word.

During the evening the brief speeches were interluded with songs and orchestral numbers. The local pipe band played and two Scottish lassies danced. Jimmie Rice from Montreal entertained in his unusual manner, Walter McCutcheon from Hamilton ably assisted with some very fine solos and a "good time was had by all."

(Copy of letter contributed)

Dear Cameron:—

Dum vivimus, vivamus! The spirit was willing and the men were weak. It was a good party.

Those of us who came from afar desire to offer a delicate appreciation to the Niagara Peninsula Branch for having combined its tenth birthday festivities with an ovation to the new President of The Engineering Institute of Canada, Alexander Joseph Grant.

Two separate celebrations would have surely constituted a riot.

We met old friends and we made new ones. Prior to the banquet, the Branch, the canal contractors, the boys from Hamilton and Peterborough extended courtesies which also reminded us of old times. During the dinner meeting we enjoyed Jimmy Rice, Jimmy Bond and Walt. McCutcheon, we listened to the speeches with close attention and, when Jack Fairbairn stated that he was proud to present the gold badge to the President because he was Sandy Grant rather than an internationally famed engineer, we pounded on the tables. A contractor leaned over to me and whispered that, although his hair was white, they still called him Sandy because an "extra" always drew forth highly coloured language.

Subsequently we adjourned to another private room and sooner or later retired. And, in the morning—forsan et haec olim meminisse juvabit.

N.B. The correspondent's name was unfortunately illegible but after some trouble, the Branch Editor was able to get a translation of the above Latin phrases which, for the benefit of other illiterate engineers, are somewhat as follows:

(1) Let us enjoy life while we are alive.
(2) At some future date it may be pleasant to remember even this.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

On Thursday, January 30th, Mr. Tom Moore gave a luncheon address on the subject, "Impressions of Japan and the Far East." Mr. Moore is well known in Ottawa and throughout Canada as the president of the Trades and Labour Congress of Canada. He was a delegate to the recent conference of The Institute of Pacific Relations at Kyoto, Japan.

Mr. Moore sketched briefly the objects of the conference, at which there were present delegates from the United States, Canada, China, Manchuria, Australia, and New Zealand, as well as observer delegates from India, Dutch West Indies, Russia and the League of Nations. About two hundred delegates in all were present and it was rather remarkable that the conference was conducted in the English language. However, Mr. Moore's chief remarks were in connection with his own observations of the country and its people. He referred to the extreme courtesy which the delegates experienced, not only in their official relations, but in all their private interviews with the people of the country. The cities, Yokohoma in particular, are in many respects very much like western cities in their streets, means of transportation, facilities for conducting business, etc. The railway system throughout the country is owned by the country, and from Mr. Moore's observations was conducted very efficiently. The countryside in densely populated and intensely cultivated. Nowhere could one see a more efficient system of irrigation.

The conference was conducted in the city of Kyoto, which has a population of about 800,000. In this city one notices the contrast of western and eastern civilizations in a marked degree. Alongside of modern efficient services in many respects and massed production of many commodities, such as textiles, silks, artificial silks, etc., was the presence of the native handicraft occupations. Modern street-cars vie with rick-shaws, modern steam shovels were working alongside hand-barrows, and automobile trucks might be seen in the same street with rows of natives carrying individual burdens.

The Japanese have made efficient and extensive use of electricity, as electric lights are everywhere in evidence. The people themselves are very efficient in their duties, and the workers are beginning to organize themselves for their protection and advancement. It was noticed that communism is endeavouring to make advances among the working classes, but so far this influence has not been felt to any great extent. There is not apparent any great desire to emigrate, as the people have deep-seated affection for their own land and for the traditions of their race. Family traditions and race traditions are a very important factor in the life of the people. The present increasing industrialization of working conditions is tending to break down these old traditions and Mr. Moore considered it very regrettable if all the ancient culture sould be blotted out by the factor system.

The people of Japan do not observe Sunday as a rule, although recognition of it is increasing. However, the first and fifteenth of each month are generally recognized as rest days—the people flocking to the shrines and temples for worship, or to the parks and public playgrounds for recreation.

Westerners find some customs in Japan a little irksome, as for instance taking off their shoes when they go into a house, sitting on the floor when they eat their meals, and eating native meals which often include portions of uncooked meat, fish and other edibles. The houses contain no furniture, such as is to be found in western countries. On the other hand, neither do they contain so many useless nick-nacks as western houses are often cumbered with.

The delegates were entertained wherever they went; these entertainments in many cases taking the form of garden parties. Japan is full of beautiful gardens, the owners of them often taking much more care of them than they do of their houses.

In conclusion, Mr. Moore emphasized the fact that Japan is developing very rapidly into one of the most powerful nations of the world and she has demonstrated her desire to co-operate with other nations on an equal basis in maintaining the peace of the world. The conference at Kyoto had as its object the furtherance of this great aim, and as such has no doubt been of great benefit to the world at large.

Present at the luncheon were Honourable Charles Stewart, Minister of Mines and of the Interior, Honourable Peter Heenan, Minister of Labour, Honourable Jean Knight, Minister from France, Honourable I. M. Tokugawa, Minister from Japan, Mr. A. J. Grant, M.E.I.C., the incoming President of the Engineering Institute of Canada, Dr. C. C. Camsell, M.E.I.C., Deputy Minister of Mines, and H. H. Ward, Deputy Minister of Labour.

Popular Lecture on Talking Motion Pictures

At the Chateau Laurier on the evening of Friday, February 28th, a popular lecture was given under the auspices of the Ottawa Branch of The Engineering Institute of Canada. The speaker of the evening was Mr. O. R. Harvey, manager of the research products department of the Northern Electric Company, of Montreal. This department was formed within the past two years to commercialize new developments in radio, scientific and medical equipment, and sound and talking pictures.

Mr. Harvey's talk was on the development of sound and talking pictures with reference to scientific developments which have led up their present position in the field of popular entertainment. It was illustrated by six reels of films, the apparatus used being a small set, remarkable for its portability. The set was so designed that it could be packed within the space of four medium-sized trunks, and at the conclusion of the lecture it took only a few minutes to pack the entire equipment and transport it to the train for its next journey.

Mr. Harvey's talk traced the development of the motion picture industry from the time some thirty years ago when Thomas Alva Edison first conceived the idea of giving eyes to his phonograph. Various early attempts were made to synchronize sight and sound although the first production of the talking motion picture on a commercial basis took place less than four years ago, when Warner Brothers, small producers in the motion picture industry at the time, put out "Don Juan" with sound effects, in which John Barrymore was the star. This sound picture was looked upon somewhat as a novelty and was only moderately successful; but another one, a talking motion picture, put out in October, 1927, really revolutionized the industry. This talkie was entitled the "Jazz Singer" with Al Jolson as the star. Within a week receipts at the theatre where it was shown were doubled. During the second week they trebled and within two months thereafter thirteen motion picture companies who had dubiously looked upon the early attempts, signed up for the installation of equipment. The result was that the factories manufacturing and installing this sound reproducing equipment were taxed to the utmost, so that it was necessary for them to work their staffs twenty-four hours of the day, a condition which still prevails. It is estimated that five hundred millions have been spent in sound production and reproduction equipment by producers and exhibitors throughout the world.

In Hollywood, old equipment representing millions of dollars in investment was scrapped overnight. The effect upon the motion picture colony was felt in many different ways. As an example, within the space of two months fifteen classes in elocution were commenced in Hollywood in order that the motion picture actors and actresses could perfect themselves in the new art that was required, namely, the art of speaking.

The effect upon the exhibitors themselves was tremendous. It was necessary to install equipment, and in the altering of the interior of their motion picture house, the expenditure of $30,000 or $40,000 for a small theatre was quite usual.

There are, stated the lecturer, approximately 50,000 motion picture theatres in the world of which about 20 per cent are at present equipped to reproduce sound. These sound reproducing motion picture houses extend into 44 different countries of the world, and include quite a number of countries which are considered to be quite backward in other respects.

In Canada there are 225 motion picture houses with equipment to reproduce sound out of a possible 750 theatres. It is estimated that approximately 8,000,000 persons attend the movies in Canada each week.

The recording of the sound in connection with the motion picture industry in done in two ways: on discs or on film. Some producers are still using the disc recording devices, notably Warner Brothers, who introduced sound talking pictures, and the First National.

The disc resembles a gramophone record but rotates more slowly and is synchronized with the picture film so that the operator may start both of them together. In the other method, the film method, an actual picture of the sound is placed upon the film. In taking sound motion pictures by this method two different films are obtained at the same time, one for the picture and the other for the sound. The negative and the picture negative are later printed together on a third film which is used in the projection.

In projecting such a film the film itself is stopped 24 times a second. The sound projection portion of the projecting apparatus is about

$14\frac{1}{2}$ inches below the picture projecting portion, and it could quite readily be believed that for the synchronization and projection of these two elements the skill required in the finest of watch making would be necessary in the manufacture and adjustment of the various working parts. The light beam, for instance, used in the sound projection is from 8/10,000 to 10/10,000 of an inch in width, less than one-third as wide as the human hair. Flutter must be guarded against, and all apparatus, of course, must be rigidly kept in the most perfect working order.

The motion pictures exhibited by Mr. Harvey during the course of his lecture showed the apparatus required in the making of the sound motion picture film. One reel prepared as a cartoon was most ingenious in simplifying the method of explanation, and the members present and their friends evinced in the discussion which followed their keen appreciation of the lecture itself.

Mr. Harvey stated that new developments at present taking place were the introduction of colour pictures and the showing of pictures twice as large in both dimensions as those at present used, the latter giving the illusion of depth, particularly in out-door shots. The lecturer stated that in his opinion, within the next two years all pictures would be in colour and it was interesting to note that in the development of this art a Canadian from the city of Kingston was one of the originators.

A future possible trend is toward the use of television, but at present the apparatus required to effect it is too great for practical application. Perhaps in the course of a few years it will be brought within the realm of practical possibilities.

The chairman of the local Branch, John McLeish, M.E.I.C., presided.

Joint Luncheon With Queen's Alumni

At a joint noon luncheon at the Chateau Laurier on March 13th, arranged in co-operation with the Ottawa branch of the Queen's Alumni Association, Colonel Alexander Macphail, M.E.I.C., professor of civil engineering at Queen's University, gave an address upon the subject of "Charles Darwin." Mr. John McLeish, chairman of the Ottawa Branch of The Engineering Institute of Canada, was chairman at the luncheon, the speaker himself being introduced by A. E. MacRea, A.M.E.I.C., the president of the Ottawa branch of the Queen's Alumni Association.

Professor Macphail delivered a most scholarly address upon the great evolutionist that was listened to with rapt attention. At the commencement he stated that the chief myth associated with the name of Darwin—all great men after their passing had myths associated with their names—was that he was responsible for the theory that man was descended from the ape. Darwin, stated the speaker, never said, believed, or even thought such a thing. He was not gifted in the sense that many other great men have been gifted, but as to whether or not he was a genius, posterity may judge for itself. He was a scientist with the mind of the engineer relying upon his facts and data to speak for themselves.

No subject can be of unbounding interest, stated the speaker, unless it relates to the physical or spiritual welfare of the people. Darwin's work did not relate to the former but to the latter, and to such an extent was this the case that it had given rise to a new word in our language, namely, the word "Darwinism."

Our forefathers, in their conceptions of life, had but a scant six thousand years and a limited space of creation at their disposal. Today, as the result of the investigations of philosophers and scientists we have time extending back into the thousands of millions of years—in fact, so vast, that we have lost track of it—and space so great that there is neither beginning nor end. With such a background it is much easier for us to believe the conclusions in Darwin's great work, the "Origin of Species," published 70 years ago.

The early life of the great evolutionist gave but little promise of his later attainments. At school and university with their standardized curricula, he was by no means a shining success. In fact, these studies bored him and it was with a feeling of relief that he seized his golden opportunity at the age of 23 to become the official naturalist to the famous expedition of The Beagle to the waters of lower South America and the Pacific. This voyage, which took five years, had a great influence on his life and laid the foundation of his later fame.

In 1831 he commenced his first great work, a work which he modestly called an "abstract." So indefatigable was he that he would spend many months of research to arrive at a definite conclusion which he might incorporate into a single sentence. His work and his writing were often carried on in the face of great physical handicap. At times he would suffer from long periods of ill-health, which must have made his work particularly onerous.

The driving power of such a life, stated the speaker, was not ambition, fame, pride, vanity, hunger, or any other of the usual motives which might actuate a lesser man, but simply the pure love of science. His ancestors were yeomen who had about a century before risen substantially to the ranks of the professions and the gentry, but there was nothing in his ancestry to indicate that he should become what he was.

Although Darwin's life was lived in private, so voluminous were his writings and so extensive his correspondence that every incident has been subsequently open to the public like an open page. A list of his works alone would occupy ten pages of ordinary print. The "Origin of Species" was, of course, his greatest life work.

In conclusion, stated Colonel Macphail, "Darwin set up no new standard of morality in the hearts of a nation, nor implanted new ideals in the conduct of domestic life; he did nothing towards enhancing the prestige of the British Empire in every corner of the globe; he founded no empire based on divine rights of kings; he was not in the least concerned with the establishment of responsible or irresponsible government anywhere; his researches did nothing to prevent the loss of human life by disease; he was neither a martyr nor a saint; yet he had a great faith, and did much to convince us that the world is a sane institution, governed by immutable laws, and not the irresponsible dream of a suffering and tormented God."

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.
B. Ottewell, A.M.E.I.C., Branch News Editor.

Aerial Mapping

An address by a member of the Canadian Government Air Services has become a much appreciated annual event with the Peterborough Branch On the evening of the February 27th, 1930, A. M. Narraway, M.E.I.C., chief aerial surveys engineer, Department of the Interior, Ottawa, gave a particularly interesting lecture on "Aerial Mapping." S. O. Shields, Jr.E.I.C., acted as chairman for this meeting.

Defining his subject as "the application of the aeroplane and photography to the investigation of the natural resources of a country," the speaker outlined the work being done in Canada. He likened the Canadian plane to the "work horse" rather than the "racehorse," in that it is being put to many useful purposes. During the past 8 years some 340,000 square miles have been surveyed by aerial photography, a feat impossible by other means.

Mr. Narraway exhibited slides of typical planes and camera equipment. Wheels, skies and pontoons are all necessary as well as a canvas canoe, strapped under the plane. The cameras are operated automatically and take some 110 exposures per roll. Stereoscopic pictures in pairs, and vertical pictures are taken. The method of plotting maps from the photographs was described and illustrations of maps so produced were shown.

Aerial photography has many other uses besides map making, such as the forestry (some 35,000 square miles of tree types were located last year), and fire patrol service. Great assistance is rendered in determining the best site for water power developments and the extent of watersheds. Location of transmission lines is much simplified and can be done entirely from the air.

Mr. Narraway described and illustrated how aerial photographs were used to determine geological formations and favourable mineral areas.

Some interesting slides showed how the camera will penetrate water and photograph water channels in an estuary, and contours of the bottom of a lake.

This meeting was largely attended, among the visitors being students of a local flying school. After an active discussion, a hearty vote of thanks to Mr. Narraway was proposed by R. C. Flitton, A.M.E.I.C.

Students' Night

The meeting of March 13th, 1930, was arranged as a "Students' Night" under the chairmanship of W. H. Hooper, Jr.E.I.C. The lecturers, all employees of the Canadian General Electric Company, Limited, were A. E. Jagger, S.E.I.C., and R. L. Morrison, S.E.I.C., both of Vancouver, and graduates of the University of British Columbia, and J. J. Taylor, S.E.I.C., of Edmonton, graduate of the University of Alberta.

Although the attendance was disappointing, keen interest was manifested by those present and the discussion after each paper paid handsome tribute to the appreciation with which the lectures were received.

The Diesel Engine

The first speaker of the evening was A. E. Jagger, S.E.I.C., who presented an interesting and comprehensive paper on the "Diesel Engine," dealing with his subject under the heads of history, cycle of events, materials, construction, fuel, lubrication and air systems, governing and application of the engine.

The solid fuel, constant pressure engine was invented by Dr. Rudolph Diesel in 1892 and a commercial engine of 25 h.p. was built in 1897. During the war, Diesel engine construction received considerable impetus and to-day their manufacture is on an enormous scale. Engines of 8 to 10 cylinders developing 1.700 h.p. per cylinder are now built.

It was explained that the higher efficiency of the Diesel over the gas engine was due to compressing the air to a high pressure and burning the fuel to give a higher mean effective pressure. Both 4 cycle and 2 cycle designs are built, the latter requiring an air compressor for scavenging.

The design and construction of the various parts were next dealt with, and illustrated by means of slides, showing typical Diesel engines of both stationary and marine types. The valve mechanism, fuel and lubrication systems and air compressor were described in considerable detail, as being vitally important to the success of the engine.

In conclusion, the speaker stated that the Diesel engine has been brought to the stage where it enjoys the confidence of companies using prime movers. Motor vessels of all types and sizes are rapidly increasing in numbers, and steam may eventually be entirely superseded for propulsion purposes.

The economy and convenience of the Diesel make it eminently suitable for generation of electric power in many locations. The development of engines of light weight and high speed is permitting the use of Diesels on dirigibles such as the R-101, whose progress will be watched with much interest.

Mr. Jagger's paper was well illustrated with diagrams and photographs, and was followed by considerable discussion.

Power Rectifiers

R. L. Morrison, S.E.I.C., next gave a paper on the theory and application of the "Mercury Arc Power Rectifier." The development of the metal tank rectifier in Europe and America, and some of the difficulties met with and overcome were outlined. Recitifiers are now being manufactured on a commercial basis and with satisfactory operating results. Capacities up to 6,500 kw. at 650 volts and voltages up to 6,000 or 7,000 have been found feasible.

The speaker dealt at some length with the voltage and current wave forms of rectifiers with different numbers of anodes or phases, and also the formulae for voltage and current relations.

It was shown that with 6 or 12 anodes the ripple in the d.c. voltage was reduced to a practical minimum. The advantages of a rectifier in respect to high efficiency were most pronounced at the high voltages, since the losses are almost independent of voltage and load.

Voltage regulation and overload capacity were briefly discussed and it was shown that troubles such as back-firing which had formerly been serious have now been practically eliminated.

The various auxiliaries necessary to the operation of the rectifiers were also described including the vacuum pumps, rotary and mercury types, the vacuum gauge, cooling system, etc.

Forestry in Alberta

"My subject covers a large area" said Mr. Taylor, in opening his interesting talk on Forestry. "It covers an area of 1,500,000 square miles." He spoke intimately of the vast forest reserves of his native province, having at one time been on a survey party at which time he took several photographs from which he made lantern slides. These he exhibited in conjunction with his address which added greatly to its success.

He discussed the duties of the fire rangers which include the cutting of trails, erection of telephone communications between camps and the erection of stop-over cabins and lookout towers.

Their three major duties are preventing of fires, detection and suppression. The first is accomplished by educating the people of the danger of forest fires and of the necessity for conservation of the vast timber resources. Detection includes patrol work by airplanes, a daily patrol of the railroad with speeders and lookout men stationed in the watch towers.

A great point in forestry is being able to recognize fire hazard periods and these are largely dependent on the humidity of the air. One of the latest methods adopted by Price Brothers of Quebec is to measure the moisture content of the "duff" or top soil. It is a method which is meeting with success and which is likely to be adopted by all provinces.

Mr. Taylor also dealt with the control of insect pests which attack standing timber, adding that another menace to forest reserves was fungus diseases.

The aim of the Forestry Service is a system of management which will lead to a sustained yield of timber and the speaker was of the opinion that it should be managed solely by the government and not left to the exploitation of private concerns.

In addition to his own slides Mr. Taylor used some very artistic coloured slides kindly provided by the Department of the Interior.

Saguenay Branch

R. Lanctot, Jr.E.I.C., Secretary-Treasurer.

At Arvida, on Monday, February 24th, at 8.00 p.m., there was a meeting of the Saguenay Branch of The Engineering Institute of Canada, at which about 35 were present, mostly from Arvida. The speaker for the evening was N. D. Paine, A.M.E.I.C., who gave a very interesting address on "Electric Drives for Paper Machines."

Mr. Paine first gave a brief description of a paper machine and its operation; he also pointed out the factors necessitating uniform or closely regulated speeds of the drives of the various parts of the paper machine. He described the sectionalized electric drive for speed differentials, which is a rather modern development of that industry. The speaker then compared the mechanical differential with the electrical one; both control the relative speeds of the driving motors automatically and are quite satisfactory, but, in his opinion, the electrical differential has the advantage because of its cheaper repair and maintenance cost.

The meeting proved very interesting and the paper was appreciated by all.

Saint John Branch

E. J. Owens, A.M.E.I.C., Secretary-Treasurer.

"A sustained yield policy—an allowable cut estimated to be within the annual growth—must be adopted in Canada if the successful industrial life built up on wood-using industries is to be passed on as an asset to the next generation," declared Professor J. Myles Gibson, B.Sc., professor of forestry at the University of New Brunswick, in speaking on forest production, protection and reforestation before a meeeting of the Saint John Branch of The Engineering Institute of Canada, held in the Board of Trade rooms on February 20th last.

Professor Gibson, who is a native of New Brunswick, described the organization and workings of the British Columbia Forestry Service, having spent upwards of 10 years in the Forestry Service on the Pacific coast. He pointed out that few government forestry staffs on the continent have such complete control over the forest and forest lands as the forest branch of British Columbia, and contended that such a service should be established in other provinces of the Dominion which are heavily wooded and where lumber is one of the leading industries, such as is the case in New Brunswick.

In his address he dealt with forestry from the standpoint of the administration of the forest resources in the province of British Columbia, describing the development of the organization from the time it was controlled by two men and a chief ranger down to 1928 when the forestry branch had a staff of 560 employees, 314 of whom were seasonal employees and 246 permanent employees.

Professor Gibson pointed out that the framing of the Forest Act in British Columbia in 1912, following the report of the Royal Commission appointed in 1909 to make an enquiry into timber and forestry, was responsible for the organization and operation of the forestry branch at the present time.

In the organization of this department the natural resources in land, forest and water were placed under the administration of a minister of lands, the present minister of the department being Hon. F. P. Burden, a native of New Brunswick, and a graduate of the University of New Brunswick. The department was divided into four branches—lands, surveys, water and forest.

In dealing with the department of forestry, Professor Gibson made reference to the fact that the present chief forester under whose direction the department functions was P. Z. Caverhill, also a native of New Brunswick and a member of the first graduating class in forestry at the University of New Brunswick. The speaker then described the activities of the various divisions, touching on management, operation, records, surveys, research, trade extension and grazing.

The total forest area of British Columbia is 372,630 square miles, he stated, with 4,000 square miles of water surface.

The organized area of the province, he stated, had been divided into six forest districts, each being in charge of a district forester and several assistants. Each forest district was further divided into ranges, of which there are some 59.

Referring to the surveys division, Professor Gibson mentioned that in 1925 the legislature of British Columbia created a statutory fund for the purpose of developing, protecting and maintaining continuous crops of timber on provincial forests. Eighteen areas, containing approximately 7,000,000 acres, have so far been so dedicated and additional areas are being set aside at the rate of 1,000,000 acres per year, with the object of having 25,000,000 set aside by 1950.

The speaker explained that the forest survey department is at the present time developing a forest cover map of the province on which a provincial stock taking will be based. Vancouver island, an area of 8,000,000 acres, has already been covered and shows an area of 3,703,000 acres of merchantable timber with a total stand of almost 95 billion feet. Forest cover maps, he said, are of great assistance to the administration staffs in both management and operation work.

Professor Gibson touched also on the research work being carried on in British Columbia, and gave some idea of the accurate knowledge being gathered by the forest research division. Research work in British Columbia, he said, is being carried out along two lines—forest production and forest protection.

Trade expansion, he stated, is an essential factor in the life of a province which has commercial forests ready for cutting and whose product must be exported.

In connection with his lecture, Professor Gibson produced photos of some forest scenes and conditions in different phases of forestry work in British Columbia which were flashed on a screen for the benefit of those attending the meeting.

The meeting was presided over by W. J. Johnston, A.M.E.I.C., chairman, who introduced the speaker. A hearty vote moved by C. C. Langstroth, A.M.E.I.C., and seconded by J. A. W. Waring, A.M.E.I.C., was extended to the speaker by the chairman.

Halifax Branch

R. R. Murray, A.M.E.I.C., Secretary-Treasurer.
W. J. DeWolfe, A.M.E.I.C., Branch News Editor.

The February meeting of the Halifax Branch was held on the 20th of the month at the Halifax hotel, chairman W. P. Copp, M.E.I.C., presiding. The meeting was preceded by a supper at which twenty members were present.

In opening the meeting, chairman Copp referred to the election of Prof. F. R. Faulkner, M.E.I.C., as Vice-President of The Institute for this zone and of H. F. Bennett, A.M.E.I.C., as councillor for this district.

Mr. Bennett noted that the chairman of the Saint John Branch, E. A. Thomas, A.M.E.I.C., had died recently and that he had arranged for this Branch to be represented at the funeral.

Chairman Copp then called upon J. S. Misener, M.E.I.C., manager of the Acadia Sugar Refinery at Woodside, N.S., who delivered a very interesting address on "Sugar Refining."

At the conclusion of his address, Mr. Misener invited the members to visit the plant and answered several questions.

For table use, he stated, cane sugar is better than beet root sugar.

Sugar grading was described and it was noted that the product is bought according to sugar content.

The activated carbon method of cleaning sugar is not used very much, being not as good as the char method nor any cheaper.

The reason that sugar does not dissolve during washing is that the water is thrown off centrifugally, about 2¼ millions of lake water per day being used.

A very hearty vote of thanks was tendered to Mr. Misener on motion of K. L. Dawson, M.E.I.C., seconded by H. F. Bennett, A.M.E.I.C.

Mr. D. R. Turnbull, Secretary of Acadia Sugar Refining Company, was called upon and added some very interesting references to Mr. Misener's address. He said carbon had been tried but the quality of product was not as good as from char. He stated that the tropical zone is the natural cane sugar country. The reason for the development of the beet sugar industry he traced to Napoleon's need for sugar for his armies. Beet root sugar is manufactured largely in Europe but not well favoured in this country, being too expensive to produce and needs tariff protection for the industry to live in Canada. Large grained beet sugar is used because of custom of the users but is harder to market than cane sugar.

The Acadia sugar refinery is the second oldest in Canada and the product of refinery is made with every care and very much cheaper than in England. The new machine referred to by Mr. Misener, of which there is not another of quite the same kind anywhere, certainly not in Canada.

Mr. Turnbull, who is an ex-president of the Halifax Board of Trade, made some quite interesting remarks on the economic side of sugar making and manufacturing in general and said that active competition is the cause of labour saving machinery and consequently unemployment. He thought the solution of unemployment lay in methods of distribution, which will take up the number of unemployed.

At the conclusion of Mr. Turnbull's remarks the chairman closed one of the most interesting of recent Branch meetings.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Sault Ste. Marie Branch was held on February 28th, following a dinner.

Chairman C. H. E. Rounthwaite, A.M.E.I.C., presided. J. W. LeB. Ross, M.E.I.C., gave a short report of the Annual Meeting held in Ottawa. He also reported that Mr. McLachlan, of the St. Lawrence Waterways, was willing to give a paper before the Branch.

The chairman then introduced the speaker of the evening, A. H. Russell, A.M.E.I.C., who spoke on the subject, "Winter Maintenance of Streets and Sidewalks."

An animated discussion followed and a vote of appreciation was tendered Mr. Russell, on motion of C. H. Speer, M.E.I.C., and J. Hayes Jenkinson, A.M.E.I.C.

Before adjourning the chairman announced that the next meeting would be addressed by A. M. Wilson, Jr.E.I.C., on "The Michipicoten Coal Dock."

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
Archie B. Crealock, A.M.E.I.C., Branch News Editor.

On Thursday evening, February 6th, Mr. A. E. Davidson, C.E. transmission engineer of the Hydro-Electric Power Commision of Ontario, gave an address on the construction features of the Gatineau-Toronto 220-kv. transmission line which was erected in 1927 and 1928. The lecture was generously illustrated by lantern slides and moving pictures.

Mr. Davidson told of the location surveys in which the aeroplane played an important part, also the difficulty of finding and getting reasonable terms with the land owners when purchasing the 130-foot right-of-way. The line is 230 miles long, 27 miles being in Quebec. The work consisted of clearing the right-of-way, transporting the material, erection and maintenance of camps about 12 miles apart, placing anchorages, erecting the towers, stringing the conductors and ground wires, removing the camps, equipment and excess materials. While Mr. Davidson apparently regarded such an undertaking as a piece of routine work, his audience, even if not acquainted with the country through which the line passed, could judge by the pictures that everything from open fields to tangled second growth and from swamps to solid rock was encountered.

The right-of-way was kept surprisingly straight considering the nature of the country, so that the number of dead end and angle towers was reduced to a minimum. A novel feature of the clearing of the right-of-way was that most of it was done by the land owners under contract. There are 994 galvanized towers with silicon steel leg angles and structural steel web members. The use of silicon steel reduced the weight of these heavy members of the towers by about one third thereby diminishing the transportation difficulties. The towers are of the single circuit type with the standard towers having a conductor suspended on each side from the overhanging head and the centre conductor strung through the structure. The transposition towers have two conductors suspended from arms on one side of the tower with the third conductor strung through the structure. The towers carry two standard galvanized steel ground wires on the top of the head and a telephone circuit on the tower leg.

The anchorages were of three types, earth, rock and concrete footings; very few of the latter being found necessary. The earth and rock anchors were accurately placed by using setting templates which bolted to the stub angles. The stub angles had groups of extra holes punched in them to provide for considerable adjustment of the tower legs. Several types of side hill extensions were used.

In erection, panels were loosely bolted together and raised. For the upper sections a 30-foot gin pole was slung in cables fastened to the tower legs and as there was no horizontal bracing, the head was raised inside the tower. After the tower was trued up, the bolts were tightened but no burring of the bolt threads to lock the nuts was permitted. The average erection time was one tower per day with a seven man gang.

The conductor is stranded aluminum with a stranded steel core. It is designated as 795,000 circular mils, has an external diameter of 1.1 inches and was shipped on 4,000-foot reels. The stringing was done by teams of horses in some places and by a tractor in others. The tractor pulled up three conductors at once. The joints were made by lapping the steel cores inside of an oval steel tube and twisting it and compressing heavy aluminum sleeves onto the aluminum conductors. A portable hand operated hydraulic press was used for this purpose and the splice is mechanically and electrically better than the cable itself. The conductor was secured to the insulator strings by galvanized malleable iron clamps and a six-foot length of the aluminum cable was secured above the conductor to act as a vibration damper and to protect the conductor in case of arcing from the tower arms.

The moving pictures showed many phases of the construction such as the teaming of material in the winter, erection of the towers and the stringing of the conductors. At the conclusion of the pictures a hearty vote of thanks was moved by Mr. Wilkie and was enthusiastically carried by the members present.

Winnipeg Branch

E. W. M. James, A.M.E.I.C., Secretary-Treasurer.

The Winnipeg Branch held their annual meeting on February 6th, 1930, at which the attendance numbered fifty-two.

The speaker of the evening was Mr. J. C. Burkholder, chief engineer, Canadian National Telegraphs, who spoke on "The Carrier Current."

Mr. Burkholder delivered a most interesting address showing the development of the telegraph as a means of communication, from the state at which twenty-six wires were required for the sending of a single message to the recent accomplishment of sending twenty-four messages simultaneously in both directions over a single pair of wires, by means of the "carrier current."

At the close of the discussion of Mr. Burkholder's address the business of the annual meeting was transacted.

A resolution of sympathy and well-wishing was passed to be expressed to Chairman F. H. Martin, M.E.I.C., whose severe illness has made it necessary for him to spend the winter in California.

The report of the scrutineers showing those elected to office for the year 1930 was then presented as follows:—

Chairman	J. W. Porter, M.E.I.C.
Secretary-Treasurer	E. W. M. James, A.M.E.I.C.
Executive Committee	A. L. Cavanagh, A.M.E.I.C.
	F. G. Goodspeed, M.E.I.C.
	R. W. Moffatt, A.M.E.I.C.
Nomination Committee	J. N. Finlayson, M.E.I.C.
Auditors	J. M. Morton, A.M.E.I.C.
	C. H. Fox, M.E.I.C.
Library and Publications	W. Fulton, A.M.E.I.C.
Legislation and Public Affairs	D. L. McLean, A.M.E.I.C.
Advisory Committee	E. P. Fetherstonhaugh, M.E.I.C.
Remuneration Committee	D. A. Ross, M.E.I.C.
Students' Prize Committee	W. M. Scott, M.E.I.C.
Programme Committee	E. V. Caton, M.E.I.C.
Research and Investigation Committee	Theo. Kipp, M.E.I.C.

Preliminary Notice

of Applications for Admission and for Transfer

March 24th, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in May 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may includs apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council. be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall he considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BREWER—HAROLD BYRON, of 169 Strathcona Avenue, Fredericton, N.B., Born at Fredericton, N.B., Aug. 13th, 1907; Educ., B.Sc., Univ. of N.B., 1928; 1928-29, instr'man., munic. and rld. work, field and office, in model townsite, (Arvida); May 1929 to date, hydrographic engr., Dept. of Marine and Fisheries.

References: N. D. Wilson, H. R. Wake, J. A. Knight, R. M. Carmichael, E. O. Turner, J. Stephens.

CREIGHTON—LESLIE FLOYD, of Regina, Sask., Born at Cypress River, Man., June 14th, 1899; Educ., B.A., 1925, B.E., 1930, Univ. of Sask.; 1915-17 and 1919-20, rodman on Sask. land surveys; 1921-25, instr'man; 1925-27 (Apr.-Oct.), 1927-30 (full year), and at present, asst. engr., Dept. of Highways, Govt. of Sask., Regina, Sask.

References: H. S. Carpenter, H. R. MacKenzie, C. S. Cameron, J. J. White, W. E. Denley, C. J. Mackenzie, R. A. Spencer, G. H. N. Monkman.

CROSBY—IRVING BALLARD, of Cambridge, Mass., Born at Boston, Mass., Jan. 4th, 1891; Educ., S.B , Mass. Inst. Tech., 1918. 2 years' grad. study at Harvard Univ., with A.M. degree in 1920. 1 year grad. study at Columbia Univ.; 1919-23, asst. to W. O. Crosby, consltg. geologist; 1924-25. associate with W. O. Crosby, consltg. geologist; 1926 to date, consltg. geologist, 6 Beacon St., Boston, Mass.

References: J. H. Brace, S. Svenningson, C. R. Lindsey, A. M. Narraway, G. C. Clarke.

GRAY—REGINALD ARTHUR GEORGE, of Montreal, Que., Born at Woodford, Essex, England, Dec. 12th, 1902; Educ., East London College, 1920-22 (day courses). 1923-27, Regent Street Polytechnic, rec'd. fourth year elect'l. engrg. diploma (evening classes). Student, Inst., C.E., 1925; 1919-28, with London & North Eastern Rly., as follows: 1919-20, ap'tice, generating station; 1923-25, dftsman., elect'l. engr's. office; 1925-27, dftsman., signal engr's. office; 1927 to Jan. 1928, dftsman., telegraph engr's. office; Mar. 1828 to date, asst. engr., elect'l. engr's. office, C.N.R., Montreal.

References: R. G. Gage, H. F. Finnemore, K. Gordon, H. L. Currie, J. Whitelaw.

JACKSON—WILLIAM LESLIE, of 550 Balliol St., Toronto 12, Ont., Born at Egremont, Cheshire, England, June 27th, 1901; Educ., 1915-1918, maths., and surveying, Toronto Tech. School. (evenings); 1917-19, Toronto Harbour Comm., harbour constrn., base lines, fills, sewer, road and bldg. constrn.; 1919, bridge and culvert concrete inspr., Dept. Public Highways, Ontario; 1920-22, and 1924-25, Ontario land surveyor's asst.; 1922-24, and 1926 to date, dftsman., Ontario Dept. of Public Highways, Toronto, Ont.

References: A. Hay, N. A. Burwash, G. Hogarth, N. D. Wilson, R. M. Smith, A. A. Smith.

KREBSER—EDWARD MEILI, of Walkerville, Ont., Born at Cambridge, Vt., April 9th, 1900; Educ., B.Sc. (C.E.), Univ. of Vt., 1924; 1923, rodman and transitman; Rutland Railroad; 1924-25, inspr., Grosse Ile Bridge Co.; 1925 to date, with Canadian Bridge Co. Ltd., as follows: 1925-27, dftsman., 1927-29, checker, 1929-30, asst. to operating mgr., and at present, asst. shop supt.

References: A. E. West, F. H. Kester, R. C. Leslie, J. G. Campbell, G. V. Davies.

McGRATH—JOHN REDMOND, of 5977a Park Avenue, Montreal, Que., Born at Montreal, May 17th, 1900; Educ., Grad., St. Patrick's Academy, 1914. 1st year Arts, Montreal College (Laval), 1914-15. Diploma (three years day course), Montreal Technical School, 1922; 1922 to date, telephone engrg., Northern Electric Company, Ltd., Montreal, Que.

References: A. J. Lawrence, A. R. Sprenger, W. H. Jarand, A. Frigon, N. L. Morgan, W. H. Eastlake, W. C. Adams.

MOES—GERIACUS, of 105 Flett Avenue, Hamilton, Ont., Born at Bussum, Holland, Aug. 10th, 1902; Educ., 1918-21. 1st class cert., Electro Technical School, Amsterdam. Cert. E. Engrg., Liverpool Univ., 1925; 1925-26, experimental elect'l. engr., Simplex Wire & Cable Co., Cambridge, Mass., in H. T. Research Labs.; 1926-28, engr. dftsman., switching equipment, engrg. dept., and 1928 to date, elect'l. engr. in plant engr's. dept., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

References: W. F. McLaren, E. M. Coles, G. M. Bayne, D. W. Callander, J. R. Dunbar, E. G. Grant, G. W. Arnold, J. C. Nash.

SCOULAR—WILLIAM BUICK, of Montreal, Que., Born at Kilmarnock, Scotland, May 9th, 1903; Educ., B.Sc. (Eng.), Glasgow Univ., 1923; 1921-26, ap'tice with A. Barclay Sons & Co. Ltd., locomotive bldrs., Kilmarnock; 1926-29, designer, Glenfield & Kennedy Ltd., hydraulic engrs., Kilmarnock; 1929 to date, designer, Dominion Bridge Company, Ltd., Lachine Que.

References: F. P. Shearwood, F. Newell, D. C. Tennant, R. H. Findlay, A. Peden, A. Hutchison.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

MIFFLEN—SYDNEY CLARENCE, of Sydney, N.S., Born at Catalina, Nfld., July 5th, 1891; Educ., B.Sc. (C.E.), McGill Univ., 1914; 1910 (6 mos.), Crown land surveying, Nfld.; 1911 (6 mos.), G.T.R. office, Montreal; 1912 (6 mos.), mtce. of way, Alta., G.T.P.; 1913 (5 mos.), instr'man; and later res. engr., pneumatic caisson work on foundations of Montreal examining warehouse, Foundation Company; 1914-15, owner's engr. for Furness Withy S.S. Co., on shipping pier, freight sheds, office bldg. and coal handling equipment, at St. John's, Nfld.; 1915, supt., municipal development Halifax, N.S.; 1916-18, private venture, lumbering; 1918-21, res. struct'l. engr. at Wabana Iron Mines, Nfld., for Dominion Iron & Steel Co.; 1921-22, mining engrg. dept., and from 1923 to date, office engr., mining engr. dept., Dominion Coal Company, Glace Bay, N.S.

References: A. L. Hay, M. Dwyer, K. L. Dawson, J. B. Petrie, F. W. Angel.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

BONHAM—ROBERT LINCOLN, of 1049 Dorchester Ave., Winnipeg, Man, Born at Ancaster, Ont., Aug. 26th, 1894; Educ., B.Sc., Queen's University, 1921; 1920 (5 mos.), instr'man., Reclam. Service, Alta.; 1921 to date, with Canada Creosting Co. Ltd., as follows: 1921-23, retort foreman and dftsman; 1924-27, plant supt. (with intervals as constrn. engr.), Sudbury plant; 1927-28, constrn. engr; 1928 to date, asst. supt. of operation and mtce.

References: W. P. Wilgar, A. Macphail, D. S. Ellis, W. D. Pender, W. L. Malcolm.

BUCHMANN—KARL EMIL, of Copper Cliff, Ont., Born at Vesterburg, Nakskov, Denmark, Oct. 5th, 1896; Educ., B.A.Sc., Univ. of Toronto, 1925; 1913-24 (attended school during winters), mechanic in planing mill, later bandsaw filer for Fraser Bros. Lbr. Co., and for Price Bros. Lbr. Co.; 1925-26, 6 mos. on gen. plant engrg. with Kent-McLain Showcase Co., and 6 mos. on time study work with Massey Harris Co., both in Toronto; 1926-29, dftsman and gen. asst. to chief engr., Delora Smelting & Refining Co. Ltd., Delora, Ont.; April 1929 to date, on mach'y. layouts for the new smelter under constrn. for the International Nickel Co., Copper Cliff, Ont.

References: N. H. Kearns, C. O. Maddock, W. J. Ripley, C. S. Millard, H. H. Hawkes.

CAMPBELL—GEORGE WILFRED, of Winnipeg, Man., Born at Portage la Prairie, Man., Aug. 26th, 1889; Educ., High School, 2 years private tuition, maths.; 1906-13, rodman, topog'r., leveller, dftsman., transitman, C.P.R. location and constrn., Sask. and Alta.; 1913-14, engr. in charge of party, drainage surveys and constrn., Manitoba Public Works; 1914-15, engr. in charge of party on surveys of new drainage district, completing plans, profiles and estimate of same; 1915-18, overseas, Observer in Battn. Scouts, 8th Battn.; 1918 to date, asst. engr., Reclam. Branch, Dept. of Public Works, Winnipeg, Man., in charge of drainage surveys, roads, bridges, etc.

References: H. A. Bowman, R. W. McKinnon, N. Barritt, F. A. W. MacLean, W. Fulton, G. Affleck, A. G. Connell.

FARNSWORTH—RAYMOND HARRINGTON, of 246 Fraser St., Quebec, Que., Born at Cookshire, Que., Sept. 13th, 1893; Educ., B.Sc., Queen's Univ., 1916; 1914-19, with Can. Engrs., in Canada and overseas; 1913 (summer), Dominion land surveys; 1919-22, mtce., constrn. and field engrg. work, engrg. dept., Brompton Pulp & Paper Co., East Angus, Que.; 1922-23, designing dftsman., St. Lawrence Paper Mills, Ltd., Three Rivers; 1923, designing dftsman., Donnacona Paper Co. Ltd., Donnacona, Que.; 1923-26, designing dftsman., Nfld. Power & Paper Co. Ltd., Corner Brook, Nfld.; 1926-28, designing dftsman., and from 1928 to date, chief dftsman., Price Bros. & Co. Ltd., Quebec, Que.

References: W. P. Wilgar, F. O. White, R. L. Weldon, J. B. Gough, W. G. Mitchell, A. A. MacDiarmid.

GUY—RICHARD W., of 451 Echo Drive, Ottawa, Ont., Born at Ottawa, Apr. 29th, 1894; Educ., B.Sc., McGill Univ., 1915; 1915-19, overseas, Can. Engrs. (Signals); 1919-20, electr'l. constrn. and substation operation, and 1920 (Feb.-June), shift foreman i/c operation roasters, copper tank dept., and electric furnaces, British American Nickel Corpn.; 1920-21, examiner, and Sept. 1921 to date, senior examiner, i/c standards of measurement of electricity for Dominion Electrical Standards Laboratory, Dept. of Trade and Commerce, Ottawa, Ont.

References: H. A. Dupre, J. Murphy, W. A. Rush, J. L. Rannie, R. F. Howard.

HUMPHREY—HAROLD WILLIAM, of Newark, N.J., Born at Monckton, N.B., Dec. 16th, 1895; Educ., B.Sc., N.S. Tech. Coll., 1923. 4 years extension work in New York Univ. and Columbia Univ., leading to degree of B.A.; Nova Scotia Land Surveyor; 1914-16, rodman and topog'r. on mtce., prelim. and location surveys, Can. Govt. Rlys.; (also summer 1919); 1916-19, overseas, 6th Can. Siege Bty.; 1920-22 (summers), city engr's office, Moncton, N.B., i/c cost data and materials of constrn.; 1923-24, N.S. Power Commn., chief of party and engr. in charge of constrn., section of 66 k.v. transmission line from Sheet Hbr. to Pictou County, N.S.; 1924-25, with Pickings & Wilson, Halifax, chief of party, surveys for and constrn. of township of Corner Brook, Nfld.; 1926 to date, engr. in transmission constrn. dept., i/c headquarters dfting office on constrn. of super-power interconnection system of northern New Jersey, Public Service Electric & Gas Co., Newark, N.J.

References: F. R. Faulkner, R. P. Freeman, C. St.J. Wilson, A. M. James, E. B. Martin, M. F. Cossitt, W. E. Hall.

JOHNSTON—OSWALD DANIEL, of 20 Jedburgh Road, Toronto, Ont.. Born at Glengarry, Ont.,Sept. 29th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923 to date, salesman for Dominion Engineering Agency, later name changed to D. M. Fraser, Ltd., engaged in the distribution of elect'l. and engrg. equipment, including drawing up of specifications, engrg. sales and service work, also making recommendations regarding industrial and high tension electrical equipment.

References: D. M. Fraser, A. M. Reid, C. H. Mitchell, T. R. Loudon, R. O. Wynne-Roberts.

JOHNSTONE—RALPH GEORGE, of 1233 Mountain Street, Montreal, Que. Born at Halifax, N.S., Dec. 3rd, 1900; Educ., B.Sc., N.S. Tech. Coll., 1924; 1922-23, (summers), highway constrn.; 1924-26, with Nfld. Power & Paper Co., i/c of storing and allocation of elect'l. equipment during constrn. of 500 ton paper mill at Corner Brook, Nfld. Also i/c elect'l. constrn. stores. Subsequently i/c of operation of electric paper machine drives, investigation of difficulties, etc.; 1926 (Apr.-Oct.), elect'l. constrn. (journeyman elect'n.), Comstock Co.; Oct. 1926 to Feb. 1930, elect'l. engr. on design and erection of electric paper machine drives, and at present, asst. to director of sales in paper gear dept., Harland Engineering Company, Montreal, Que.

References: R. N. Norris, H. C. Brown, C. Bang, C. H. L. Jones, W. F. McKnight.

MacKENZIE—RUSSELL GEORGE, of Vancouver, B.C., Born at Lucknow, Ont., Oct. 4th, 1890; Educ., High School and Private Study; 1910, rodman and chainman, Midland Rly.; 1911-15 and 1919-22, with Can. Nor. Rly. as follows: 1911-12, rodman and chainman; 1912-15, asst. engr., bridge engrg. dept., Calgary subdivision; 1913, transferred to Warden Jct., dfting office duties, designing trestle structures. Later transferred to field work until Nov. 1915; 1919-22, with bridge engrg. dept., as res. bridge engr.; 1923, topog'r., B.C. Electric Rly.; 1924 to date, on engrg. staff, and at present asst. engr. in charge of sidewalk constrn., City of Vancouver.

References: C. Brakenridge, R. Rome, W. B. Young, W. B. Greig, F. P. V. Cowley

MEDLAR—GEORGE ELMER, of 724 Lincoln Road, Walkerville, Ont., Born at Saltfleet Twp., Wentworth Co., Ont., Sept. 24th, 1892; Educ., Hamilton Public and High Schools. Course of study in engrg. and surveying offices, I.C.S. books. Night classes, Text books, etc., during years of field and office experience; 1908-09, misc. engrg. and surveying work, Tyrrell & McKay, Hamilton, Ont.; 1909-10, chainman, Dom. lands and misc. surveys, Edmonton district; 1910-11, asst., engrg. and surveying, Sask. District; 1911-18, asst. i/c parties Dom. lands, townsite, city subdivisions, land ties and gen. office work in Alta.; 1918 (Jan.-Dec.), Hon. Lieut., R.F.C.; 1919 (Mar.-Aug.), asst. surveys and report, Hamilton Hbr. Comm.; 1919-20, asst., sewer, waterworks and power dam development, surveys, Timmins; 1920 (Mar.-Aug.), asst. misc. surveying and engrg., Hamilton; Aug. 1920 to date, engr. in charge of of field and office work for the Essex Border Utilities Commission, Windsor, Ont., including surveys, plans, levels, descriptions, land plans for filtration plant, filtered water line, regulating tank, grand mardis drainage scheme, water mains, road widenings and all district planning maps, office records, computations, etc.

References: J. C. Keith, W. J. Fletcher, C. R. McColl, W. H. Baltzell, J. J. Newman, C. G. R. Armstrong, M. E. Brian, H. Thorne.

MOLKE—ERIC CHARLES, of Winnipeg, Man., Born at Joachimsdorf, Austria, Aug. 16th, 1900; Educ., 1918-1923, engrg. training at Univ. of Vienna, graduate engineer, 1923; 1921-22 (summers), instr'man. on power plant work in Austria; 1926 (summer), instr'man., highway dept., Govt. of Sask.; 1924-25, surveying, designing, estimating quantities for water power stations and water supply systems, J. Pfletschinger & Co., Consltg. Engrs., Vienna; 1925-26, asst. supt., during bldg. of power station and new cutlery works at Sofienhuette, for W. Rella & Weffe, Bau A. G., Engrs. and Contractors, Vienna; 1927-28, designing dftsman. on concrete structures, Truscon Steel Co. of Canada, Ltd., at Walkerville, and Montreal; Dec. 1928 to date, struct'l. engr. for design of substructure, power house, Slave Falls, for Hydro-Electric System, City of Winnipeg, Man.

References: E. G. Ryley, J. W. Sanger, C. T. Barnes, R. H. Andrew, R. W. Angus, C. R. Young, W. S. Lea.

OAKS—HAROLD ANTHONY, of Toronto, Ont., Born at Hespeler, Ont., Nov. 12th, 1896; Educ., B.A.Sc., Univ. of Toronto, 1922; 1918-19, Flight-Commdr., R.A.F.; 1921-22 (summers), geol. survey work; 1922-23, mine surveying and sampling, Hollinger Mine; 1923-24 and 1925-26, prospecting; 1924-25, senior pilot, i/c detachment, Ontario Air Service; 1926, manager, Patricia Airways (6 mos.); 1926-28, gen. mgr., Western Canada Airways; 1928 to date, director of aerial operations, and asst. gen. mgr., Northern Aerial Minerals Exploration Limited, Toronto, Ont.

References: J. H. Parkin, C. H. Mitchell, C. Camsell, E. W. Stedman, J. L. Gordon, D. W. McLachlan.

PYBUS—RALPH CARR, of 5852 Balsam Street, Vancouver, B.C., Born at Winnipeg, Man., April 13th, 1900; Educ., B.Arch., 1924. B.Sc. (C.E.), Univ. of Man. 1922; 1919 (summer), rodman, 1921 (summer), instr'man., Man. Good Roads Dept.; 1920, dftsman., Winnipeg office, G.T.R.; 1922-23 (part time), asst. engr., E. A. Turner Co., Winnipeg; 1923 (4 mos.), field engr., Carter Halls-Aldinger; 1923 (2 mos.), arch'l. dftsman., Northwood & Chivers, Winnipeg; 1924-25, asst. engr., office, Foundation Co. of Canada, Montreal; 1925-28, asst. engr., Carter Halls-Aldinger Co., Winnipeg; 1928 to date, engr. for same company in B.C.

References: J. E. Buerk, A. W. Fosness, W. Griesbach, J. N. Finlayson, C. W. Dill, E. A. Markham.

SALE—CHARLES P., of Sandwich, Ont., Born at Windsor, Ont., Aug. 6th, 1898; Educ., B.A.Sc., Univ. of Toronto, 1921. Degree of Barrister-at-law, Osgoode Hall Law School; 1920 (6 mos.), production office, Ford Motor Co. of Canada; 1918 (3 mos.), T.N.T. plant, British Chemicals Ltd.; Nov. 1924 to date, engaged in private consltg. practice, both legal and engrg. Clients include municipalities, public utilities, several constrn. and constrn. material supply firms, several firms in chemical mfg. business. Engaged on a number of occasions preparing evidence for presentation in court in important cases. Also in making reports on sources and availability of raw supplies for firms requiring large quantities of siliceous material. Also a member of two hydrographic survey parties in last year, one for a suitable site for a material handling dock and plant, and the other for purposes of litigation, Office, 304 Murray Bldg., Windsor, Ont.

References: C. R. McColl, J. C. Keith, W. J. Fletcher, M. E. Brian.

TIPPET—HENRY JACKSON, of 120 Westwood Road, New Haven, Conn., Born at Bebington, Cheshire, England, Mar. 21st, 1884; Educ., 1898-1902, British Public School of Sedbergh, Yorks., England; 1902-05, articled ap'tice in civil engrg., under John A. Brodie, city engineer of Liverpool, England, and student in bldg. constrn. and app. mechanics, Liverpool Technical School, receiving cert. as civil engr. on Sept. 22nd, 1905; 1905-07, asst. engr. in city engr's. dept., Liverpool, on outfall sewer constrn., paving and road improvements, incinerator constrn., cement and mortar tests, and tramway track constrn.; 1907-08, rodman, dftsman. and instr'man., on survey for and constrn. of 300 miles of irrigation ditch, with C.P.R. irrigation dept., Craigantler district, east of Calgary, Alta.; 1909-16, with B.C. Electric Railway Co., at Vancouver, B.C., as follows: 1909-10, asst. engr. on track constrn. and mtce.; 1911-13, engr., mtce. of way, reporting to constrn. engr.; 1914-15, i/c design and constrn. work to the value of $2,750,000 and reporting to chief engr. and asst. gen. mgr.; 1916 to date, with the Connecticut Company, at New Haven, Conn., as follows: 1916, roadmaster at Portchester, N.Y., on track constrn. and mtce. work; 1917-21, asst. engr., at New Haven; 1921 to date, divn. engr., in responsible charge of track constrn. and mtce. work involving expenditures of over $2,000,000 and reporting to the President.

References: G. R. G. Conway, J. R. Cosgrove, A. A. Plummer, M. P. Cotton, F. S. Easton, E. J. Beugler.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BLACK—HUGH MURRAY, of Toronto, Ont., Born at Windsor, N.S., July 16th, 1900; Educ., B.Sc., McGill Univ., 1923; 1922-23, part time demonstrator, mech. lab., McGill Univ.; 1923-24, gen. design and checking, steam turbine dfting room, 1924-25, engrg. design. and estimating, steam turbine engrg. dept., 1925-27, asst. to engr. in charge steam mill divn. of elect'l. dept., which included estimating, design and sales, Allis Chalmers Mfg. Co., Milwaukee, Wis.; June 1927 to date, sales throughout Canada from power and mining dept., English Electric Co. of Canada, Ltd., Toronto, Ont.

References: G. Morrison, H. A. Moore, M. W. Black, J. G. Dickenson, M. F. Goudge, J. M. Morton, W. H. Souba, M. J. Spratt, G. H. Kohl.

BOYD—IVAN WILLIAM, of Amos, Que., Born at Huntsville, Ont., Feb. 21st, 1900; Educ., B.Sc., 1924, M.Sc., 1926, Queen's Univ.; Summer work; mach. ap'tice as follows: 1915, Mond Nickel Co., 1916, Lake Superior Corpn., 1918-19, Algoma Steel Corpn., and 1919-26, mach. ap'tice and dftsman., Algoma Central & Hudson Bay Ry. Co., Sault Ste. Marie; 1924-26, mech. engrg. demonstrator, Queen's Univ.; 1926-29, sales engr. for Ingersoll Rand Co., N.Y., and Canadian Ingersoll Rand Co., Montreal; at present, master mechanic, Siscoe Gold Mines, Ltd., Amos, Que.

References: L. T. Rutledge, L. M. Arkley, D. S. Ellis, D. M. Jemmett, G. Kearney.

BROOKS—CHARLES LENNOX, of 4025 Dorchester Street, Westmount, Que., Born at Westmount, Jan. 10th, 1896; Educ., B.Sc., McGill Univ., 1922; Summer work: 1913, Montreal Hbr. Comm.; 1914, rodman, Glengarry & Stormont Rly.; 1920-21, inspection work, J. T. Donald & Co. Ltd.; June 1922 to Feb. 1923, paper mill worker, Abitibi Power & Paper Co. Ltd.; 1923 (Feb.-May), engr., The Barrett Co. Ltd.; 1923 to date, with Bell Telephone Company of Canada, as follows: May 1923 to Oct. 1924, on work dealing with estimating of quantities and arrangements of dial system central office equipment; 1924-29, dial system traffic engr., i/c of above work; 1929 (Feb.-Dec.), dist. traffic supt., North-East district, Montreal; Jan. 1930 to date, general traffic engr.

References: W. G. Mitchell, S. F. Rutherford, R. V. Macauley, J. R. Donald, A. M. Mackenzie.

CHESHIRE—WILLIAM VERNON, of Montreal, Que., Born at Winnipeg, Man., Oct. 30th, 1898; Educ., B.Sc. (E.E.), Univ. of Man., 1923; 1923 to date, with the Northern Electric Co. Ltd., Montreal, as follows: 1923-25, installer; 1925-26, member of telephone engrg. staff, writing specifications; 1926-28, telephone estimator; 1928-30, senior telephone estimator, and at present, on equipment service engr's. staff.

References: B. C. Nowlan, T. Eardley-Wilmot, E. P. Fetherstonhaugh, W. R. Warren, N. M. Hall, W. B. Cartmel.

CORNISH—WILFRED ERNEST, of Edmonton, Alta., Born at Broadview, Sask., Feb. 22nd, 1901; Educ., B.Sc. (E.E.), Univ. of Man., 1925; 1925 (summer), dfting. for Winnipeg Electric Co.; 1925-26, demonstrator, Univ. of Man.; 1926-27, testing, Can. Gen. Elec. Co.; 1927 to date, lecturer in elect'l. engrg., University of Alberta, Edmonton, Alta.

References: R. S. L. Wilson, H. J. MacLeod, C. A. Robb, W. M. Cruthers. J. N. Finlayson, R. W. Boyle, E. Stansfield.

CRAIN—GEORGE EDWIN, of Rochester, N.Y., Born at Ottawa, Ont., Oct. 27th, 1898; Educ., B.Sc. (Civil), McGill Univ., 1923; 1919-22 (summers), asst. supt., bldg. constrn., Ottawa; 1917-19, overseas, Lieut., R.F.A.; 1923-26, traffic engr., Bell Telephone Co. of Canada, Montreal; 1926-29, mgr., reinforcing bar dept., and 1929 to date, sales mgr., Genesee Bridge Co., Rochester, N.Y.

References: E. Brown, H. M. MacKay, R. DeL. French, C. M. McKergow.

EGGERTSON—E. GRETTIR, of Pittsburgh, Pa., Born at Winnipeg, Man., Feb. 9th, 1903; Educ., B.Sc. (E.E.), Univ. of Man., 1925; 1925-26, dftsman. and on distribution work, Illinois Power & Light Corpn.; 1926-27, dftsman and designer on a steam electric and hydro-electric project for Stone & Webster Inc.; 1927-28, demonstrator in elect'l. engrg. and thermodynamics labs., Univ. of Man.; 1928-29, elect'l. designing engr., Hudson Bay Mining & Smelting Co., Winnipeg; 1929, elect'l. designing engr., Alcoa Power Company, Arvida, Que.; at present, designing elect'l. engr., hydraulic dept., Aluminum Company of America, Pittsburgh, Pa.

References: E. P. Fetherstonhaugh, J. N. Finlayson, C. P. Dunn, J. A. Knight, G. O. Vogan, H. R. Wake, N. M. Hall.

EYFORD—CORNELL THOMAS, of Winnipeg, Man., Born at Winnipeg, Jan. Jan. 15th, 1900; Educ., B.Sc. (E.E.), Univ. of Man., 1923; 1923-24, dftsman., Sargent & Lundy Inc., Chicago, Ill.; 1924-25, dftsman., Duke Price Power Co., Isle Maligne; 1925-26, dftsman., and 1926 to date, distribution engr., Winnipeg Electric Company, Winnipeg, Man.
References: E. V. Caton, F. H. Cothran, J. N. Finlayson, E. P. Fetherstonhaugh, R. E. Coke.

FAGAN—JAMES WILFRID, of 528 Marcil Ave., Montreal, Que., Born at Ottawa, Ont., Dec. 9th, 1896; Educ., B.Sc. (Mech.), McGill Univ., 1923; 1922-23 (summers), jr. engr., Manson Bros., Hawkesbury; 1923 to date, with Northern Electric Co. Ltd., Montreal, as follows: 1923-25, gen. production work; 1925-29, i/c telephone scheduling dept.; 1929 (Feb.-Oct.), i/c output, telephone equipment; Oct. 1929 to date, production supt.
References: J. S. Cameron, W. C. Adams, W. H. Eastlake, H. J. Vennes, T. M. Moran.

HERSCOVITCH—CHARLES, of Montreal, Que., Born at Montreal, Dec. 17th, 1899; Educ., B.Sc., McGill Univ., 1926; 1917-18, machinist and toolmaker, Blashill Wire & Machinery Co., and the Marconi Wireless Co.; 1918-19, machinist and marker off, Canadian Allis-Chalmers; 1919-21, dftsman., tool designer, and asst. to production engr., United Shoe Machinery Co.; 1921-23 (summers), machinist and marker off, Dominion Engineering Works, Ltd.; 1923-24, with same company as marker off, and summers 1924-26, dftsman.; 1926-27, dftsman. and designer, Charles Walmsley & Co.; 1927-28, dftsman., designer and checker, and 1928 to date, estimating engr., Dominion Engineering Works Ltd., Lachine, Que.
References: C. M. McKergow, H. A. Crombie, C. E. Herd.

HILL—STANLEY CLAYTON HOWARD, of Montreal, Que., Born at Richmond, Que., July 5th, 1896; Educ., B.Sc., McGill Univ., 1921; 1922-24, with Shawinigan Engineering Company, as follows: 1922 (May-Dec.), power plant (generating station) electr'l. equipment erection; 1923-24, supervision of install'n. of elect'l. control, metering and relay protection for generating station and terminal station constrn. at Montreal, Shawinigan Falls & La Gabelle; 1925 to date, asst. protection engr., operating dept., Shawinigan Water & Power Company, Montreal.
References: P. Ackerman, C. V. Christie, E. Brown, J. A. McCrory, A. B. Rogers.

JONES—HARRY ANDERSON, of 1421 El phinstone Street, Regina, Sask., Born at Wyoming, Ont., Apr. 30th, 1898; Educ., B.Sc. (C.E.), Univ. of Sask., 1929; 1917 (June-Dec.), rodman, C.P.R., Regina; 1924, rodman and asst. instr'man., surveys br., Dept. of Mines, Ottawa; 1926 (part time), instr'man., Dept. Highways, Sask.; 1926 to date, asst. engr., City of with Regina, Sask.
References: D. A. R. McCannel, R. W. Allen, D. W. Houston, R. H. Murray, C. D. Lill, F. B. Reilly, H. R. MacKenzie, D. A. Smith.

KELLETT—JAMES EDWARD, of Dauphin, Man., Born at Vankleek Hill, Ont., Dec. 15th, 1903; Educ., B.Sc. (C.E.), Univ. of Man., 1926; Summer work; 1923, chairman, C.N.R., terminal constrn., Fort William; 1924, time-keeper, C.P.R. tie gang; 1925, power line survey, eastern Man., with McColl Bros.; transitman, power line survey, as above; Sept. 1926 to May 1927, Manitoba Paper Co.; 1927 (summer), bridge inspr., 1927-28, transitman on road location and 1928 to date, res. engr. on road constrn., Man. Good Roads Board.
References: E. W. M. James, J. N. Finlayson, E. P. Fetherstonhaugh, J. Quail, N. M. Hall, S. E. McColl, G. B. McColl.

McINTOSH—JAMES HARRINGTON, of Bamberton, Tod Inlet P.O., B.C., Born at Victoria, B.C., June 30th, 1901; Educ., B.A.Sc., Univ. of Toronto, 1923; B.C. Assay Cert.; 1923 to date, with British Columbia Cement Co. Ltd., Bamberton works, Tod Inlet, as follows: 1923 (June-Aug.), elect'l. sub-station operator; 1923 (Sept.), shipping foreman; 1923-24, asst. chemist (i/c of lab. during 2 mos. leave of absence of chief chemist); 1924-25, asst. dftsman.; 1925-26, chief dftsman.; June 1926 to date, asst. works mgr.
References: G. A. Walkem, J. N. Anderson, A. E. Foreman, W. M. Everall.

PRUDHAM—WILLIAM MERRILL, of Wilkinsburg, Pa., Born at Nagano, Japan, Oct. 21st, 1901; Educ., B.A., 1923, B.Sc., 1925, McGill Univ.; 1923 (summer), shop work, Ford Motor Co., Detroit, Mich.; 1924 (summer), Shawinigan Engineering Co., on La Gabelle development; 1925-26, grad. student course, Westinghouse Electric, East Pittsburgh; 1926-27, with same company on negotiation work, switchboard engrg. dept.; 1927-28, exchange engr. from Westinhouse to Siemens Schuckert Co., Berlin, Germany; 1928 to date, central station section, switchboard engrg. dept., Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
References: C. V. Christie, C. M. McKergow, A. R. Roberts, F. S. Howes.

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ELECTRICAL ENGINEER, B.Sc., E.E., A.M.E.I.C., Canadian, age 29, single, graduate Canadian university 1924. Have been with large power company in U.S.A. since graduation, ten months on sub-stations, remainder of time on design, construction and operation of overhead and underground distribution and transmission system. At present employed by same company. Would like return to Canada. Available on reasonable notice. Apply to Box 236-W.

CIVIL ENGINEER. A.M.E.I.C., graduate, R.P.E.P.Q. Twenty years experience surveying and construction hydro-electric, railways, and paper mills, desires position. Will go anywhere if terms satisfactory. Apply to Box No. 294-W.

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Situations Wanted

CIVIL ENGINEER, B.A.Sc., A.M.E.I.C., M.P.E.O., age 37, desires a permanent position as chief draughtsman or plant engineer, preferably in Toronto or district. Seventeen years experience with consulting engineers on industrial, structural and railway work, hydro-electric plants and pulp and paper mills. Some mechanical and electrical experience. Apply to Box No. 332-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country; twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Province. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, graduate '29, desires engineering position with possibilities of advancement. Work in hydro-electric, construction, municipal, railroad, or mining preferred. Past experience consists chiefly of survey work. Location in western provinces preferred. Apply to Box No. 338-W.

CIVIL ENGINEER, B.Sc., fifteen years experience, including surveying, construction, mining and tunnelling. Available at once. Will go anywhere, but prefer Eastern Canada. Apply to Box No. 346-W.

MECHANICAL DESIGNER, 33 years of age. First class English and Canadian experience (Rolls-Royce, Ford, Platt Bros., G. M. C.) on special machine tool jig and tool designing, maintenance, and production methods; excellent references; desires position. Montreal district preferred. Available immediately. Apply to Box No. 351-W.

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CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Apply to Box No. 352-W.

SUPERINTENDENT, competent electrical superintendent, wishes position with large industrial or power supply company. New construction programme preferred. Experienced in engineering, designing and electrical construction of power houses, sub-stations and industrial control work. Available on short notice. Apply to Box No. 353-W.

ELECTRICAL ENGINEER, graduate McGill Univ. Experience, draughting, checking, short wave radio research, radio operating (ship and shore), demonstrating, electrical measurements and radio laboratories, department electrical engineering; at present demonstrating physics department. Desires position with opportunities, preferably radio work. Location immaterial. Apply to Box No. 356-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., is open for engagement. Twenty-four years general experience both as engineer and as contractor. Has specialized in the construction of wharves, dams, foundations, etc. Apply to Box No. 358-W.

ELECTRICAL ENGINEER, graduate N.S.T.C., Halifax, 29 years of age, two years experience in power transmission and distribution with a large power company in province of Quebec, two years electric test and inspection, W.E. and Mfg. Co., East Pittsburgh, Pa., one year electrical maintenance in large mill. Experience with telephone transmission, substation layout, electrical installation and layout for factories. At present employed. Apply Box No. 361-W.

MINING ENGINEER, graduate, age 32, A.M.E.I.C., ten years experience in design, construction, erection and maintenance of paper mill and mine buildings and machinery. Several years on hydro-electric work in charge of surveys and investigation; desires permanent connection with mining or paper company. Apply to Box No. 362-W.

MECHANICAL ENGINEER, B.A.Sc., Univ. of Toronto 21, A.M.E.I.C., married. Pulp and paper mill maintenance experience: draughting, layout of buildings, machinery and piping, mechanical design. Also experienced in reinforced concrete and steel building design and construction work. Desires position of permanency in plant engineering or maintenance work with reliable organization offering opportunities for advancement. Apply to Box No. 370-W.

CONSTRUCTION SUPERINTENDENT, with twenty-five years experience on hydro-power developments, paper mills and general building construction. Apply to Box No. 372-W.

ELECTRICAL ENGINEER, B.Sc. '23, A.M.E.I.C., experience, estimating pole line, cable and wire layouts, supervising estimates, in charge of cost inventory and appraisal work, in charge of draughting, records and budget control work, instructing engineering principles. Seven years with one company. Four years instructing in electrical engineering at evening classes, desires position along the above lines with opportunities. Best of references. Apply to Box No. 376-W.

ENGINEER, age 30, with experience as railway instrumentman, assistant engineer on erection of large buildings, and mechanical, structural and railway draughting and design, desires position in Ontario. Qualified Captain in military engineering. Apply to Box No. 377-W.

STRUCTURAL DRAUGHTSMAN, age 31, well educated, with experience in designing and supervision, desires a change of position and location. Preferably north western Canada. Apply to Box No. 378-W.

Situations Vacant

STRUCTURAL DRAUGHTSMEN, experienced in detailing steel for industrial plants, city buildings or bridges, for a bridge company located in Winnipeg. Give age, experience, whether married or single, and other particulars to Box No. 474-V.

SALES ENGINEERS. Two experienced industrial paint salesmen wanted by a large paint manufacturing company; one for Toronto City, one for London and Border Cities. Applicants should state fully experience, names of three references. Apply Box No. 497-V.

DESIGNING DRAUGHTSMAN wanted by a large pulp and paper mill, ideally situated. The work will comprise general drawings and details for building construction and alterations. Applicant should be able to design reinforced concrete and structural steel. State age, education, experience, salary desired, and other particulars. Apply to Box No. 503-V.

ENGINEER, wide awake and progressive, preferably technically trained man with several years sales experience, familiar with sanitary requirements of municipal and industrial water systems. Submit with application complete details of education and positions held to date. Apply to Box No. 505-V.

DRAUGHTSMEN. Experienced in A.C. and D.C. machines, switchboard wiring diagrams and station arrangements, industrial control apparatus. State age, experience in detail, and salary expected. Location, central Ontario. Apply to Box 506-V.

GRADUATE MECHANICAL ENGINEER required, preferably single man about twenty-five years of age, with special training, operation, maintenance boiler plant equipment. Preferably junior engineer who has completed apprenticeship course offered by Babcock-Wilcox or other boiler manufacturers. Applicant please state particulars, experience, references, etc. Location Mexico. Apply to Box No. 507-V.

RECENT GRADUATE, in electrical or mechanical engineering, for general industrial work. Work part in office and part in the plant. Must be competent to do transit work and levelling in connection with laying out new building sites. Location, Northern Quebec. Apply to Box No. 508-V.

MECHANICAL DRAUGHTSMAN wanted, with good technical training and acquainted with heavy duty cranes, regulating gates, movable bridges, etc. Not over 30 years of age. Apply, giving full personal particulars and salary expected, to Box No. 509-V.

DRAUGHTSMEN—One or two good draughtsmen familiar with heavy wood mill construction. Acquaintance with gold milling desirable but not essential. State age, education, experience, references, if employed, married or single, salary wanted, and how soon you can report, to Box No. 510-V.

CONSTRUCTION ENGINEER, on hydro-electric power development; capable of taking charge of laying out of work. Reply, stating experience, age and salary. Apply to Box No. 513-V.

MECHANICAL ENGINEER, graduate with three or four years experience in industrial plant maintenance, for metallurgical plant in province of Quebec. Permanent connection for right applicant. Please give complete information. Apply to Box 516-V.

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SALES MANAGER.—Firm in Eastern Ontario, manufacturing chiefly pulp and paper machinery, requires manager to take direct charge of sales. Apply with references, giving experience and salary expected, to No. 521-V.

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CONTENTS

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Reinforcement in Place of the Stoney Creek Arch Bridge

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Paper read before the Montreal Branch of The Engineering Institute of Canada, February 20th, 1930.

The Stoney Creek bridge is situated on the line of the Canadian Pacific Railway on the eastern slope of the Selkirk range at a point immediately east of the summit, where the famous Connaught tunnel is located, and about 428.5 miles from Vancouver.

It consists of a 336-foot three-hinged arch, on which are supported plate girder track spans which are extended to the abutments at both ends of the bridge, making a structure 486 feet long. There is a curve on the west approach to the bridge, but otherwise it is on tangent, and the distance from track level to bottom of gorge on centre line of bridge is 307 feet.

It was orginally on that portion of the railway commenced by the Dominion Government in British Columbia just before the inception of the Canadian Pacific Railway Company, in 1887 or a little earlier. It formed a part of what was known as the "Onderdonck Contract," Mr. Onderdonck being a noted contractor of the eighties who employed a consulting engineer in New York, Mr. C. C. Schneider—later of international reputation—to design a deck Howe truss bridge of two 200-foot spans and one 100-foot span (approximately), supported on two tall, wooden towers, which, at that time, had the reputation of being the highest wooden structure in the world.

Figure No. 1 shows this structure as it was in 1893, when it became necessary to renew the timber spans.

This was during the chief engineership of P. A. Peterson, Past-President of the Canadian Society of Civil Engineers, who entrusted H. E. Vautelet, M.E.I.C., then a company's assistant engineer, with the task of designing a bridge to replace the old structure. Mr. Vautelet decided upon a 336-foot double-chorded, three-hinged arch, as shown in figure No. 2.

The erection of this 336-foot original steel arch was commenced in the early summer of 1893 and the falsework was completely removed by July, 1894. The method of reconstruction was to fill the gorge with falsework, as shown in figure No. 3, which was so designed that first the lower chord of the arch ribs could be erected upon it. After it was connected up, the web members and upper chord of the arch ribs were erected seriatim. Having completed the two arch ribs and their swaybracing and laterals, the track was supported on the falsework by means of suitable pony bents located between the arch trusses and the track spans. The new steel track spans consisted of lattice girders ranging from 63 feet to 84 feet in length, supported on steel bents. These lattice girder spans were lowered into place by means of gantries and screws at one end, and a small double-boomed derrick car at the other. This work, with the removal of the interlaced timber work, was done between trains without disturbing traffic.

The contract for the manufacture and erection of this original arch bridge was entrusted to the Hamilton Bridge Company, of Hamilton, Ont., who had at that time as their erection superintendent Mr. James Finley, who later achieved considerable reputation as an efficient and successful bridge erector, being responsible for a large number of the creditable pieces of construction in Canada in this branch of engineering during the last thirty years.

A derrick car having double booms was employed for lowering the floor beams framing into the bents carrying the track spans, and this double boom car was understood in 1893 to have been unusual in American bridge practice. It is interesting to note that it is still in service on the Canadian Pacific Railway at Revelstoke, B.C.

A deflection test was made on November 20th, 1893, of the steel structure after it had been swung clear of the falsework. In this test six locomotives of that period were used, which completely covered the 336-foot arch and weighed altogether some 550 tons. The amount of the deflection is not available, but the bridge was considered eminently stiff in service. It is interesting to know that in a recent test, after the completion of the reinforcement, it was only possible to get four modern locomotives over the arch proper to occupy the space which six locomotives occupied in 1893.

The structure presented the general appearance shown in figure No. 4. In comparison with contemporary arches, of which there were only a few in existence at that period, it created favourable comment. As far as is known, it was the only double parallel chorded railway arch in existence with its main hinge pins on its lower chord, in contradistinction to the taper-chorded arch in the Garabit viaduct in France. It was, however, similar to the highway arch at Niagara, except that the latter has its pins located midway between chords.

The structure continued in service from its completion in 1893, accommodating heavier and heavier engines, and

Figure No. 1.—Original Wooden Bridge of 1886.

although as a result various members were overstrained as compared with original designing stresses, yet the limits of good practice in such matters were not exceeded until the summer of 1928, when it was decided to increase the capacity of all the bridges on the mountain subdivision of the Canadian Pacific Railway between Field and Revelstoke, B.C., in order to accommodate new and heavier power. Careful studies were made of these structures, some being reinforced and others completely renewed either in place or on new locations alongside. At Stoney Creek, on account of the desire to avoid the various inconveniences and possible delays both to the bridge replacement and to traffic, it was planned to put the new structure on a location about 40 feet north of the existing one, and use a cantilever deck truss bridge supported on two new piers and abutments. The centre span of this cantilever bridge was to have been 311 feet with a 111-foot flanking span at either side.

However, it was found that on the west side of the canyon a clay fault about 2 feet thick ran down the mountain side at such an angle as to come just under the proposed pier on that side of the opening, and exploratory borings showed that it was impossible to locate the pier entirely clear of it. In addition to this the walls of the canyon, which are composed of soft schist with outcropping ledges of hard rock, afforded no better location for a pier than was occupied by the original bridge. After exhaustive exploration it was decided to abandon the plan of an independent bridge alongside and revert to the original location, the details of which form the subject of this paper.

Figure No. 2.—Original Arch Bridge of 1893.

Cooper's E-60 was decided upon as the loading for the remodelled bridge and a complete investigation was made of the old structure, using this loading, which disclosed the fact that it was entirely feasible to erect new arch ribs outside the existing ones and attach them together in place in such a manner as would equally distribute the new live load between the old and the new ribs. This was accomplished by the use of equalizing beams, on top of which are located the bents carrying the track spans above. In the original bridge the track spans were of such length as to give concentrated loads upon the arch every third panel, except in the centre of the bridge. It was found economical to shorten the track spans to one panel each, except in the centre of the bridge where this was impracticable, and two panel spans were used. In addition to this, the calculations

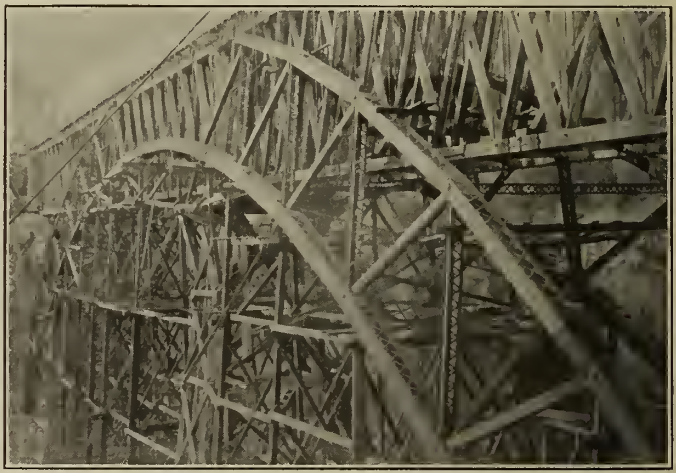


Figure No. 3.—Erection of 1893 Arch.

showed that in the original arch structure the new scheme of loading required some reinforcement in certain members, and this was done as shown in figure No. 4.

The resulting structure, therefore, consists of four arch ribs, attached to one another in pairs by equalizing diaphragms, and of a system of bents so located over the diaphragms that the arch ribs all share the loads equally. There is an exception to this statement in connection with the bents over the end pins. On account of the fact that these are considerably eased of their loading by the shortening of the adjoining spans it was decided for practical reasons to leave these old bents untouched. They are, therefore, slightly out of line as regards the other new bents, but on account of the extra hazard in handling them during erection and the extreme difficulty in avoiding interference with traffic, it was found later that this decision was justified.

There were no serious difficulties in manufacture, the drawings of the old arch ribs being followed closely in fabricating the new ones and the sections and material were, as far as possible, made identical, both as to dimensions and physical characteristics, so as to ensure uniform stiffness in both old and new ribs. The same system of double-flanged thimbles and pins was used as in the old structure. This feature deserves some description, as it formed an important detail in Mr. Vautelet's original design. In the old structure, the lower chord was first erected with thimbles upon a bed of falsework and without, in the first case, a single pin being used. These thimbles were 12 inches in diameter and provided generous bearing surfaces between chord sections. On the finished lower chord were erected the web members and top chords pinned together at all intersections with pins passing through the thimbles, or members, as the case may be, the large main pins of the structure, namely at the skewbacks and centre of span, forming the hinges or turning points of the arch. The wisdom of this arrangement will be apparent, since the thimbles allowed the original lower chord to be erected and swung clear of falsework, if necessary, the pins later taking care of the web members and upper chord.

On these completed arch ribs, after transverse and lateral bracing had been put in, the vertical bents were erected. These were provided with disc bearings at their lower ends and pin bearings at the upper where the track spans rested. The function of these articulated bearings was not actually to rotate in service but to provide good bearing and adjustment to the grade which exists on the bridge, besides tying the track spans together longitudinally. This disc bearing has been used extensively since the construction of the original bridge in Canadian Pacific bridge practice; from many personal experiences during erection the author can testify to its value.

The general features of both the old and the new construction will be apparent from figure No. 4. Broadly speaking, the track spans on the old arch bridge delivered their reactions at six points on the old arch, including the haunches. In the reconstructed bridge, the arch has the reactions delivered to it at thirteen points and the flanking spans have been approximately bisected by new bents located on new substructures provided for the purpose. Thus the structure has been improved, both aesthetically and theoretically, and, while it appears to be broad enough for double track service, this is not a disadvantage, in that it makes for lateral stiffness in service on account of the broad base provided by the widened haunches.

The new vertical bents are located so as to be attached to the loading beams midway between the arch ribs. In the central portion of the arch, however, where no equalizing beams nor bents were necessary, new long double floor

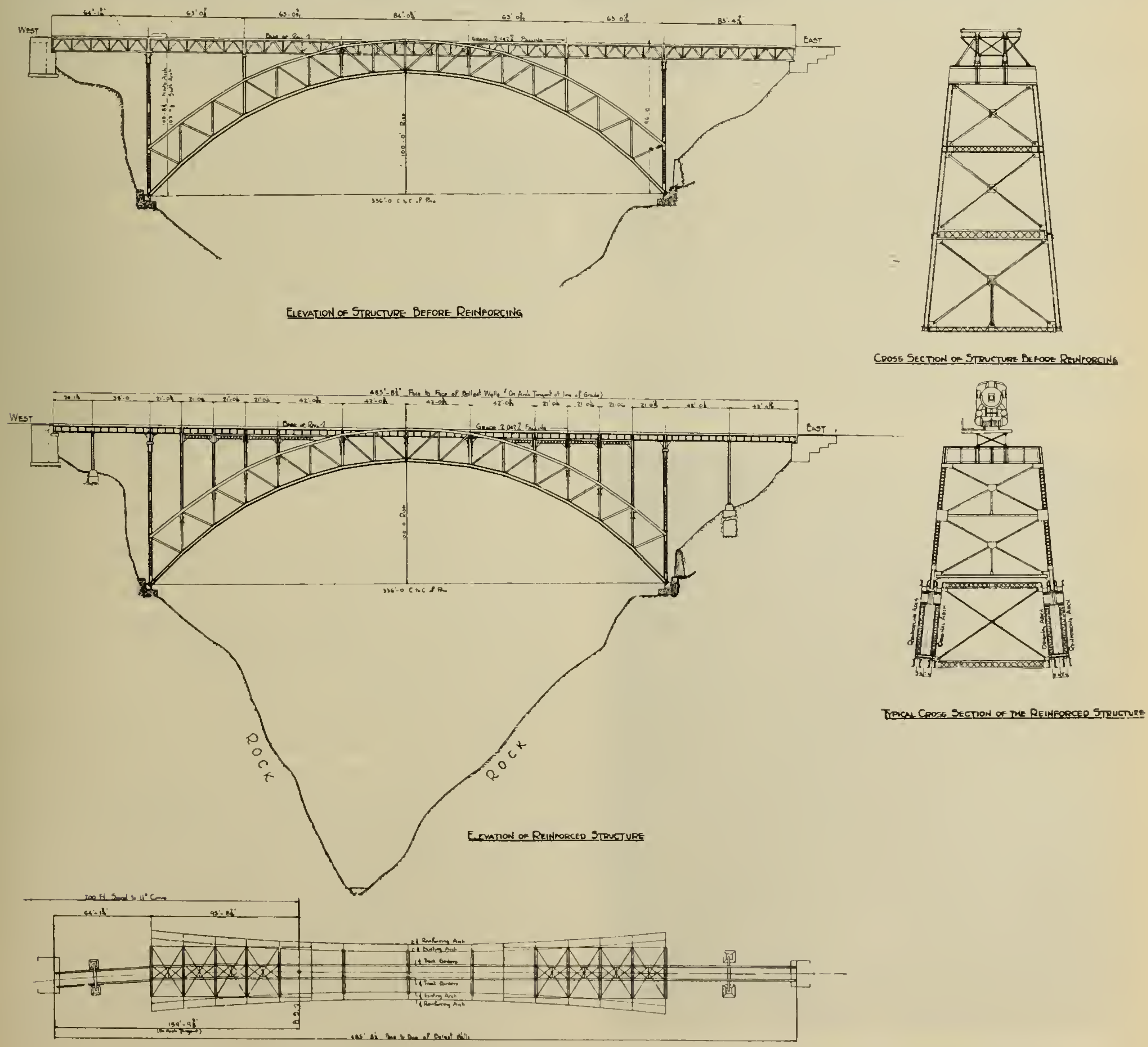


Figure No. 4.—View of Bridge before and after Reinforcement.

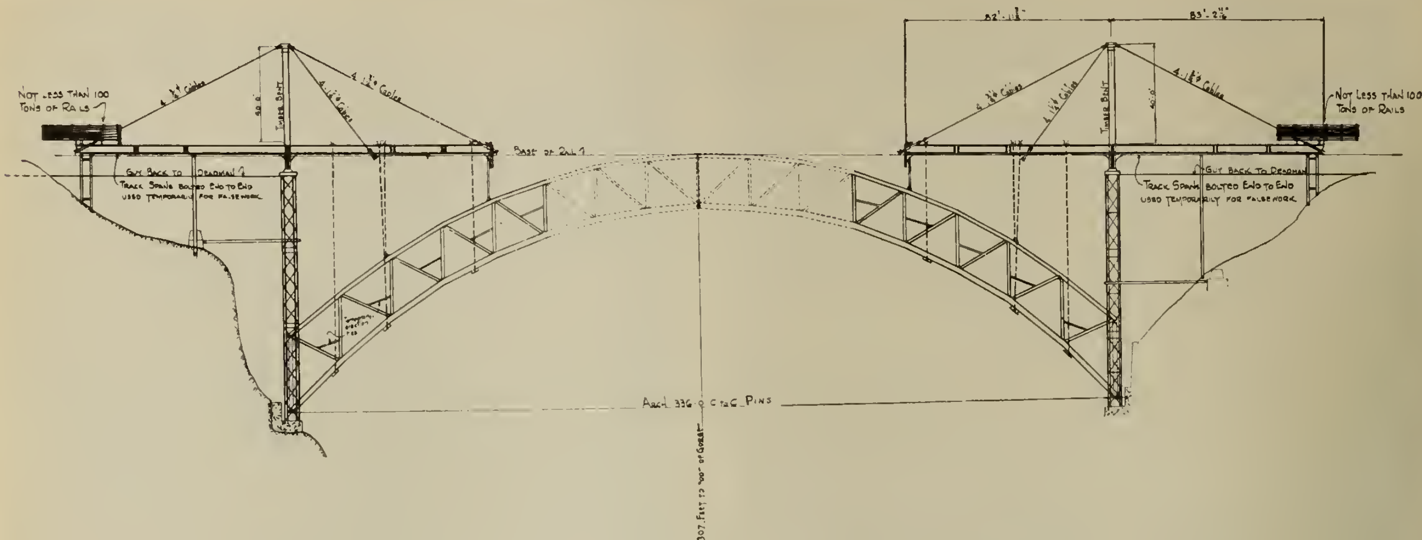


Figure No. 5.—Scheme for Erecting New Arch Ribs by Cantilever Trusses without Loading Old Bridge.

beams are provided which run through the structure, rivetted to both old and new trusses, thus combining floor beams with loading beams.

The track spans themselves are generally equal to the length of a panel, namely 21 feet, except as shown in the centre of the bridge, where they are 42 feet. They are all provided with articulated key bearings at their ends so as to deliver their reactions over the webs of the double floor beams. In order to provide a continuous tie between track spans longitudinally it was felt advisable to put a link and pin connection between the ends of all track spans.

The tractive forces in the new structure are transmitted through lattice struts to the arch ribs themselves.

Having been driven to reinforcing the bridge in place on the main line of a very busy section of the railway, when sometimes fifteen passenger trains had to be taken care of during the hours of daylight when work was possible, naturally the problem of reconstruction resolved itself largely into one of erection methods, which will now be taken up in detail.

Figure No. 6.—Erecting Outer Arch by means of Cantilever Falsework without Loading Old Bridge.

It was not allowable to utilize the old structure for any erection loads, and it was therefore incumbent upon the engineers to so design the work that the arches could be erected by means entirely self-contained and self-supporting.

The scheme decided upon and carried out consisted of a pair of cantilever trusses, counterweighted with old rails at their shore ends, including a wooden tower carried up from a convenient point on the skewback substructure to such a height as to reduce the stresses to convenient limits. (See figure No. 5). The upper chords of these cantilevers consisted of cables, and for the lower chord a series of the new track spans, complete with laterals and brace frames, were bolted together end to end. These were located just above the base of rail and at first extended only three panels out from the skewback panel points. From these plate girder lower chords the panels of the new outer arch truss or rib were suspended by means of suitable wire cables, building out panel by panel, until finally the lower chords and their suspenders had been extended to four panels. There was no further extension from this point, and, instead, the arch ribs were cantilevered out the remaining four panels from each side of the canyon until they met in the centre. It will thus be seen that each of the arch ribs was built out in a self-supporting manner, except for a system of short temporary horizontal struts from the old arch ribs, but otherwise entirely independent of it as far as loading is concerned.

The arch ribs having been thus completed, the work of fastening them together by means of diaphragms or equalizing beams was commenced. Before doing this, however, a system of brackets was erected outside the arch ribs at each vertical, on which was supported, panel by panel, a temporary group of old rails, carefully calculated to provide precisely the same dead load upon the new arch rib as existed on the old. This arrangement is shown in figure No. 8. The effect of this was that the new arches deflected to a point which was considered to be relatively equal to the dead load deflection of the old arches, thus producing conditions which were as nearly as possible theoretically similar in both. Elevations were taken on panel points of the arch ribs as a check, and the similarity of the deflection of the old and the new work was remarkable.

Figure No. 7.—View of Cantilever Falsework, 1929.

There is another feature in connection with these falsework trusses which is worthy of note. As was to be expected, the wire cables stretched considerably during loading. In fact, the upper ones lengthened between six and nine inches, and a system of jacks and jacking beams was provided for adjusting them, which functioned very satisfactorily.

After the arch ribs were coupled up on one side of the bridge, the falsework cantilevers were taken down and re-erected on the other side of the bridge and the same procedure followed in erecting the second arch rib. Progress in the various stages of the work was extremely rapid, and deserves to be placed on record. There were always two gangs working on each portion of the work, one from the east and the other from the west end. The north arch, which was first erected, took fourteen days to couple, and the south one twelve days, and all this in the face of the heavy traffic before referred to. In order to avoid the worst of the traffic the erection crews started work at five a.m. and it was possible to have a somewhat free space of time until about ten a.m. when the usual rush of traffic for the day commenced and continued until five p.m. Some days some extra work was done after this hour, but usually the working day extended from five a.m. to five p.m., with short intervals for meals. The force consisted of upwards of sixty men.

The portion of the work which presented the most difficult problems and needed the most careful preparation commenced after the new arch ribs were erected and the sway and lateral bracing had been reinforced, or renewed, as required. By the plans, the problem resolved itself into a series of operations in which the track was opened, old track spans and bents removed, and new bents and track spans placed. Commencing at the east, or down grade end, after the old wooden deck had been removed, the first 84-foot lattice span was cut apart as to its laterals and brace frames and the two lattice trusses separated to such an extent as to be completely clear of the new work. At the east abutment this necessitated a small amount of temporary cribbing upon which the trusses could rest until, at a more convenient time, they could be entirely removed to the land. The operation of splitting this span made a suitable gap in the work to enable the two single boom derrick cars to place the first two 42-foot flanking spans at the east end, the first land bent having been placed previously. This operation, with the opening and closing of track, removal of old 84-foot span and replacement by the two 42-foot flanking span E-X^1 and X^1-0^1, opening and closing of tracks, placing of ties, rails, etc. took place on June 26th, 1929. Work commenced at five a.m. and track was cleared in good time by ten a.m.

July 1st.—Old 63-foot span removed and spans 0^1-1^1, 1^1-2^1 and 2^1-3^1 put in, together with their bents. Time occupied—five hours.

July 4th.—Old 63-foot span removed and spans 3^1-4^1, 4^1-5^1 and 5^1-6^1 put in, together with their bents and bracing. Time—five hours.

July 8th.—Old 84-foot centre span replaced by new spans 6^1-7^1, 7^1-8, 8-7 and 7-6. Time—five hours.

July 10th.—Old 63-foot span removed and new spans 6-5, 5-4, 4-3 put in, together with their bents and bracing. Time—five hours.

July 15th.—Old 63-foot span removed and new spans 3-2, 2-1 and 1-0 put in, together with their bents, bracing, etc. Time five—hours.

July 17th.—Removed old 84-foot span and put in new spans O-X and X-7. Time—five hours.

This was the final operation involving breaking of track and, as this end of the bridge has some curved alignment on it, there was considerable preparation and many small adjustments to be made during the work, which, however, were completed without delaying passenger trains.

An account of these difficult operations would not be complete without reference to the fact that the seven breaks of track just described involved the removal and transportation along the track of old truss spans, some of the single pieces of which weighed twenty tons. Had there been any failure of tackle or equipment the results would have been serious, it can readily be seen, for the arch trusses and their bracing, and, incidentally, for the traffic of the railway company. It is not too much to say that the men responsible for the organization and erection outfit are to be congratulated on the fact that all this hazardous work was accomplished without mishap to men or equipment.

A deformation diagram (under dead load only) of the trusses indicated that there should be about ⅝ inch deflection at the centre pin. That is to say, the unloaded new arch trusses should have been relatively ⅝ inch higher at their centres than the old ones when first erected, without the dead load which should come to them by reason of the track spans, bents and other attachments. This was realized almost to a fraction by the accuracy of the layout of the skewbacks. It is hardly necessary to point out that it was extremely difficult to lay out this work and to attain precisely the required distance back to back of skewbacks across this 336-foot air line.

As before stated, there were brackets attached to certain panel points of the outer trusses, as shown in one of the slides, on which 115 tons of rails were distributed, this

Figure No. 8.—View showing Temporary Loading of New Arch Ribs with Old Rails before attaching to Old Arch Ribs.

Figure No. 9.—Erecting Track Spans between Trains.

being the estimated amount of the dead load included in the track span, bents, etc. coming to each of the arch trusses. When this dead load was put upon the new arches they behaved identically; that is to say, they deflected an equal amount, namely ⅝ inch as expected by the deformation diagram originally calculated in the drawing office. After deflecting they were securely rivetted together by means of the distributing beams and other details previously decided upon. In order to make sure that the loads were being shared by the trusses as expected a final test was made of the bridge on August 21st, 1929, as shown in figure No. 10, using four of the heaviest engines available, namely,

	Class	Weighing	Total
C.P.R. Engine No. 5768	R-3-c	230 tons	1100 tons
" " " 5900	T-1-a	376 tons	approxi-
" " " 5808	S-2-a	268 tons	mately
" " " 5770	R-3-c	230 tons	

These four engines just about covered the 336-foot arch span, with a slight overlap, and the observed maximum deflections in the centre of the arch were 1-66 inches or 1⅝ inches. While the deflection of the new north arch rib was slightly less, those of the other three were reasonably uniform. It is a fact, however, that the unreinforced arch under ordinary traffic, which was usually composed of double headed engines weighing 230 tons each at a customary speed of 10-15 miles per hour, deflected 2¾ inches, whereas after the reinforcement of the structure the deflection under a standing load of the four engines was only 1⅝ inches.

It is also interesting to note that the aggregate weight of four engines used in the test load of 1929 was almost exactly double that of six engines in 1893.

The field work was commenced in April, 1929, and completed in August, thus occupying less than five months.

The contract for the manufacture and erection of the reinforcing arch ribs, new bracing, and new track spans was entrusted to the Canadian Bridge Company, of Walkerville, Ont., Mr. F. W. Parr being in immediate charge of the work in the field under Mr. Chas. Prettie, superintendent of erection for the Bridge Company, and E. Chorolsky, S.E.I.C., as field engineer.

For the railway company, J. M. R. Fairbairn, M.E.I.C., chief engineer, was responsible for the work as a whole.

The scheme of reinforcing the structure in the manner described was developed and designed in the bridge department of the Railway under the supervision of the author, with A. R. Ketterson, A.M.E.I.C., assistant engineer of bridges, in direct charge.

Discussion

P. L. Pratley, M.E.I.C.[(1)]

Mr. Pratley remarked firstly that the applause indicated a general agreement with his own view that the members present had listened with interest to a most entertaining presentation of a very important piece of bridge engineering. He was sure there would be many members in the audience who would wish to take advantage of the author's offer to answer intelligent inquiries and expand special details. Personally he found a very interesting feature in the references to two famous bridge engineers of the past half century who had been associated with the earlier structures at Stoney Creek, namely, Mr. C. C. Schneider who built the first wooden bridge there, and Mr. H. E. Vautelet who as Chief Engineer was responsible for the original arch construction. They were indeed outstanding men in the profession, and he wished to pay his tribute to his old Chief, Mr. Vautelet, whom he regarded as perhaps the most capable and scientific engineer we had had in Canada, and who had left his mark not only in the vast Canadian Pacific system but also in the Quebec Bridge. The author had shown them some most instructive views of the old arch and the methods of building it, and had followed with equally interesting illustrations of the means adopted for retaining it, while adding new trusses alongside. Doubtless many bridge engineers would find points of interest in the field conditions and the design of the new work, which might now be presented as discussion on the paper.

(1) Monsarrat & Pratley, Consulting Engineers, Montreal.

Figure No. 10.—Official Test, August 21st, 1929.

J. A. McCrory, M.E.I.C.[2]

Mr. McCrory asked the author to outline in a little more detail the means adopted for loading the new arches in order to impress upon them dead-load stresses and deflections equal to those existing in the old.

P. B. Motley, M.E.I.C.[3]

The author replied by recalling the appropriate slides and indicating the bundles of rails applied at the panel points for this purpose.

F. P. Shearwood, M.E.I.C.[4]

Mr. Shearwood complimented Mr. Motley and the Canadian Bridge Company on the successful accomplishment of a very ticklish undertaking. He remarked on the soudness of the principle governing the choice of material and enquired how closely the new steel approached the old in its physical and chemical properties. He also asked whether the duplication of the old detail was so thorough as to involve similar thimbles to those previously used, noting that while these were an essential part of Mr. Vautelet's erection scheme, they would serve no useful purpose in the new arch. Mr. Shearwood made further reference to the work of Mr. Vautelet and the late Mr. Schneider, remarking on the very sound and practical views held by the latter on all matters of bridge construction. He pointed out that Mr. Schneider's specifications were still the basis of the best bridge practice on this continent. A third notable figure who appeared on some of the old views was Mr. James Finley, one of the best known and most widely experienced erection superintendents that this country had ever seen. He was a genius in his line and was still well remembered by many present, although it was now some years since he had joined the great majority.

P. B. Motley, M.E.I.C.

The author in answering the inquiries repeated that the steel was substantially the same in physical properties as that used by Mr. Vautelet. While they had not been able to definitely establish the precise specifications to which the old material had been rolled, they did possess reliable information as to the type of steel being made and used at that time. The thimbles and other details of the old arches had all been faithfully reproduced by the Canadian Bridge Company in accordance with the general understanding to make the new arches as exactly as possible duplicates of the old.

P. L. Pratley, M.E.I.C.

Mr. Pratley then asked whether any difficulty had arisen at the rolling mills in connection with securing the new steel to an old specification, but was advised that no particular trouble had been experienced in obtaining a grade very close to that requested.

R. S. Eadie, A.M.E.I.C.[5]

Mr. Eadie, referring to the loading scheme, asked whether, in view of the fact that the new arch was connected up to the old and participated in carrying the actual dead-load and the train loads before the bundles of rails had been removed, the new arch did not for a time carry practically twice its normal dead-load.

P. B. Motley, M.E.I.C.

The author admitted that this was the case for a short period until the rails could be removed, but that with the trains under careful speed control, the excess load was hardly noticeable. Very few trains passed over until normal conditions had been established.

D. C. Tennant, M.E.I.C.[6]

Mr. Tennant after some general remarks on the classification of engineers and the importance of the Canadian Pacific Railway as a transportation system, enquired whether any actual tests of the old materials had been made with a view to establishing its properties and its metallurgical condition after thirty-six years' service. The answer was in the negative, as Mr. Motley and his staff had not wished to disturb the old structure, even to the extent of replacing lattice-bars or gusset plates from which, conceivably, such test specimens would have been cut. Mr. Tennant also made reference to the economic aspect, alluding to the statement in the paper that an alternative site for a new span had been chosen first and then abandoned. He enquired whether the use of the old span to carry half the track and live-load would not in any event have been the economic procedure, even admitting some increase in the unit erection costs.

P. B. Motley, M.E.I.C.

The author replied that while the method adopted had of necessity been expensive in various particulars, there was quite a satisfactory general economy, having regard to the substructure difficulties that would have arisen if the alternative site had been persisted in.

P. L. Pratley, M.E.I.C.

Mr. Pratley next asked whether any scheme of converting the 3-hinged arch into a 2-hinged arch had been inquired into. He quite realised that the upper chord and web members were light compared to the lower chord, and that any such consideration would have to take account of the actual sections of these members.

A. R. Ketterson, A.M.E.I.C.[7]

Mr. Ketterson rose to explain that any interference with the old arch was considered unwise as, apart from the difference in section of the upper and lower chord, it would have introduced new conditions, whereas the object had been to maintain the same relative stress distribution in the old arch as far as practicable.

F. P. Shearwood, M.E.I.C.

Mr. Shearwood added a further remark on the disparity between the sections of the upper and lower chords, and the consequent unsuitability of the old arch for conversion.

P. L. Pratley, M.E.I.C.

Mr. Pratley stated that the only possible procedure would have been to introduce by jacks a predetermined stress into the top chord, dependent on its figured capacity, as was done at Niagara. He felt satisfied, however, that such attempt at conversion would not have proved of practical value under the circumstances, and it was evident that the better solution was the duplication method actually adopted.

J. W. Seens, A.M.E.I.C.[8]

Mr. Seens, President of the Canadian Bridge Company, offered some observations on the erection work, remarking on the hazardous experiences of the men concerned and the fortunate freedom from accident. He congratulated Mr. Motley on the delivery of a very fine description of the undertaking and moved that the thanks of the meeting be accorded the author in the usual way.

P. L. Pratley, M.E.I.C.

Mr. Pratley then put the vote which was carried with hearty applause, and the author in replying expressed his hope that the members would realise how much he owed his staff, of whom several were present at the meeting, and how much had depended on the co-operation of the contractors. He closed by suggesting that in years to come it would be a matter for legitimate pride to be able to say that one had been connected with this unique and effective piece of bridge engineering at the third construction of the Stoney Creek arch.

(2) Office Engineer, Power Engineering Co., Montreal.
(3) Engineer of Bridges, C.P.R., Montreal.
(4) Chief Engineer, Dominion Bridge Co., Montreal.
(5) Assistant to Chief Engineer, Dominion Bridge Co., Montreal.
(6) Designing Engineer, Dominion Bridge Co., Montreal.
(7) Assistant Engineer of Bridges, C.P.R., Montreal.
(8) President and General Manager, Canadian Bridge Co., Walkerville, Ont.

Load Ratio Control

C. E. Sisson, M.E.I.C., Works Engineer,
Canadian General Electric Company, Davenport Works, Toronto.

Paper read before Montreal Branch of The Engineering Institute of Canada, February 27th, 1930.

In speaking of the process or operation of controlling load ratio we have in mind changing the voltage ratio of a transformer or transformers without interrupting the load. It is also referred to as "tap changing under load," although with the modern load ratio control equipment described below it will be noted that in shifting from one tap to another, no load is carried by the contacts used, the current having been interrupted on the operating section of the equipment by a circuit breaker of some sort before any movement of the contacts begins.

Application

The applications of this equipment fall into three general classes: (1) control of voltage; (2) control of reactive kv.-a.; (3) control of power flow in loops.

Control of Voltage

The rapid development of the use of electrical energy in industrial processes has given rise to the need of equipment for regulating the voltage applied, without interrupting the current flow. Especially is this true where the voltage range is very great. Such applications are found in electric furnaces, in the electrolytic refining of metals, etc. It has also been found desirable to employ this type of equipment, in order to maintain constant voltages at the distribution end of large systems, although in the case of isolated or independent systems this result can usually be obtained by other means more economical and sufficiently suitable.

Control of Reactive Kv.-a.

By far the most important application of load ratio control is in tying together two or more power systems or stations. It is not so very long since power systems or stations of the same power company were operated entirely independently. However, with the rapidly increasing demand for greater volumes of power, additional stations of the same system were developed and in order to insure reliability of service and improve the load factor, were tied together. Similarly it has been found advantageous to interconnect different systems in greater networks. Such interconnection of stations and systems has brought with it many problems of operation which have created a demand for control equipment other than that already available, for example, field rheostats, synchronous condensers and induction regulators. It is not the purpose of this paper to make lengthy comparison between load ratio control equipment and induction regulators or synchronous condensers except to point out that outside of certain peculiar conditions, the more recently developed equipment has been found more economical so far as space occupied or cost of installation and operation are concerned; and has been found entirely reliable.

When two systems are tied together by an intervening transmission line there are possibly and probably three elements to be controlled:—

(a) The division of energy between the two systems.
(b) The voltage at the busses.
(c) The division of the wattless kilovolt-amperes.

Due to local distribution it is usually desirable to maintain constant voltage on the busses independent of the variation and distribution of the load throughout the system. The adjustment of current between systems is necessary in order to obtain either the maximum economy of operation or the most desirable utilization of equipment. However, when two systems, having their voltages maintained at slightly different levels, are tied together, sufficient lagging current will flow through the reactance of the tie line to absorb the voltage difference in line drop. This lagging current may be highly undesirable especially as it may flow in the opposite direction to the flow of power and thus add to the burden on the generating station.

The division of energy is determined by and can be controlled by the characteristics and regulation of the prime movers. The voltage may be regulated by the field currents, as can also the power factor of the line and the division of wattless current. But while these two quantities may be separately controlled by field they cannot be simultaneously regulated. We, therefore, are compelled to be satisfied with field control of line power factor and one

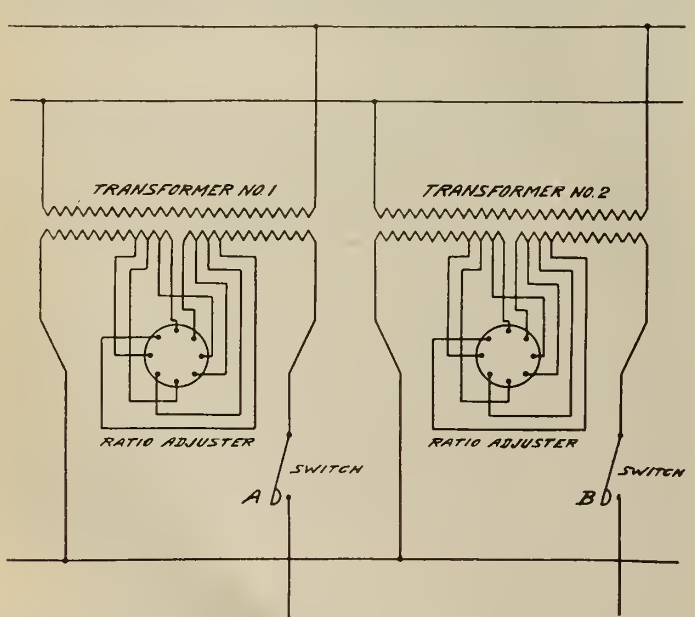


Figure No. 1.—Load Ratio Control using Two Transformers.

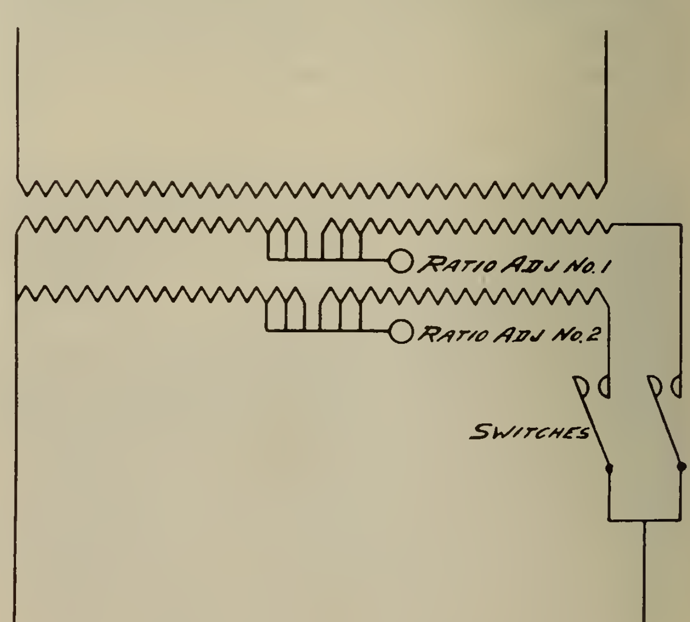


Figure No. 2.—Load Ratio Control obtained by using Two Circuits in Transformer Winding.

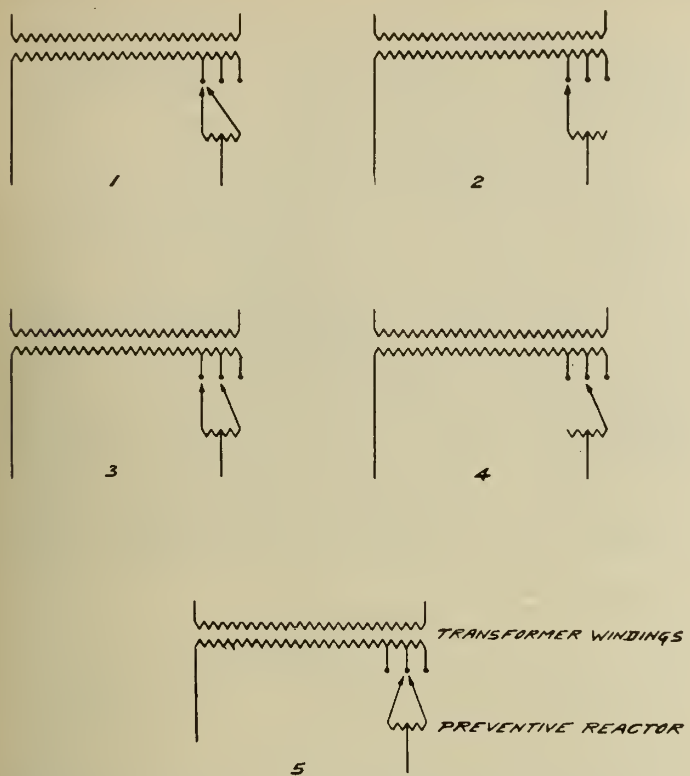


Figure No. 3.—Sequence of Positions for One Change of Ratio.

voltage or of both voltages ignoring the power factor or as a third alternative to introduce some means of assisting the field control. This is accomplished by inserting some variable ratio between the systems, which takes care of the division of wattless current, leaving the voltage control to be taken care of by field regulation. By this means the wattless current may be increased, eliminated or reversed at will, in order to secure the best operating conditions. Inserting such a ratio of transformation in a tie line is equivalent, in its effect on the flow of reactive current, to raising or lowering the voltage on one of the two systems. This scheme can be extended to any number of stations operating on a line, so that by installing one voltage control equipment less than there are stations it is possible to maintain the bus voltage constant at all stations and at the same time obtain the desired current in any part of the line.

Phase Angle Control of Power in a Loop

If, however, we have parallel lines of different characteristics or high voltage loops, a new problem presents itself, in the solution of which the same type of equipment can be employed to provide phase angle control as well as power factor control.

If the currents in the different sections of the two branches of a loop are to be independently variable a resultant voltage will probably exist between the two ends, if the loop is opened. This resultant voltage is the summation of the impedance drops in the different sections, and varies in magnitude and in phase depending upon the variations in the currents in the lines. If the loop is closed a circulating current flows around the loop equal to the voltage between the open ends divided by the complete line impedance. This circulating current alters the total current in different sections of the line and may or may not be sufficient to be objectionable.

If the ratio of the resistance to the reactance in every portion of a loop is the same, and therefore equal to the ratio of the total line resistance to reactance, the currents will divide to give minimum copper losses in the line. This will rarely be found to be the case, but it may be found sufficient and desirable to readjust the lines by the use of reactors. If the line is naturally properly balanced or sufficient adjustment is obtained by the addition of reactors, the necessary flexibility of operation, at minimum line losses, and including local distribution at fixed voltages from each station bus, can be obtained by installing power factor control on the transformers connected to the loop.

However, it may be found that in order to secure the flexibility of current necessary to insure against overloading of parts of the system, such as cables and transformers, phase angle control accompanied by power factor control offers the most satisfactory solution. What is necessary is to introduce into the line a voltage which is always equal to but opposite to the resultant voltage between the ends of the open loop. As this voltage will vary both in value and in phase depending upon how much the currents in the line vary, the control equipment must be adjustable. We, therefore, employ two ratio control equipments, one providing the proper in-phase and the other providing the proper quadrature voltage; these equipments operating independently of each other. It is possible to combine the two into one outfit, arranged, however, to give independent control of power factor and phase angle.

A 20 per cent range in ratio, in the form of 10 per cent boost and 10 per cent buck, when connected in circuit 90 degrees out of phase will give a range in phase angle of approximately 6 degrees each side of normal.

Development of Ratio Control Equipment

Early in the history of transformer design and manufacture the possibility and desirability of placing taps in the winding became evident, and with a growing appreciation of the flexibility of this type of apparatus, there has developed a desire to increase the availability of these taps. The designer, although opposed in general to the addition

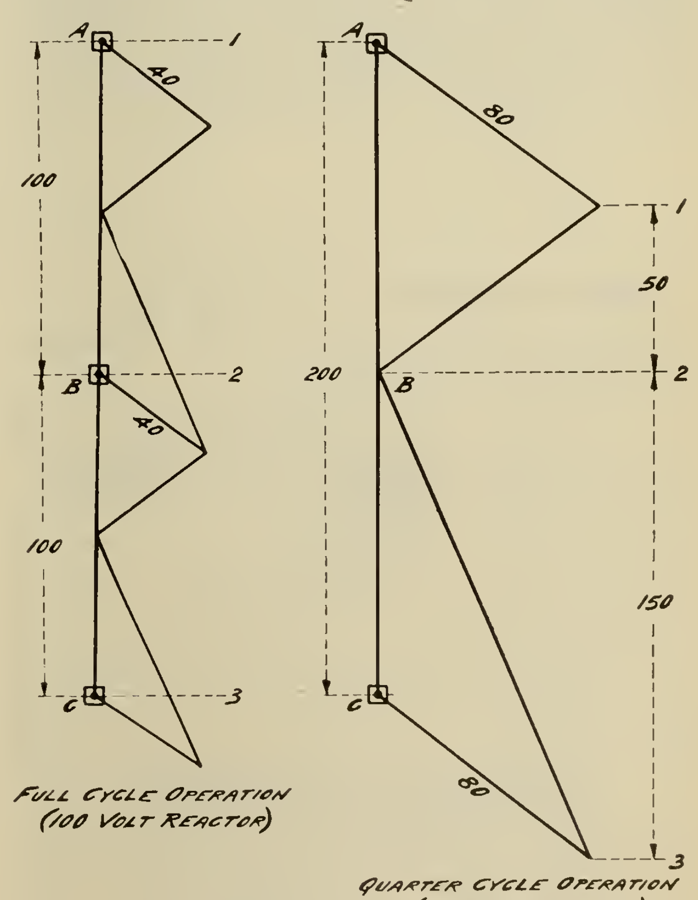


Figure No. 4.—Diagram showing the Voltage Derived during Ratio-Changing under Full Load at 80 per cent Power Factor with a Circulating Current of 60 per cent Full Load in the Preventive Reactor.

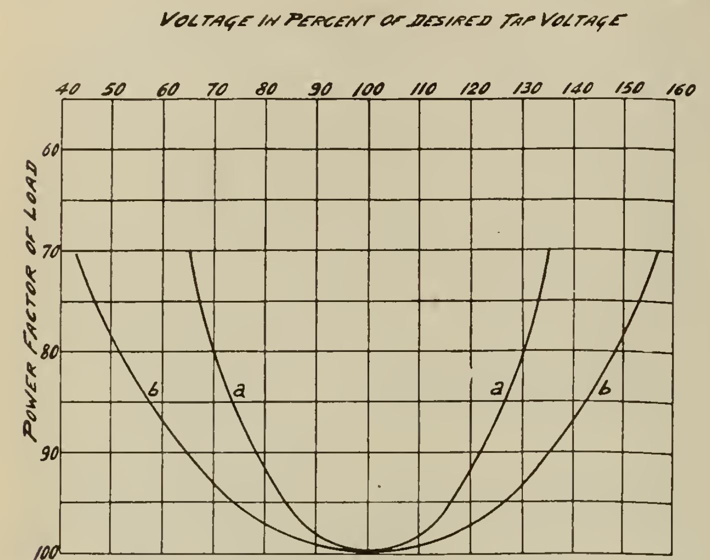
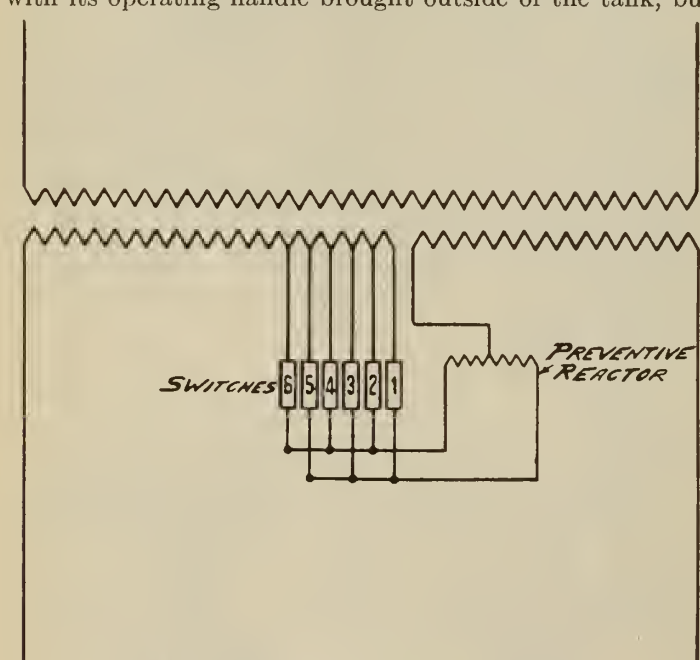


Figure No. 5.—Unequal Voltage Steps Resulting from Quarter Cycle Operation at Full Load.
Curve "aa"—reactor designed for 100 per cent circulating current.
Curve "bb"—reactor designed for 60 per cent circulating current.

of taps in the transformer windings, has long since accepted them as inevitable and reserves any vestige of opposition he may have left, for those cases when some decidedly objectionable features of manufacture would result, if the taps asked for were accepted. In the early development, these taps were brought to a terminal board with movable links for changing connections, it being necessary to disconnect the transformer from service and open the handhole in order to change the ratio. Only average operating conditions were provided for, and changes were seldom made. The necessity for changing taps more frequently, led to the development of the ratio adjuster with its operating handle brought outside of the tank, but



RATIOS	1	2	3	4	5	6	7	8	9	10	11
SWITCH 1	O	O									
2		O	O	O							
3				O	O	O					
4						O	O	O			
5								O	O	O	
6										O	O

SWITCH CLOSED-O

Figure No. 6.—Method of Obtaining Eleven Ratios from Six Taps Quarter Cycle Operation.

it was still necessary to take the unit out of service during the operation of the tap changer. As the necessity for making these changes became daily rather than seasonal, we were led to the study of ways and means of changing taps without interrupting the load.

It will be recalled that many years ago a device was developed for changing the ratio by means of taps brought to a dial-head which was manually operated at will. The section of winding between taps was short-circuited through a reactance during the transition from point to point. Some similarity will be noted between this scheme and those described below. This scheme was only used in relatively small capacities and since the induction regulator was being developed about the same time and with comparatively small loads to be taken care of, the regulator satisfactorily handled the situation and dominated the field. However, there has been a very rapid increase in the kv.-a. capacity of central stations and simultaneously in transformer banks, with the accompanying natural increase in voltage, which, along with the tendency to connect these

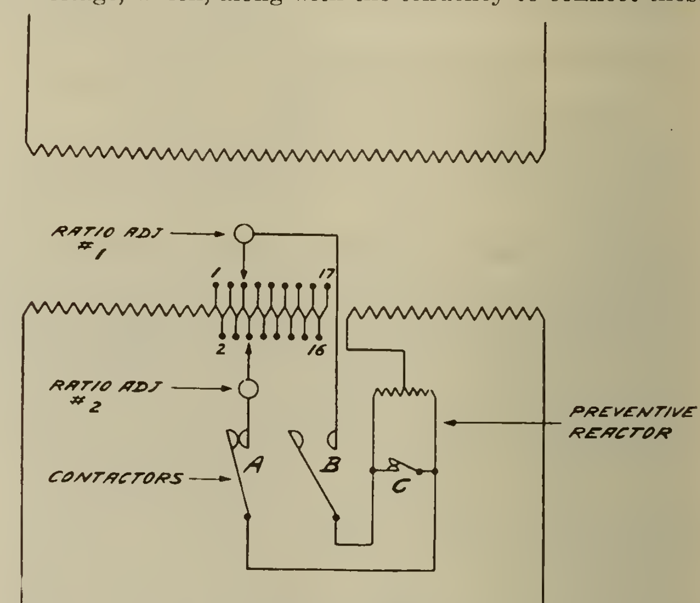


Figure No. 7.—Method of Obtaining Seventeen Ratios from Seventeen Taps.

stations into networks, has given rise to voltage control devices in larger units. In making comparison on a cost basis it will be found that for small loads and lower voltages the induction regulator has an advantage, but the situation is quite the reverse as the capacities, and particularly the voltages to be regulated, become greater. The neutral point from an economical point of view is reached when the capacity of the induction regulators per bank is between 300 kv.-a. and 500 kv.-a. depending upon the voltage involved. There is no definite upper limit to the present type of load ratio control application either of kv.-a., voltage or current, although in some cases, more particularly in tie-in banks, it is necessary to use series transformers and sometimes also exciting transformers to keep within the voltage or current limitations of available or more desirable apparatus. Reference is made to some of these special requirements later.

Theory of Load Ratio Control

Load ratio control, of any type, involves the use of two local circuits capable of carrying the load simultaneously. This permits picking up the load on one ratio before it is dropped from another. Obviously, carrying a load simultaneously on two tap connections would involve a destructive short circuit between those taps unless suitable impedance was introduced to limit the exchange current. All types of load ratio control include such an impedance, either in the form of leakage reactance between special

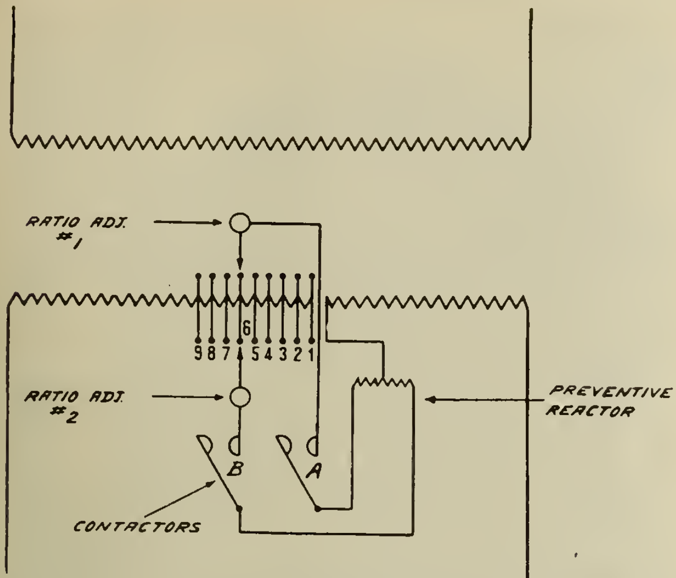


Figure No. 8.—Method of Obtaining Nine Ratios from Nine Taps Full Cycle Operation.

windings on the transformer core, or of a separate iron core reactor.

Perhaps the first method to suggest itself in the consideration of load ratio control was the use of two similar transformers operating in multiple, each equipped with some form of tap changing switch and the two so arranged that each may in turn be cut out of circuit momentarily to permit change of taps, the load being carried by the other during this interval. Such an arrangement is represented in figure No. 1, where transformers Nos. 1 and 2 are operating in parallel, and each is provided with a ratio adjuster. A tap change may be made without dropping the load by first opening circuit breaker *A* which shifts the load from transformer No. 1 but does not remove the excitation, since the high-voltage side is still connected to the line. The ratio adjuster in transformer No. 1 can now be moved to the next position, after which the circuit is again closed. The two transformers are now operating, with unequal ratios, in parallel; and a circulating current which is limited by the inherent reactance of the transformers will flow between them. Next, circuit breaker *B* is opened and the ratio adjuster of transformer No. 2 moved to its next position. When circuit breaker *B* is closed, the two transformers are again operating under normal conditions, but with a changed ratio.

It is important to note that when one of the breakers is open, the voltage which exists across the open breaker is

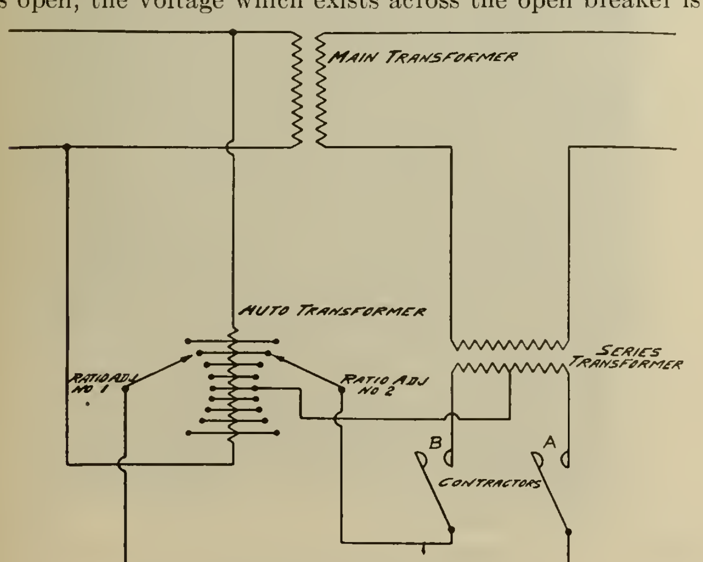


Figure No. 9.—Regulating Transformer.

not the line voltage, but a very small fraction of it, owing to the fact that the disconnected transformer receives excitation from the high voltage side. The greatest voltage which the breakers are obliged to open is equal to that arising from the difference in ratio of transformation of the two transformers plus the impedance drop of the loaded one.

The above method of tap changing is not entirely satisfactory, because the doubling of the load on one transformer, during the switching period, doubles the impedance drop, which results in an undesirable fluctuation in secondary voltage. Thus with 10 per cent transformer reactance at full load, the reactance drop is increased to 20 per cent, which is several times the voltage between adjacent taps.

We turn, therefore, to a single transformer, figure No. 2, which has been designed with a multiple circuit, each circuit, as in the case of the two transformers being provided with a ratio adjuster and arranged so that it may in turn be cut out of circuit. The reactance between the multiple circuits can now be controlled independently of the main transformer reactance, and it can be made small enough to prevent objectionable fluctuations in voltage during the

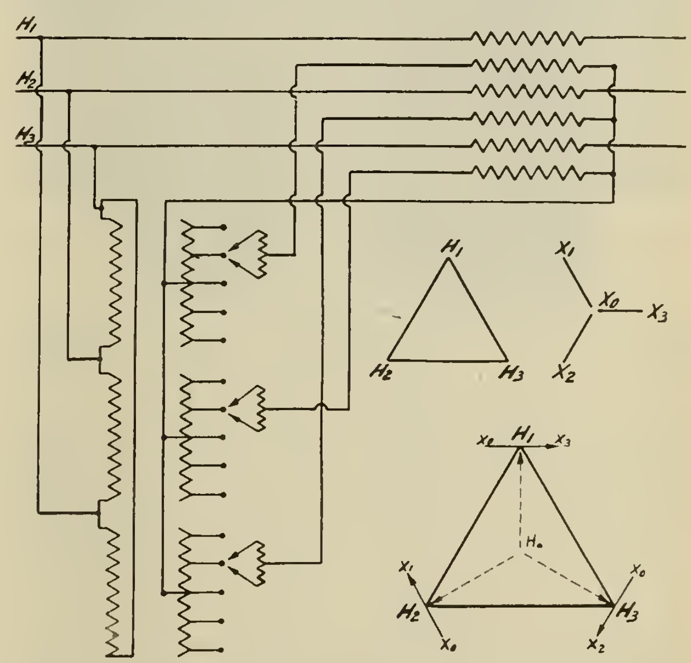


Figure No. 10.—Tap Changing for Phase Angle Control.

process of switching, keeping it at the same time large enough to prevent excessive circulating current.

This method, although in many respects desirable, is also open to two inherent objections. In the first place, it is often the case that the transformer design does not lend itself readily to a multiple circuit without appreciable increase in cost, and secondly, since during the process of switching, transformer full load is momentarily thrown on one half of the winding, in the very remote possibility of the operating motor failing to complete its cycle, this load may be present for a sufficient time to seriously overheat the windings. To provide against this contingency would mean the design of windings with an appreciably greater cross-section of copper, again at a corresponding increase in cost.

The practical consideration, therefore, of these methods has led us, in many cases, to depart from the simple arrangement just described and to adopt an arrangement where only a small portion of the circuit is in multiple. In figure No. 8 is shown an arrangement where the multiple circuit consists only of the ratio adjusters, the circuit breakers and an auxiliary reactance, which has been termed "the preventive reactance," provided to limit the circulating current.

Such an arrangement lends itself, in general, to three

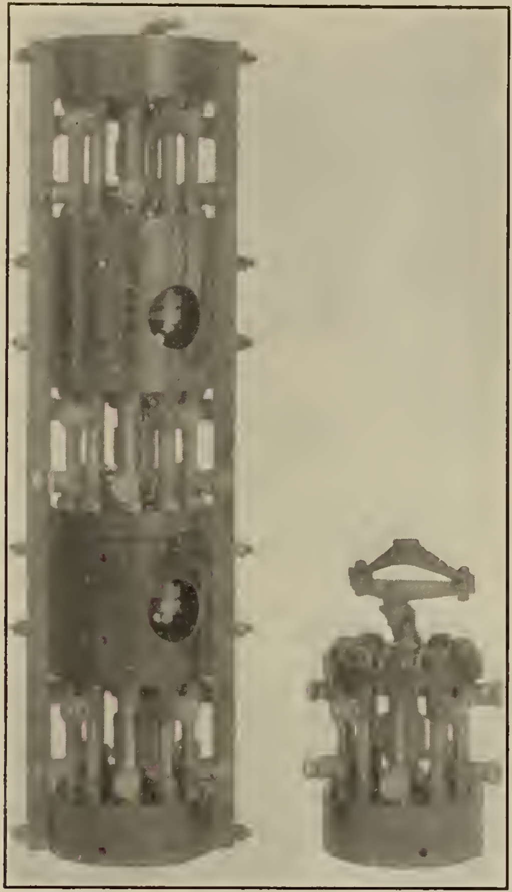


Figure No. 11.—600-Ampere, 10-Point Star Crab Ratio Adjuster—Three-phase Stack and Single Phase.

different schemes of operation which may better be explained by referring to figure No. 3. Here it will be noted that one lead of the transformer is taken from the middle point of the so called preventive reactor. The ends of this reactor are arranged so that they may be connected to any of the several taps, brought from the transformer winding, through some form of tap changing switch. Sketches 1 to 5 indicate the five progressive steps necessary in passing from one tap of the transformer to the next. It will be noted that in steps 1 and 5, both ends of the reactor are connected to the same tap. The reactor is, therefore, short circuited and has no appreciable effect on the voltage obtained from that tap. They are the points of full cycle operation. In either position the reactor core is not excited and does not add any loss to the transformer. These are, therefore, the desirable points of operation, and except perhaps in cases where a very large number of taps are required, are the only operating points used in Canadian General Electric Company apparatus.

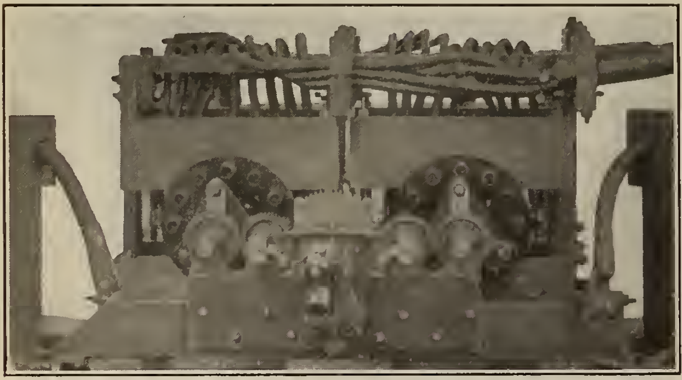


Figure No. 12.—Intermittent Gear and Ratio Adjusters for Load Ratio Control.

Step 3 places the reactor across two adjacent taps of the transformer. The voltage obtained is approximately half-way between that of the two taps. In this position the reactor is fully excited and increases the no load loss and reactive load on the system. This is not a desirable point of operation.

In the case of steps 2 and 4 one-half of the reactor winding is in series with the tap, thus somewhat increasing the regulation drop. Points 2 and 4, therefore, known as quarter cycle operation, should be used only in very special cases. Full cycle operation gives equal steps in voltage at any power factor. Figures Nos. 4 and 5 indicate how far from equal these steps may be in the case of quarter cycle operation.

Perhaps the simplest method of using the preventive reactor in obtaining load ratio control suggests itself in figure No. 6. Here the ends of the reactor are arranged so that they may be connected to the several taps by means of a set of switches which may be operated singly or in pairs in progressing from one tap to the next. Figure No. 6 indicates the various steps used in obtaining eleven ratios from six taps. This method is open to all the objections of quarter and half cycle operation and should, therefore, be avoided.

Figure No. 7 illustrates a method of load ratio control particularly designed to take care of a large number of taps. Here use is made only of the quarter cycle points as indicated

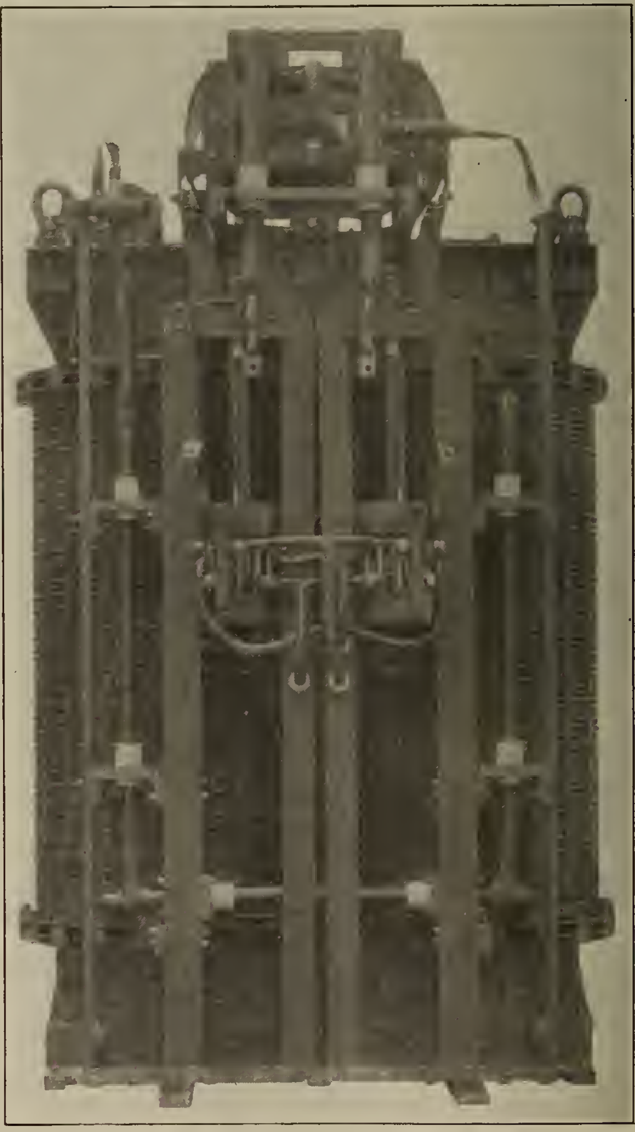


Figure No. 13.—Assembled Core and Coils with Reactor on Top with Type LR-9 Load Ratio Control.

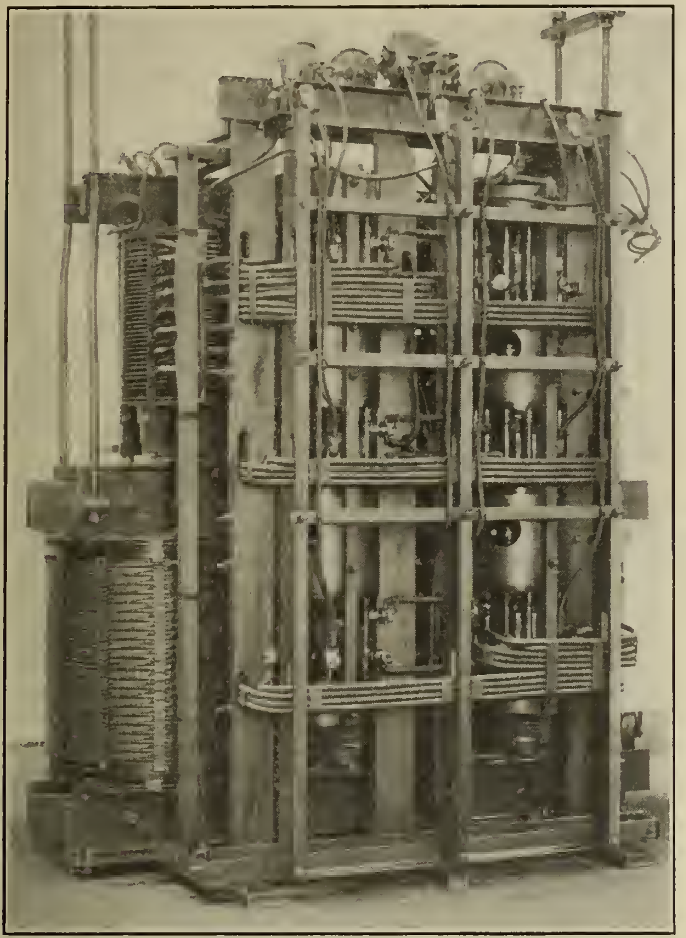


Figure No. 14.—Type LR-9 Load Ratio Control Regulating Transformer—Assembled Core, Coils and Control.

in sketches 2 and 4 of figure No. 3 but the objectionable features of the reactor are to some extent overcome by the addition of switch *C* which short-circuits the reactor on all operating points, this switch being open only during changing of taps.

And now we come to load ratio control in what is

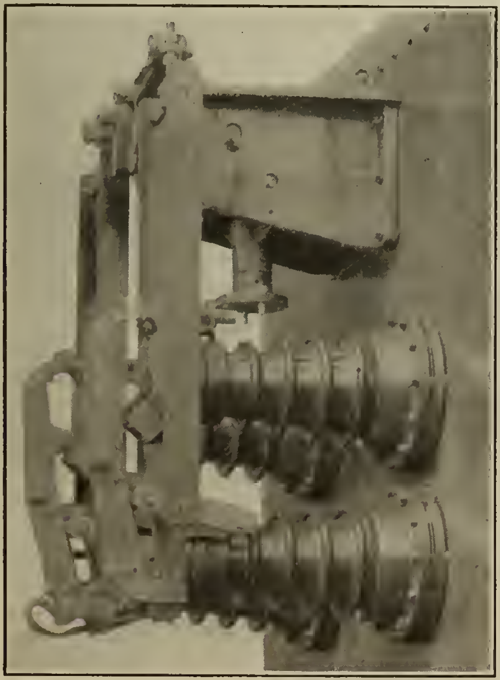


Figure No. 15.—Contactors for Transformer Load Ratio Control, Type LRS-9, 73-Kv.

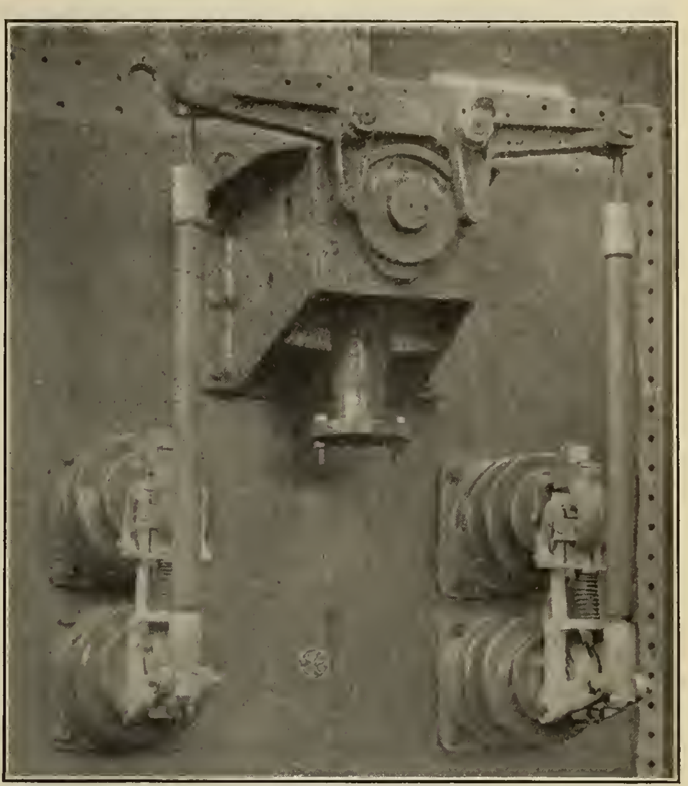


Figure No. 16.—37-Kv., 1,000-Amp., Single-phase Contactors for Type LR-9 Load Ratio Control.

believed to be its most satisfactory form of development in apparatus which makes use only of the full cycle points of operation as indicated at 1 and 5 in figure No. 3. Figure No. 8 is typical of load ratio control as applied to C.G.E. transformers of low and moderate voltage. Here the preventive reactor is connected through contactors to two ratio adjusters, the whole being positively geared to a common driving shaft and designed to complete the cycle shown in figure No. 3 for each change of tap. In changing from tap 6 to tap 5 therefore the following order is followed—

Contactor *A* opens—ratio adjuster No. 1 moves to tap 5—contactor *A* closes.

Contactor *B* opens—ratio adjuster No. 2 moves to tap 5—contactor *B* closes and the cycle is complete.

It will be noted that since both sides of the reactor are connected to the same tap while in an operating position the only voltage which appears across it is due to the leakage reactance between the reactor halves, and this may be made negligible by interlacing the reactor windings. The load current divides equally between the two halves.

Where high voltages are involved a modification of this arrangement is necessary as illustrated in figure No. 9. Here variation in voltage is obtained from an auto-transformer which is designed with a number of taps symmetrically arranged on either side of its centre. This auto-transformer provides excitation through the necessary ratio adjusters and contactors to the primary winding of a series transformer. The cycle of operation is exactly similar to that just described. No preventive reactor is necessary since the primary of the series transformer replaces it. The series winding which may readily be insulated for any desired operating voltage is placed in series with the system and provides the tying link between the tap changing mechanism and the high voltage circuit. The auto-transformer may be excited from the low voltage winding of the main transformer or from any other source which is in synchronism with it; or it may, if desirable, be provided with a separate primary winding designed to take power at any convenient voltage.

Equipment similar to that just described in connection

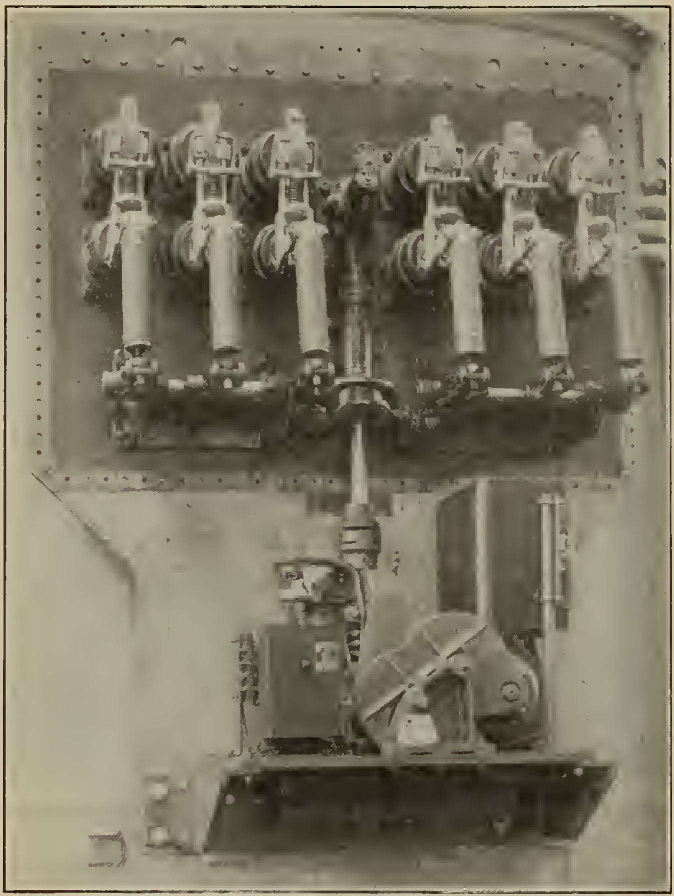


Figure No. 17.—Contactor Panel and Motor Drive for LRT-9-15 Kv., Oil Tank and Motor Housing Removed.

with figure No. 9 may readily be adapted to phase angle control by so interconnecting the auto-transformers with the series transformers that the regulating voltage is at right angles to the system voltage. Figure No. 10 illustrates this equipment when so arranged. It will be noted that the regulating voltage X_0X_1 is at right angles to the system voltage H_0H_2 etc.

Mechanical Equipment

In determining upon standard equipment for load ratio control the following features have been given careful consideration:—

(1) As far as possible standard and proven apparatus should be employed.
(2) This apparatus should be selected so as to provide as wide a range of application as possible with a minimum amount of detailed changes.
(3) The equipment should be made simple of operation and suitable for either hand or remote control.

With these objects in mind the modern equipment consists of:—

(1) Transformers with taps which are by this time thoroughly familiar to everyone.
(2) Two ratio adjusters connected to the transformer taps.
(3) An intermittent gear for operating these adjusters.
(4) Two cam operated oil immersed contactors.
(5) A motor driving mechanism.

The ratio adjusters which may be arranged either for single or three phase are shown in figure No. 11. They are quite suitable for motor drive, and in operation, the driving mechanism turns first one and then the other to an adjacent position, at the same time holding the corresponding contactor open during the movement of each adjuster. It will be noted that these ratio adjusters operate by means of an eccentric, so that with a light torque on the shaft a heavy pressure is placed on the contacts as they wipe into position. The cylindrical bars to which the taps are connected are insulated with herkolite tubes where they pass through the moulded compound head.

Figure No. 12 shows an intermittent gear for driving these adjusters. It is designed to pick up each ratio adjuster in succession without shock and to lock it in position at all other times. There is a universal joint between the gear and the tank wall. Since the number of operations that this equipment is subjected to is not likely to be more than say 3,000 per year, practically no mechanical deterioration takes place during the entire life of the transformer. This intermittent gearing is placed inside of the transformer tank proper. Figure No. 13 shows an assembled core and coils with the preventive reactor, while figure No. 14 shows the interior of a regulating transformer used on high voltage system. It will be noted that both the series and exciting transformers are shown.

Figure No. 15 shows a 73-kv. contactor and figure No. 16 a 37-kv. contactor. They are mounted in a chamber on the side of the tank and are completely immersed in oil, but this oil is entirely separate from that of the transformer proper. Since the taps are changed by the ratio adjusters instead of the transformer tank it is only necessary to have two contactors, one in series with each ratio adjuster. This reduces the number of bushings through the tank wall as well as the voltages in the contactor box. Provision is made for inspecting or replacing the arcing tips, although this replacement will not be necessary, at the most, more than once a year.

The driving mechanism shown in figure No. 17 consists

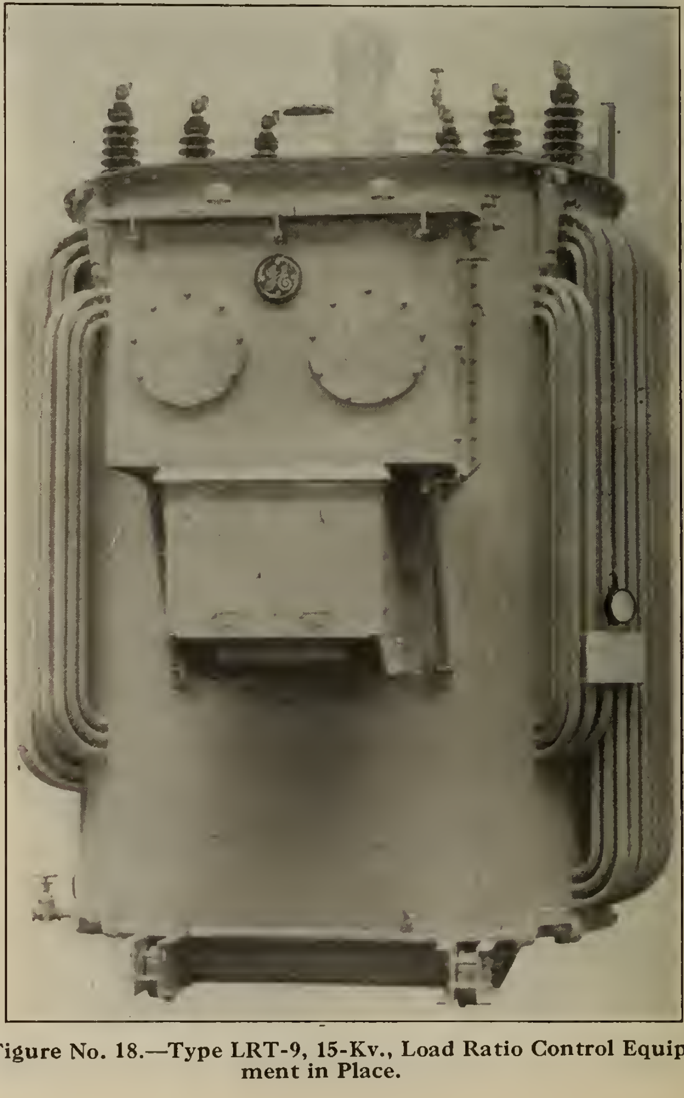


Figure No. 18.—Type LRT-9, 15-Kv., Load Ratio Control Equipment in Place.

of a motor, brake, relay switch, limit switch, drum controller, position indicator and dial switch for remote indication. This mechanism is controlled by means of a pushbutton switch which may be located at any convenient point. Once the motor is started the operation is independent of the operator until a complete tap change has taken place.

Figure No. 17 also shows a combination of contactor panel and motor drive with the heavy steel plate on which the contactors are mounted projected downward so that the motor driving mechanism can be assembled on the same plate, insuring better alignment. However, should it be found that this will carry the motor driving mechanism too high up, the operating mechanism can be lowered and the driving shaft extended. It will be noticed also that this equipment is provided for hand operation.

Figure No. 18 shows the completely assembled equipment, which gives a compact, rugged and entirely reliable piece of apparatus, the necessity and application of which is becoming more and more general.

The author wishes to acknowledge the assistance given by Mr. R. B. Carson, power transformer engineer, Canadian General Electric Company, in the preparation of this paper.

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Discussion of Paper on the Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge by L. R. Wilson, M.E.I.C.[1]

P. L. PRATLEY, M.E.I.C.[2]

Mr Pratley remarked that the paper formed a masterly presentation of the detailed work involved in the fabrication and erection of the bridge superstructure. A good many of the members present belonging to one or other of the branches of The Institute between the St. Clair and the Atlantic where he had had the pleasure of lecturing on the Montreal Harbour Bridge would perhaps remember that he had expressed the hope that some day we would be able to listen to one of the engineers of the Dominion Bridge Company giving a detailed and descriptive account of the operations included in the steel erection on the South Shore Bridge. To-day we were much indebted to Mr. Wilson for his most instructive description of that work. In using the names South Shore Bridge and Harbour Bridge alternately Mr. Pratley was participating in that popular but not particularly profound pastime, adopted by both public and press, of proposing an appropriate patronymic for this product of our prolific profession.

In the erection of such structures as the South Shore Bridge, the public were naturally more impressed by the building of the steel superstructure than by any other phase of the construction. That part of the work was spectacular and for this reason made an appeal. It represented to them the actual spanning of great gaps, the visible process of reaching out to isolated places and the producing of a continuous structure ready to serve them as a highway for their traffic. But he thought the author would agree with him when he stated that in addition, a great and important work was represented in the piers and foundations, which beside supporting the superstructures, had positively to resist the "irresistible" ice pressures to which reference had been made. Several million dollars had been sunk in those foundations, and although the superstructure cost a few millions more, much time, much effort, and much profound engineering study had been consecrated to the varied, serious and fascinating problems which arose in providing the necessary substructures to carry the steelwork described in the paper.

There were many points arising out of the paper which should form the subject of interesting discussion, and he regretted sincerely that the necessary time was not at our disposal to cover these. He desired, however, to point out one or two things that had impressed him in Mr. Wilson's paper.

The author had said, on the very first page of his admirable presentation, that "it is noteworthy to observe that complete agreement was reached in every instance between the engineers and the contractors."

This was no lame statement put in the text simply to suggest that everything was "pie." There had been years of real labour both for the engineers and the Bridge Company as contractors, before arriving at all these agreements, which in their turn had led to the successful erection of this great structure. But it was undoubtedly true that the co-operation offered by the Bridge Company engineers was of the most splendid type. They had given of their time, and of their effort; and possibly something of their profits towards the realization of this steel structure, which was one of the outstanding pieces of bridgework of modern times. It was also true that the "shop practice" achieved in this work surpassed anything yet accomplished in bridge fabrication and erection, particularly in regard to the degree of accuracy obtained both in shop and field.

The author had stated that the design of the bridge was such that there was the very minimum of temporary material left in the permanent structure. This was quite true, and meant of course, that erection conditions were so taken care of in the design that general economy was the result. Mr. Wilson had also mentioned that profiting by the experience at Quebec, the type of main span was adopted with this same idea of convenience in erection and total economy. Mr. Pratley emphasized that where the minimum of permanent material is introduced on account of the temporary erection conditions, definite economy is achieved. In the case considered in the paper practically nothing had been left in the permanent structure that was not required for permanent use, and that he considered that an achievement which deserved to be recorded.

There were admittedly quite a number of details, some of major importance, particularly in the main span, which were contributed by the contractors to the design as built. It should be realized that when putting out the plans for tender, although the designers had to go very carefully into detail and to work out a structure that was practicable of construction and erection, it would be very easy to go too far in that direction. The engineers realized that preparation must be made for the individual disposition of the successful bidder, who would become in due course the responsible contractor. The contractor, in order to make the best use of his own equipment, or equipment with which he is familiar, and in order to bring to bear his own accumulated experience, must make his own complete study of the erection methods and must of necessity control

[1] This paper was presented at the Annual General Meeting of The Institute, at Ottawa, Ont., February 14th, 1930, and published in the January 1930 Journal.

[2] Monsarrat & Pratley, Consulting Engineers, Montreal.

certain features of the design. Several changes were, in virtue of the facts, suggested by the contractors in order to facilitate and improve erection conditions. One such important suggestion was that the height of the main post be reduced. After studies had been made of the effect of such reduction on economy, it was decided to accede to the contractors' request and thus eliminate the need for excess height on their tower traveller, which would only at the most construct a very few panels. The main post was accordingly reduced about 12 feet. Another change effected by the ideas of the contractors was the introduction of an additional panel in the suspended span. It would be noticed from the illustrations and the slides that there are actually seven double panels. There were originally six. Another change was the introduction of two floorbeams at the junction points of the suspended span with the two cantilever arms. From these instances it would be seen that any helpful suggestions received sympathetic consideration, and, if found desirable, were accepted. He would like to tell more of the splendid spirit of co-operation that existed between all those engaged in this monumental piece of work, but time compelled him to close his remarks which he did by again thanking the author for his interesting and instructive paper.

T. W. HARVIE, M.E.I.C.[3]

Mr. Harvie confessed that he had no criticism to offer with regard to this important paper on the fabrication and erection of the steel superstructure of the Montreal-South Shore Bridge, and would only say that he regarded it as a most valuable record of a great work well done. Mr. Pratley had already indicated that Mr. Wilson's paper would be the first of the final authoritative records of this work, and he hoped that the contractors for the substructure, who also carried out their work very meritoriously, and the joint consulting and designing engineers, would feel it their duty to give an account of their labours for the benefit of the engineering profession. Now, although the technical side of such an undertaking was probably by far the most interesting, perhaps the most worrying side was what might be called the "promotion stage." He feared that engineers and contractors alike would be without an occupation but for the "promoter," and was sure that all present who were in any way connected with the construction of the Montreal-South Shore Bridge would cheerfully give that title to the Hon. Dr. W. L. McDougald, who for many years spared no effort in the furtherance of this great project, and gave unstintedly of his time to bring a dream of fifty years to a reality. He was the first man to get the scheme actually going, and all would appreciate that enthusiasm which had resulted in the erection of this great bridge.

Referring to his own function in the enterprise, Mr. Harvie had the privilege of being Chairman of the Advisory Board of Engineers, while at the same time General Manager for the Harbour Commissioners. He was, therefore, the target for the Commissioners, the contractors, and the engineers, particularly his good friend, Mr. Pratley, and in fact for all who cared to shoot, but was glad to say they usually fired blank shot and he had sustained no serious injuries.

That advisory Board consisted of I. E. Vallee, A.M.E.I.C., chief engineer of the Department of Public Works of the Province of Quebec, representing the Province; H. A. Terreault, M.E.I.C., Director of Public Works for the City of Montreal, representing the City; Dr. H. M. MacKay, M.E.I.C., Dean of the Faculty of Applied Science, McGill University; Professor S. A. Baulne, of the University of Montreal, G. H. Duggan, M.E.I.C., as consulting engineer to the Board, and himself, as Chairman, representing the Harbour Commissioners of Montreal. Unfortunately, however, Mr. Duggan, much to the regret of his colleagues, felt it his duty to retire from the Board at a comparatively early stage in the proceedings, and on behalf of the Advisory Board of Engineers Mr. Harvie wished to say how much they appreciated the benefit of his great experience and mature judgment and tender him their thanks for the invaluable assistance he was able to render.

The author and Mr. Pratley had already referred to the friendly spirit which prevailed throughout. Seldom, he believed, had a public work of this magnitude been carried out with such good feeling all round. It would be improper and unjust to close his remarks without paying tribute to the excellent work of the joint consulting and designing engineers, particularly Mr. P. L. Pratley, with whom he had been in the closest contact throughout the whole undertaking. He desired to take this opportunity of thanking him for the great assistance he had given.

C. S. G. ROGERS, A.M.E.I.C.[4]

Mr. Rogers felt that while the author had described the problems met with in the fabrication of this great bridge, he had let us read between the lines the difficulties encountered in its erection. Therein, it seemed to him, lay the value of this paper to all engineers—particularly to the younger generation. Back of all this ease of procedure there had been thoughtful preparation of every step in the whole sequence of seeming simplicity. We admired the man who was sure in his computations of the stresses produced in the members of a complicated bridge structure by equally complicated possible groupings of applied loads. It was possible for such a man to design a finished structure which for its ultimate purpose would be a masterpiece of its kind. On the other hand it was quite possible, perhaps probable, that the structure so designed could never be built (that is from an economic standpoint). And from this extreme of purely theoretical designer, bridge-builders travelled down—or rather up—the long intermediate series to those who possessed the full requirements of theoretical gifts, of knowledge of economic shop processes, of shipping and handling and erection possibilities combined with that careful methodical mind that planned each move and long beforehand was sure that there was a way.

This grouping of engineering gifts was evident as the author's story unfolds.

In studying this paper few would attempt to think of simpler process of erection than those described. Doubtless the engineers responsible for the methods selected could now improve some details. But the outstanding fact of value to all was that careful preparation, detail study of all governing factors, and a complete scheme and programme covering the sequence of all operations had led to the completion of this great structure well over a year before the contract date.

RALPH MODJESKI, M.E.I.C.[5]

Mr. Modjeski wished to congratulate the engineers upon the successful completion of this fine project, and noted that the bridge was most carefully designed, and the whole had been carried out in a very effective and economical manner. There was only one feature which seemed to him subject to slight criticism, namely, that the stone facing of the main piers and abutments had not been carried to the top. He was quite sure that the increased cost would not have been great, and would have paid for itself in the greater durability of the stone masonry over that of concrete.

M. B. ATKINSON, M.E.I.C.[6]

Mr. Atkinson observed that the author was indeed to be complimented on his description of the fabrication and erection of that very fine piece of work, the Montreal-South Shore Bridge, a masterly accomplishment for which the

(3) General Manager, Montreal Harbour Commissioners.

(4) Bridge Engineer, Canadian National Railways, Moncton, N.B.

(5) Consulting Engineer, New York City.

(6) Structural Engineer, Welland Ship Canal, Dept. of Railways and Canals.

engineers and the contractors deserved hearty congratulations of the engineering profession.

The paper did not deal in detail with the general design of the superstructure, and it could be assumed from the general nature of the work described that unsymmetrical members had been compensated to reduce eccentricity as much as possible and all eccentric moments, whether permanent or only occurring during erection, had been fully taken care of. The general design was pleasing to the eye and the treatment of tapering the top chords of the main span was interesting.

He would ask if the timber ties had been specially treated for fire protection and whether the use of non-inflammable material had been considered.

The roadway, although not described, would appear to be of concrete with some kind of paving as a wearing surface and Mr. Atkinson inquired if the use of light weight concrete had been investigated. On the lift spans of the vertical lift bridges over the Welland Ship canal, Haydite concrete had been used for both the sidewalk and roadway reinforced slabs, the roadway having a wearing surface of asphaltic pavement one inch thick. This Haydite concrete, if made out of the aggregate manufactured in Canada, gave concrete weighing under 100 lbs. per cubic foot instead of 150 lbs. per cubic foot for ordinary reinforced concrete. Tests of this concrete had been made at different ages and the following data might be of interest,—

Weight per cu. ft.	*Haydite Concrete Tests made from American Haydite* Unit Compressive Strength in pounds per square inch at various ages			
	28 days	*9 months*	*one year*	*18 months*
105.5	1831	3180	3428	3756
107.9	2570	2724	3186	3101
108.2	2798	3863	4349	4235
111.3	4000	3916	4655	4752
108.9	3598	4325	5320	..

Tests from Canadian-Made Haydite

Weight	*28 days*	*3 months*
94.2	2002	3451

It was interesting to note the experiences met with in the shop in fabricating the silicon steel, and the author had properly laid stress on the necessity of rigid inspection for this material, especially at the mills. Had any excessive brittleness made itself apparent in pieces as they were handled in the shop or field?

He had not noticed any reference to the use of tapered rivets for long grips and therefore presumed that cylindrical rivets were used throughout; had any special care been taken in the heating of the rivets or the quenching of the rivet tips to ensure complete filling of the holes when the rivets were driven? He would also like to know the lengths of some of the longest grips.

The author had stated that the laterals of the main span had holes for 1-inch diameter rivets and that ⅞-inch bolts were used until the holes faired up under load. In this regard Mr. Atkinson would ask whether the bottom laterals had been manufactured to the geometrical dimensions which corresponded to the shapes of the trusses under full, dead and half live loads, so that, under dead load only, the laterals would have an initial draw corresponding to the deformation of the bottom chords under half live load.

The description of the general shop work would show that the same care had been taken with the material for this bridge that was formerly taken in the case of the Quebec Bridge. Had any trouble been experienced when planing the large castings for the main shoes; in other words, did the castings tend to spring as they were being planed, due to internal stress. He would also ask what special precautions were taken for the removal of mill scale before painting, as he understood that at one time the Dominion Bridge Company advocated no shop painting and preferred painting in the field only, after sufficient time had elapsed for rusting the mill scale.

Mr. Atkinson had noted that the pins were painted with oil before shipment and were paraffined before erection, and he would enquire if any attempt had been made in the shop to paint the pins while warm with hot paraffin as he believed that if the paraffin were put on a cold pin it would be easily cracked off, whereas when put on a warm pin, the paraffin would stick to the steel very tenaciously.

Were any special cars necessary for shipment of the members, or were ordinary flat cars used?

From the paper it was evident that the whole question of erection had been thoroughly and painstakingly investigated, and that no necessary expense had been spared to ensure the safety of the structure during every stage of its erection. He noted that various members had lugs attached in the shop for the support of working platforms and would ask if the use was considered of such a flying bridge as was used for the erection of the bottom chords of the cantilever arms of the Quebec bridge.

Regarding the author's statement that the bottoms of the cylinders for the two circular falsework piers were sealed with sand bags by a diver, Mr. Atkinson supposed that these sand bags were placed around the outside of the cylinders, but, if not, and if these bags had been placed inside, he would ask why bags of cement had not been used.

Several of the large travellers used in the work evidently had had to be taken down and re-erected several times for use at various parts of the structure; it would be of interest to know whether special bolts were used and also if they were fitted bolts and what provision was made to prevent the nuts from loosening. Were any special mechanisms used for anchoring the travellers against longitudinal motion and overturning, or was this left to the field forces to take care of and what instructions were issued therefor.

He had noticed that in dismantling the temporary span under the south anchor arm, the members were fleeted back to the anchor pier on suspended tackles so that they could be handled by the traveller situated on the deck approach span. This was presumably necessary on account of the truss members of the anchor arm interfering with the hoisting operations.

He found the information regarding the wedge mechanisms and their use to be of great interest, and would ask what was the maximum pressure contemplated on the lubrite plates, both on the whole area of the plate and on the restricted area of the graphite. He hoped that the author would give a sketch of the pin ends of the structural members at *CU0* and *SL0* with the wedge shoes in place against the pins, as this information was not directly given, or in the case at *CU0*, clearly shown.

The paper brought out the point that close agreement had been found throughout the field operations between the calculated and axial deflections in the various parts of the structure. This had also been obtained in the case of the Quebec Bridge, and demonstrated that in the case of cantilever bridges, if proper care were taken to compute the loading and the effect of details on deformations, the deflections under various conditions of loading could be predicted with reasonable accuracy.

L. R. Wilson, M.E.I.C.[7]

The Author expressed appreciation of the kindly references contained in the discussion on the paper. A number of questions had been raised by Mr. Atkinson which were of such general interest as to warrant a detailed reply.

The permanent roadway construction was, of course, determined by the engineers in collaboration with the Advisory Board after careful investigation of the data available at the time. The railway ties used during construction were not part of the permanent structure, being

[7] Vice-Pres. in charge of operations, Dom. Bridge Co. Ltd.

supplied by the contractor for his own use. In the interest of economy the ties were left untreated.

Regarding the silicon steel, it would be incorrect to suggest that excessive brittleness was found. The characteristics of this material were, of course, sufficiently different from those of medium structural steel as to make silicon steel appear somewhat brittle by comparison. Such characteristics affected shop operations such as straightening, shearing, punching, drilling and planing. Providing proper care was used during these stages, no apparent adverse results were found either in the latter stages of fabrication or in the field.

The maximum grip of shop rivets was 10¾ inches, with a considerable number of about 9¾ inches, tapered rivets being used in these cases. The maximum grip in the field was 6¾ inches, cylindrical rivets being used, but heated with special care. Satisfactory results were obtained with the rivetting although subjected to most rigid inspection.

The answer to Mr. Atkinson's question concerning the length of bottom laterals, was in the affirmative.

The large castings for the main shoes were planed with a roughing cut on both sides first before finishing; this method obviated deformation due to internal stresses. The specification called for one shop coat of paint on all surfaces after assembling; painting of surfaces in contact was not required. The length of time by which fabrication preceded erection made the application of a shop coat advisable. The steel was cleaned thoroughly for painting in the usual manner by brushing, scraping, etc.

The heating of pins in the shop prior to the application of hot paraffin was difficult in practice and somewhat objectionable, particularly as grit, etc., frequently became embedded in the paraffin before the actual driving of the pins. This was true regardless of the care with which the pins were wrapped or packed. It was particularly true at this site where the air was charged with dust, cinders, etc. from the shipping and railway traffic in the vicinity of the bridge. After experience with different methods the most satisfactory results were obtained from that described in the paper.

The use of special cars for shipment of steel to the site was not necessary. The use of a flying bridge similar to

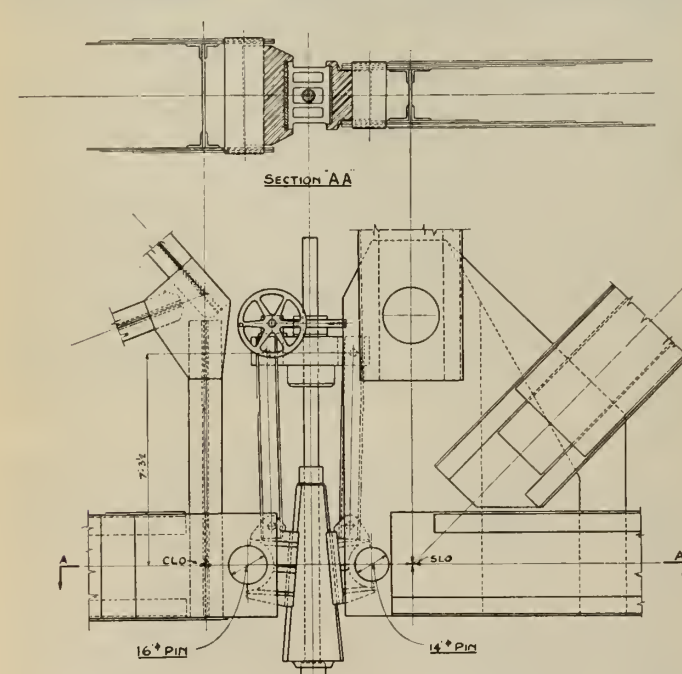

Figure No. 103.—Main Span, Centre Section, Assembly of Wedge Mechanism in Bottom Chord at *CLO*.

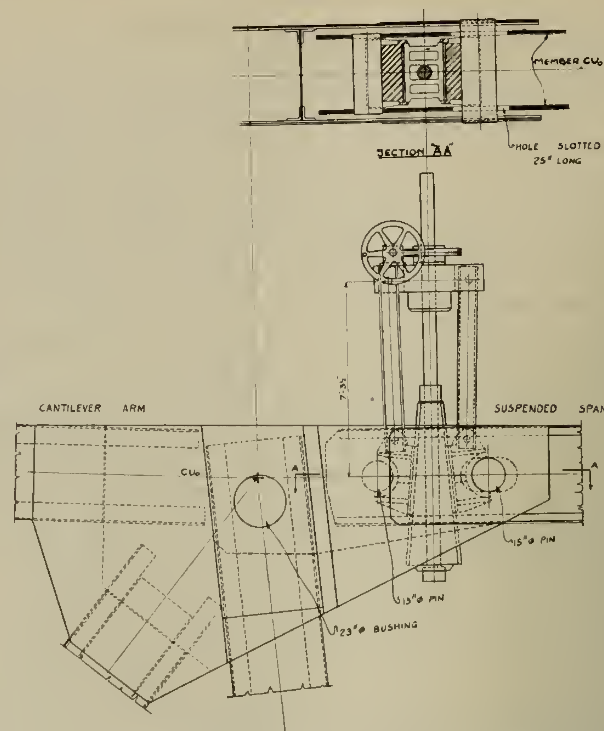

Figure No. 104.—Main Span, Centre Section, Assembly of Wedge Mechanism in Top Chord at *CUO*.

that of Quebec was given careful consideration, but discarded in favour of the use of adjustable tackles for the support of the bottom chord sections as illustrated in figure No. 39 of the paper. The results obtained from the latter were most satisfactory and the equipment was much simpler in every respect.

The cylinders for the falsework piers under the south anchor arm were sealed on the outside with sand bags, thus permitting the internal area to be covered with concrete.

In assembling the travellers, ordinary machine bolts $\frac{1}{16}$ inch smaller than the holes were used. At a few points where heavy stresses occurred, rivets were driven and cut out before dismantling the traveller. The nuts were well tightened at the time of assembly, no further precaution being found necessary. All travellers were provided with special rigging for anchorage against longitudinal movement; the same policy was followed as regards overturning wherever necessary. The instructions issued to the field force were complete as regards the precautions to be taken at all stages, and the field engineers were charged with verifying that the instructions were followed.

The method of dismantling the temporary span under the south anchor arm was dictated by the considerations mentioned by Mr. Atkinson.

To illustrate more clearly the assembly in the structure of the wedge mechanisms used for the suspended span, two additional diagrams had been prepared. Figure No. 103 illustrated the assembly of the bottom wedge at *SU0*, and figure No. 104 that of the top wedge at *CU0*. The maximum average pressure on the lubrite bearing plates was about 2,000 lbs. per square inch on the whole area. The area of the graphite was about 27 per cent of the total area, which corresponded to a pressure of about 7,400 lbs. per square inch on the graphite area if the entire load were taken on the latter.

A feature not illustrated in the diagrams was the method of resisting the twisting action on the mechanism during the operation of the worm drive. In the case of the bottom wedges the cross-head of the mechanism was shimmed snugly between the gusset plates at *SL0* on one side and against a bracket on the opposite side at *CL0*. For the top wedges, a structural frame was securely bolted to the upper side of the top chord and the cross-head shimmed in such a manner as to prevent twisting of the mechanism. The frame also served to carry the working platform.

Discussion of Paper on Water Power Resources of Canada by Norman Marr, M.E.I.C.[1]

G. Gordon Gale, m.e.i.c.[2]

Mr. Gale pointed out that from an analysis of the figures which the author had presented, it would appear that the pulp and paper industry used about one-fourth of the total power development of Canada today, that is, 560,000 horse power installed in their own plants, and about 800,000 horse power purchased from central stations. Including the 400,000 horse power now used for the production of steam, the total used in the pulp and paper industry would represent about one-third of the total power developed. A large proportion of this expansion had taken place quite recently. Notwithstanding this, he believed that the curve which had been projected was quite conservative. There were great possibilities for metallurgical, mining and chemical development, the use of electricity in the home and on the farm was still far from the saturation point, and the estimate of ten million horse power installed in 1940 did not seem excessive.

Within the last six years, 1924-1930,—he selected these years because this period extended from the first to the second World Power Conference,—Canada had increased its installed capacity in a greater proportion than any other country in the world. He was sure that these facts were in the mind of the Hon. Charles Stewart when he addressed the letter to the President which had been read at the morning meeting on Wednesday, and he would suggest that we should do our utmost to assist the World Power Conference Committee in making Canada's participation as representative as possible.

Dr. R. W. Boyle, m.e.i.c.[3]

Dr. Boyle remarked that some years ago, on studying a report of a survey of the requirements of the United States in mechanical power, he had found that the figures for 1920 indicated that every man, woman and child in the United States was using about five horse power to satisfy their mechanical requirements.

Assuming that a man power is one tenth of a horse power, this would mean that every man, woman and child had then available power which was the equivalent of the effort of fifty slaves. Commenting on this survey, a writer had pointed out that the old Greek civilization was based on human slavery, and at one time there were in Athens about one hundred thousand freeman to four hundred thousand slaves, a proportion of four to one. In our days, we had in the shape of mechanical power about fifty slaves to each person, and our mechanical civilization had not yet reached its peak. It was striking to note from the author's curves that if his predictions held good we should have developed in Canada in 1940 about ten million water horse power, at which time the population of Canada would be well over ten millions. Even under these conditions we should have less than one horse power per person. Dr. Boyle therefore agreed with Mr. Gale in believing that all our possible developments would be needed, since even if in time we were to reach an installed capacity of forty-three million horse power, the maximum estimated in the paper, we should not have more than one or two horse power per person. It would therefore appear that all the available water power in Canada would be needed, together with additional energy from other sources, including coal.

Prof. A. F. Baird, m.e.i.c.[4]

Professor Baird inquired whether the author had made any economic studies of the relative cost of small water power plants, as compared with the modern coal installation in similar units? In regard to some of the smaller plants which had been installed in New Brunswick, he had noted during the last year, that the modern powdered coal plant was producing electric energy at a considerably lower rate than the hydro-electric plant, and he would ask if that was a condition peculiar to New Brunswick. The capital cost and fixed charges of the hydro plant were usually high, and perhaps the author could give some data as to other plants throughout the Dominion.

Norman Marr, m.e.i.c.[5]

The author replied that he had no figures in mind, which would bear on that particular question, because each locality was a problem in itself. He might point to the experience of the Calgary Power Company in Alberta, in the centre of the coal fields, where coal could be obtained at a comparatively low rate, but where they still looked to water power, as far as possible, to supply their needs. In fact, in the month of November, regardless of the fact that the Calgary Power Company had taken over a number of steam stations, ninety-five per cent of the energy produced was from hydro stations and many of the steam stations had been closed down.

Prof. A. F. Baird, m.e.i.c.

Professor Baird asked whether the steam plants were modern.

Norman Marr, m.e.i.c.

The author replied that the Lethbridge station was comparatively modern; the Calgary station was modern, and the installation at Edmonton would not be complete until mid-summer, but the problem was essentially a local one. The hydro plant in New Brunswick had been built at a comparatively high rate per horse power, and this was really the essence of the whole matter.

Dr. Julian C. Smith, m.e.i.c.[6]

Dr. Julian C. Smith remarked that in furnishing an up-to-date, comprehensive, and accurate analysis of hydro-electric progress in Canada, and in indicating as he had done so clearly the vital importance of this progress to the basic industries of the Dominion, the author had made a valuable contribution to the records of The Institute. Few engineers realized the vast amount of patient and careful inquiry with subsequent monotonous computational work that was involved in the preparation of such a paper. For all this, but more particularly for the rational presentation of his conclusions, he would offer his personal congratulations.

It was to be hoped that the authorities responsible for financing the excellent statistical work of the Dominion Government, and particularly such specialized diagnosis as that under consideration, understood how very general was

(1) This was paper presented at the Annual General Meeting of The Institute, Ottawa, Ont., February 14th, 1930, and published in the February 1930 Journal.

(2) Vice-President, Canadian Hydro-Electric Corp., Ottawa.

(3) Director, Division of Physics and Engineering Physics, National Research Council, Ottawa.

(4) Professor of Physics and Electrical Engineering, University of New Brunswick.

(5) Chief Hydraulic Engineer, Dom. Water Power and Reclamation Service.

(6) Vice-Pres. and Gen. Mgr., Shawinigan Water & Power Co.

the use made of such data, and how genuinely it was appreciated by the interested business community.

The remarkable and unprecedented extent to which the water powers of the Dominion had been brought into use during the last two decades represented an engineering achievement which was perhaps unparalleled elsewhere. This achievement would be the arresting fact when some future historian reviewed the period in which we were living.

Realizing, from such presentation as the author's, that but a small percentage of our available power resources had yet been harnessed and that we had great reserves of "white coal" still intact, it was impossible to be anything but optimistic as to the continued progress and expansion of Canada.

R. G. Swan, A.M.E.I.C.[7]

Mr. Swan desired to compliment the author upon the striking way in which he had portrayed the development of the hydro-electric industry and its importance in relation to the rapid industrial expansion in Canada.

The subject had been covered so thoroughly and with such a fund of interesting information of a statistical nature that a general discussion of the paper would be somewhat difficult to undertake. He wished, however, to make reference to the terms used by the author in estimating the available water power in Canada.

The basis of flow adopted by the Dominion Water Power and Reclamation Service and used by the author for the purpose of power calculations was expressed in the following terms, with their definitions:

(a) Ordinary minimum flow—i.e., the average, over all the years for which records are available, of the mean flow for the two lowest seven-day periods in each year.

(b) Ordinary six months flow—i.e., the average, over all the years for which records are available, of the mean flow for the lowest seven consecutive days in the lowest of the six high months in each year.

To understand what these flows actually represent in practice it would be necessary to prepare a frequency or duration-of-flow curve for any particular stream or river in order to determine the percentage of total time for which such flows were available. For instance, at first sight one would naturally suppose the "ordinary six months flow" to be a flow that could be depended upon six months of the year for fifty per cent of the total time, whereas the frequency or duration-of-flow curve might show this flow to be available for sixty to even seventy per cent of the total time.

The United States Geological Survey, and nearly all authors on hydraulics, had adopted "percentage of total time" as a term for expressing the availability of run-off and power, and Mr. Swan would suggest that for the sake of uniformity, and in order that such information should be of the greatest practical value not only to engineers but to the layman, interested in the development of power, the term "percentage of total time" should be adopted by federal and provincial departments having to do with the investigation and publication of water and power resources data.

Professor G. J. Dodd, A.M.E.I.C.[8]

Professor Dodd felt that in his paper the author had given a clear and concise review of the statistics of the subject. Behind his figures lay years of work on the part of hundreds of engineers who had surveyed the power to be derived from the important rivers. The country owed a great debt of gratitude to them.

In figure No. 1, the author had shown in graphical form the remarkable growth of the development of water power. According to the Canada Year Book, Canada had 5,371,315 people in 1901, 7,206,643 in 1911 and 8,788,483 in 1921. The estimated population to June 1st, 1929, as given by the author, was 9,796,800. These figures could easily be plotted on the graph, to show how the population had increased alongside the growth in the development of water power, and if the line were projected to 1940, it would appear probable that there will be about 10,900,000 people in Canada in 1940. This would correspond to a development of 10,300,000 h.p., or a total installation of 945 h.p. per 1,000 people.

The graphs also indicated that in the period 1921-1929 the population had increased by a little over a million, whereas the horse power had increased by slightly less than three million. Roughly the growth of the one was three times as fast as the other. One cause for this had been the development of the pulp and paper industry and mining. It was not likely that the former industry would in the near future require very much more power than it was using at present. In mining, however, there undoubtedly would be a great demand for power. This had been foreseen, and already there were developments under construction and others under consideration to meet this demand.

Roughly twenty-five per cent of the total power was now being used by the pulp and paper industries; or 1,437,976 h.p. If we knew exactly how much of this had been developed in the last ten years, we could more safely predict the probable growth of the water power development in the next ten years. Placing this figure at a million h.p., a figure of 9,700,000 h.p. would be arrived at as the probable development in 1940.

Another thing brought out forcibly by the graphs was that the population of Canada did not increase at anything like the same rate as did the development of water power. It would be a wise prophet indeed who could predict the growth of population in any one district due to the installation of a power house there, after looking at these curves.

This valuable paper should draw the attention of people both in Canada and outside to the wonderful possibilities lying in the development of her water powers.

Professor G. H. Herriot, M.E.I.C.[9]

Professor Herriot had read the paper with a great deal of interest, and felt that it contained a wealth of information that could be obtained from no other source. A most striking feature was the astonishing growth of the hydro-electric industry in the brief period of a generation and a half. It was necessary to picture the increase, from an installed capacity of 193,323 horse power prior to 1900, to 5,710,802 installed horse power in 1929, to realize this. The first long distance transmission line was only placed in service in 1898. In these figures the story was but sketched in outline.

The establishment of the Dominion Water Power and Reclamation Service by the Department of the Interior of the Federal Government more than twenty years ago had been a most progressive step. The extension of the field covered and the scope of the work of this branch had always kept considerably in advance of the growth of the hydro-electric and reclamation requirements. The information the branch had furnished from time to time in its reports had been of inestimable value to engineers associated with such engineering problems. The paper under discussion was only one of the many valuable additions that our engineering libraries have received from this branch.

To be more specific, he believed that the value of the paper would have been increased, if the author had given not only the installed capacity but also the average operating capacity of the various plants throughout the

(7) Engineer, Water Resources Dept., Shawinigan Water & Power Co.

(8) Asst. Prof. in Civil Engineering and Mathematics, McGill University.

(9) Asst. Prof., Dept. of Civil Engineering, University of Manitoba.

year. In this connection he might cite the Montreal Island Power development, where the installed capacity will be 120,000 horse power, but the year round power development will be only about 65,000 horse power.

He had often felt that the officials of the Water Powers Branch were in a very favourable position to gather data relative to steam-plant electrical production, and it would seem that statistics that would set forth the costs per k.w. hour as produced by the large steam plants in the United States would form a valuable addition to any engineer's library.

In looking over table No. 4, it struck him that while the preponderance of hydro power was developed by commercial stations a large percentage was developed and distributed by municipal stations. The percentage produced by municipal stations in Ontario was extremely high while that in Manitoba was a large figure indeed. Engineers realized that such municipal stations pay no federal income taxes while their municipal payments had probably been tempered by mercy. The consumer in Winnipeg who received service from the Winnipeg Electric Railway Co. while paying the same rate per k.w. hour for his current as if he purchased it from the publicly owned utility, the city "Hydro," was none the less contributing a small fraction of each monthly payment due to the Dominion Government by way of federal income tax. It might be said that since he is paying the same rate, he is not harmed, but the privately owned utility pays the piper. The consumer was none the less paying the shot indirectly and thus contributing more towards the federal income tax from this cause than his neighbour using the publicly owned current. He would ask whether this was fair, or equitable. When we applied this example to the province of Ontario with its extensive production of publicly owned electricity, and considered it alongside of Quebec and British Columbia with their hundreds of thousands of horse power of privately owned utilities, the burden would run up into millions of dollars.

He would urge that the membership of The Institute get behind a movement to have the federal income tax removed from the privately owned companies distributing electricity to domestic consumers.

He might call attention to two outstanding fields for extension, one in the field of consumption of power and the other in the field of increased production current.

In regard to the former of these, it was safe to say that the supply of electricity to the individual farmers throughout the country had not as yet been touched. This great potential demand was still unmet. It might of course be said that the supply to individual farmers scattered throughout the country is uneconomic; but let us not forget that we are living in a progressive age and what is an economic impossibility to-day will be with us to-morrow, and prove quite profitable.

And what of the farmer, who was now awakening to the importance of mechanization. Last year in Canada he purchased more farm tractors and harvesting combines than in any previous year in our history. The need of real flexible power in the farm yard, home and stables of the farmer was far beyond the domestic requirements of the town or city home. The farmer could turn his current to many uses. The lighting of the hen houses might well convince the hen that she had moved to the land of sunshine. The general illumination requirements were common to all the farm buildings. The use of current for power purposes would be applicable to such duties as pumping water, operating the mechanical milker, the turnip and feed cutters, the fanning mill, the churn, the washing machine, etc., in fact, the uses to which such flexible power might be put on the farm seemed almost unlimited.

In regard to the field of increased production of current he need only point to the fine work of the Quebec Streams Commission, who by means of storage dams had been able to regulate the flow of water to give practically a constant supply throughout the year, thus materially increasing the available all year power. Work of this nature might well change the complexion of a hydro development from an economic blunder into a justifiable development.

Looking at the maps of the transmission lines in the several provinces of the Dominion it seemed evident that the field for the extension of hydro-electric power is still practically unlimited. Portions of our provinces had as yet scarcely been touched by the life giving current. Picturing all that this implies, could we fail to have confidence in the future of this great industry.

N. Marr, M.E.I.C.

The author in reply observed that Mr. Swan in his comments had drawn attention to the basis of flow adopted by the Dominion Water Power and Reclamation Service and used in the paper for the purpose of power calculations, viz,—"ordinary minimum flow" and "ordinary six-months flow." Mr. Swan had pointed out certain advantages in the "percentage of total time" basis which had been adopted for the purpose of power estimates by the United States Geological Survey and others, suggesting that this method should be followed by federal and provincial agencies having to do with the investigation and publication of water and power resources data.

In detailed studies of the power resources of any river where adequate records of flow are available the value of the "flow duration curve" and the "percentage of total time method" was fully recognized, but for a country of the extent of Canada with a multitude of streams in territory remote from ready means of communication on which stream flow records are either fragmentary or entirely lacking, a method of this precision was found difficult of application. Accordingly the Dominion Water Power and Reclamation Service and the various provincial organizations with which it co-operates in making an inventory of the country's water-power resources, had adopted the more general method on the basis of "ordinary minimum flow" and "ordinary six-months flow". The advantages of this method were briefly as follows:—

The flow factors could be quickly determined from a series of flow records and might, furthermore, be readily revised as new records became available.

The two conditions of flow indicated approximately the low and high limits of the capacity of any power site and an estimate on this basis gave a very fair indication of the limits of a country's resources.

The definitions themselves, "ordinary minimum flow" and "ordinary six-months flow" were self-explanatory and did not create an impression of too-great accuracy such as would be given by a definite percentage-of-time definition, which precision would be in no way warranted in a large proportion of the power sites estimated, because of a lack of fundamental stream flow data.

In brief the two bases of "ordinary minimum flow" and "ordinary six-months flow" provided a common measure for comparing the power values of sites on rivers upon which very complete run-off data were available, with sites on rivers upon which the run-off data available were incomplete, fragmentary, or entirely lacking.

Keeping in mind that the primary purpose of these estimates is to indicate the approximate limits of a country's, a district's, or a river's resources, the method adopted was considered more applicable to existing conditions in Canada than one which would indicate a greater degree of precision. Such estimates were simply indicative of power possibilities, as, when the actual development of a site is contemplated or determined upon, an exhaustive analysis of all the run-off records available, in conjunction with the reservoir and regulation possibilities, was always essential as an initial investigatory study, quite irrespective of the manner in which the power estimates might have been tabulated for statistical purposes.

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The Registration of Professional Engineers in Canada

The relations of The Engineering Institute of Canada with the various Provincial Associations of Professional Engineers are the subject of real interest to our members, as was clearly shown by the active discussion on this question which took place at the recent Annual Meeting in Ottawa.

The fact that The Institute was instrumental in originating the associations gives them a claim on the good offices of The Institute, and the endorsement given at our Annual Meeting to the recommendations of the report of The Institute's committee, which has for three years being studying the possibilities of co-ordination, indicates that the activities of the associations will continue to receive the encouragement and support of the members of The Institute.

Among the provinces where the most effective recognition has been secured for the principle of the registration of professional engineers, British Columbia and Quebec are prominent. In certain others, legislation, while more or less effective, has not put into the hands of the associations such extensive powers as in the provinces named.

The degree of success which the associations have attained in the different provinces is naturally dependent on the extent of the powers given them by their respective provincial legislatures.

The Association of Professional Engineers of the Province of British Columbia, with a definite policy and well organized secretariat, has made marked progress in obtaining general recognition of the legal functions of the association. Its council early realized that systematic training is necessary for all who would become members of the profession, and has prescribed a definite programme of training and examinations which covers the cases both of applicants who have taken a university course and those who are gaining their professional experience in offices or in engineering works.

Somewhat similar and equally effective action as regards registration and education has been taken by the Corporation of Professional Engineers of the Province of Quebec, and, indeed, the policy outlined above is carried out by all the associations to the extent permitted by their respective legal authorities.

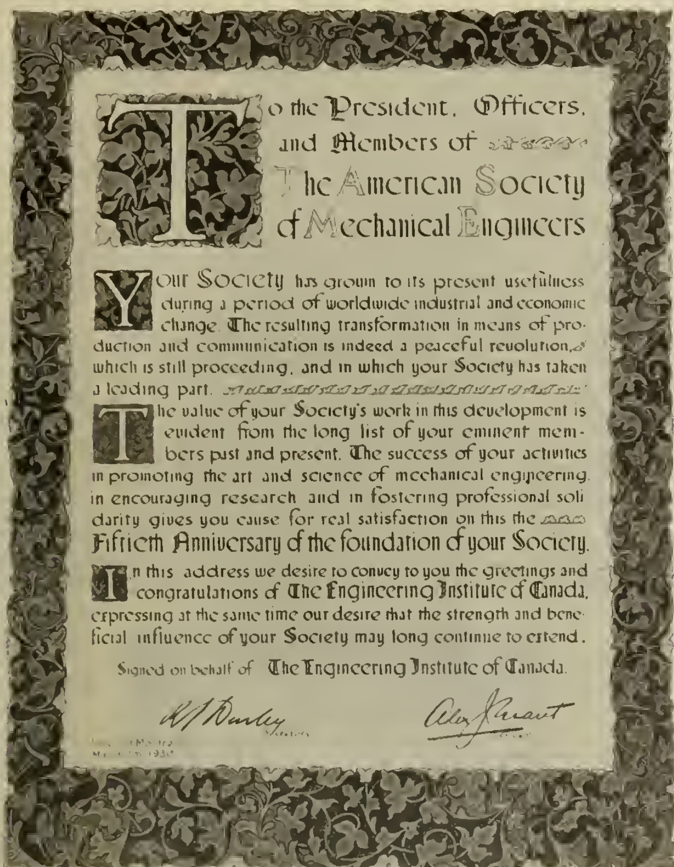
It is gratifying to note that Saskatchewan, the only province, with the exception of Prince Edward Island, which has not hitherto had a registration act upon its books, has now made good this omission. The "Engineering Profession Act 1930 (Saskatchewan)" has just received assent, and goes into force on the 1st day of May. It establishes the Association of Professional Engineers of Saskatchewan, and gives that association power to regulate the profession in the province. The act follows generally the lines of the more effective provincial enactments and definitely establishes the principle of the registration of professional engineers in Saskatchewan.

In Alberta also, it is understood that the powers given to the Alberta Association by its original act and amendments have been consolidated and revised by a new "Engineering Profession Act 1930 (Alberta)" which provides more effective legislation in that province. All who are interested in the development of professional legislation for engineers will welcome these signs that within the last few months a real advance has been made in Canada in the general recognition of the principle of registration.

The Fiftieth Anniversary of the American Society of Mechanical Engineers

The Institute has had many opportunities of welcoming to Canada sister societies from the United States. In 1923 the American Society of Civil Engineers held its semi-annual meeting in Montreal; in 1925 the fall meeting of the American Society of Civil Engineers took place in the same city, and this year the summer meeting of the American Institute of Electrical Engineers will be held in Toronto. Such events enable The Institute to express its appreciation of the cordial relations which have always existed between engineers of all branches of the profession in Canada and their brethren in the United States, but a special occasion was afforded this year by the invitation of the American Society of Mechanical Engineers to send delegates to its Fiftieth Anniversary ceremonies in New York, Hoboken and Washington. These have just taken place, and President A. J. Grant and Past-President C. H. Mitchell were The Institute's official representatives, while others of our members attended as delegates from other scientific bodies. The Council of The Institute prepared and presented an address of congratulation, a photograph of which is shown here, and it was a source of real gratification to assist in celebrating the fiftieth year of such an important body as the American Society of Mechanical Engineers.

The commemoration brought together eminent engineers from all parts of the world. Those from Japan



To the President, Officers, and Members of The American Society of Mechanical Engineers

Your Society has grown to its present usefulness during a period of worldwide industrial and economic change. The resulting transformation in means of production and communication is indeed a peaceful revolution, which is still proceeding, and in which your Society has taken a leading part.

The value of your Society's work in this development is evident from the long list of your eminent members past and present. The success of your activities in promoting the art and science of mechanical engineering, in encouraging research and in fostering professional solidarity gives you cause for real satisfaction on this the Fiftieth Anniversary of the foundation of your Society.

In this address we desire to convey to you the greetings and congratulations of The Engineering Institute of Canada, expressing at the same time our desire that the strength and beneficial influence of your Society may long continue to extend.

Signed on behalf of The Engineering Institute of Canada.

and South America rubbed shoulders with their confrères from Britain and Canada. A salient feature was the realization by those participating, that the engineers of all countries and of all branches of the profession have the same high ideals and are animated by the same desire to work for the common good.

The impressive services in the Cathedral of St. John the Divine; the dramatic pageant at the Stevens Institute, reviewing the work of the engineer; the array of celebrities in Washington at the welcoming assembly, the official dinner, and the convocation for the conferring of honours, all these left a profound impression upon our representatives, who came away convinced of the great effect of such gatherings in furthering international amity and concord.

The American Society of Mechanical Engineers are to be congratulated upon a celebration which was worthy of such an occasion.

Past-Presidents' Prize 1929-1930

Members of The Institute of all classes are reminded that papers for the second competition for the Past-Presidents' Prize must be received by the General Secretary prior to June 30th, 1930, and that the subject prescribed by Council is "The Engineering of Aviation." An announcement, giving the rules under which the prize is awarded, and directions to be followed in the preparation of papers, was published on page 286 of The Engineering Journal for March, 1930. The value of the prize is one hundred dollars, and the competition affords to our members an opportunity of contributing a noteworthy paper to the records of The Institute, and of winning one of the highest distinctions in the gift of The Institute.

Meeting of Council

A meeting of Council was held at eight o'clock p.m. on Friday, April 11th, 1930, with President A. J. Grant, M.E.I.C., in the chair, and nine other members of Council present.

The minutes of the meeting held on March 7th, 1930, were taken as read and approved.

At the invitation of Council, Past-President H. H. Vaughan, M.E.I.C., was present, and after a discussion on the work of the Committee on the Relations of The Institute with the Provincial Associations of Professional Engineers, during which Mr. Vaughan expressed his views on the subject, it was unanimously resolved to request Mr. Vaughan to accept the appointment as chairman of the committee in succession to S. G. Porter, M.E.I.C. In accepting this appointment Mr. Vaughan felt that the solution of the various problems concerning the committee would gradually develop, and hoped that he would have the unanimous support of Council in the policy adopted.

It was noted that the Association of Professional Engineers of New Brunswick had appointed a committee to consider the question of closer co-operation between the various provincial associations and The Engineering Institute.

A question having been raised as to the interpretation of the rules for the award of the Gzowski Medal, the matter was discussed, and it was decided to appoint a small committee under the chairmanship of Vice-President T. R. Loudon, M.E.I.C., to consider these rules and to report to Council as to any notes which might usefully be added to them as an aid in their interpretation.

The membership of the Papers Committee, as submitted by the various branches of The Institute to date, was noted as follows:

T. R. Loudon, M.E.I.C.	Chairman
M. Dwyer, A.M.E.I.C.	Cape Breton Branch
L. H. Robinson, M.E.I.C.	Moncton Branch
H. R. Wake, A.M.E.I.C.	Saguenay Branch
E. Wilson, M.E.I.C.	St. Maurice Valley Branch
P. E. Jarman, A.M.E.I.C.	Montreal Branch
J. J. Traill, M.E.I.C.	Toronto Branch
H. A. Lumsden, M.E.I.C.	Hamilton Branch
C. G. Moon, A.M.E.I.C.	Niagara Peninsula Branch
H. J. Coulter, Jr.E.I.C.	Border Cities Branch
W. S. Wilson, A.M.E.I.C.	Sault Ste. Marie Branch
J. W. D. Farrell, A.M.E.I.C.	Saskatchewan Branch
H. F. Bourne, A.M.E.I.C.	Victoria Branch
P. H. Buchan, A.M.E.I.C.	Vancouver Branch

The examiners for the Students' and Juniors' Prizes, as submitted by the chairman in the various zones, were approved as follows:

Zone A	Vice-President C. J. Mackenzie, M.E.I.C.,	Chairman
	Councillor C. H. Attwood, A.M.E.I.C.,	Winnipeg
	Councillor E. Stansfield, M.E.I.C.,	Edmonton
Zone B	Vice-President T. R. Loudon, M.E.I.C.,	Chairman
	Councillor R. L. Dobbin, M.E.I.C.,	Peterborough
	Councillor W. L. Malcolm, M.E.I.C.,	Kingston
Zone C (English)	Vice-President W. G. Mitchell, M.E.I.C.,	Chairman
	Councillor H. Cimon, A.M.E.I.C.,	Quebec
	Councillor J. A. McCrory, M.E.I.C.,	Montreal
Zone C (French)	Vice-President Geo. R. MacLeod, M.E.I.C.,	Chairman
	Councillor B. Grandmont, A.M.E.I.C.,	Three Rivers
	Councillor O. O. Lefebvre, M.E.I.C.,	Montreal
Zone D	Vice-President F. R. Faulkner, M.E.I.C.,	Chairman
	Councillor H. F. Bennett, A.M.E.I.C.,	Halifax
	Councillor W. J. Johnston, A.M.E.I.C.,	Saint John

The membership of the Committee on Classification and Remuneration of Engineers, as submitted by the chairman, was approved as follows:—

J. L. Busfield, M.E.I.C., Chairman
R. A. C. Henry, M.E.I.C.
P. S. Gregory, M.E.I.C

On the nomination of the Executive Committee of the Lakehead Branch, it was unanimously resolved that

D. G. Calvert, A.M.E.I.C., be appointed councillor for the Lakehead Branch until the next annual election, to replace F. Y. Harcourt, M.E.I.C., who had resigned owing to his removal to London, Ontario.

During discussion on the location to be selected for the Annual Meeting for 1931, a letter was presented from the Executive Committee of the Montreal Branch proposing that that meeting should be held in Montreal. This proposal was accepted with appreciation.

A letter was also submitted from the Executive Committee of the Toronto Branch stating that conditions in 1932 would be favourable and that it was hoped that the Annual meeting of 1932 would be held in Toronto. This was noted, and the Secretary was directed to thank the Toronto Branch for their offer which was accepted subject to later confirmation.

A communication was presented from Major-General A. G. L. McNaughton, M.E.I.C., drawing attention to the desirability of some action by The Institute which would be of benefit to those members who are interested in aviation and radio engineering. The letter welcomed the formation of an Aeronautical Section by the Montreal Branch, and expressed the hope that this example would be followed by other Branches, but General McNaughton felt that some further action than this was very desirable, and that the question should receive the attention of Council. After discussion the matter was referred to a small committee of members interested in these special branches of engineering with a request to make such recommendations to Council as may facilitate progress in the desired direction.

The Secretary submitted a copy of the Bill of the Saskatchewan Legislature incorporating the Association of Professional Engineers of Saskatchewan, and coming into effect on May 1st, 1930. He was directed to write and congratulate the members of The Institute in Saskatchewan who had been instrumental in obtaining this legislation.

The Secretary reported that a letter had been received offering the facilities of the New Zealand Society of Civil Engineers to Institute members passing through or visiting Wellington, New Zealand, and he was directed to express Council's appreciation of this courtesy, and to inform the Society that reciprocal privileges would willingly be granted.

The Secretary presented a list of over-age Students and Juniors who have not replied to three notifications that they are over-age and should apply for transfer to a higher class in The Institute. He was directed to submit these names to the Branches concerned, advising that unless some action is taken within sixty days their names will be removed from the membership list of The Institute.

Nine resignations were accepted, one reinstatement was effected, two life memberships were granted, and a number of special cases were considered.

A number of applications for admission and for transfer were considered, and the following elections and transfers were effected:

Elections	
Member	1
Associate Member	6
Juniors	5
Students admitted	30

Transfers	
Assoc. Member to Member	3
Junior to Assoc. Member	4
Student to Assoc. Member	4
Student to Junior	3
Student to Affiliate	1

The Council rose at one fifty-five a.m.

OBITUARIES

William Pearce, M.E.I.C.

The death of William Pearce, M.E.I.C., which occurred at Calgary, Alta., on March 3rd, is recorded with much regret.

Mr. Pearce was born on February 1st, 1848, in Dunwich township, Elgin county, Ont., and was educated at the county grammar school at St. Thomas, Ont., later attending the University of Toronto.

He specialized in surveying and spent the major portion of his life in western Canada. Between 1874 and 1881 he was engaged on surveying meridians and parallels in Manitoba and the Northwest Territories, and in 1882 he was appointed inspector of Dominion Land Agencies, being appointed superintendent of mines for the federal government in 1884. These duties caused Mr. Pearce to traverse most of the country between the Red river and the Rocky mountains; and between the international boundary and latitude 57. In 1898-1901 he was chiefly engaged in the

William Pearce, M.E.I.C.

adjustment of railway land grants. From 1901 to 1904 Mr. Pearce was inspector of surveys for the Dominion government, and at the end of that period he left the service and entered the employ of the Canadian Pacific Railway Company, in connection with the administration of their lands in the west. Mr. Pearce was always an enthusiast on the possibilities of irrigation development wherever feasible in western Canada, and he promoted the Calgary Irrigation Company. It was in no small measure due to his pronounced views on such matters that the Canadian Pacific Railway Company decided to proceed with such undertakings on a very large scale.

Mr. Pearce was always very much interested in statistics and the compilation of data of all kinds, and along these lines he did most valuable work for the Canadian Pacific Railway. He was a man of broad vision and retentive memory, and visualized the wonderful possibilities of the undeveloped resources of the Canadian west.

His life was an active one, and no one knew western Canada better than he, as he had been closely associated with its development since he first went to Winnipeg in 1874. He was one of the pioneers who helped to map out the west, to develop its resources and to shape its destiny.

The valuable services Mr. Pearce rendered were deeply appreciated and valued by the government and by the Canadian Pacific Railway, and at all times he gave his best efforts to the city of Calgary which had been his home since 1887. To know him was to admire him, and the memories of his active and useful life, his intrinsic worth, and the depth of his human kindness will long be remembered by a host of friends scattered from coast to coast, and far beyond the boundaries of his native land.

Mr. Pearce became a member of The Engineering Institute of Canada on October 14th, 1913, and was subsequently made a Life Member.

John James York, M.E.I.C.

Deep regret is expressed in recording the death of John James York, M.E.I.C., which occurred at Montreal, Que. on April 8th, 1930.

Mr. York was born at Lacadie, near St. Johns, Que., on June 12th, 1861, and commenced his engineering career by serving a six years apprenticeship in heating and ventilation.

In 1881 Mr. York entered the engineering department of the St. Lawrence Sugar Refineries, Montreal, and remained with them until 1894, when he left to take charge of contracts for the Garth Company. In 1895 he became superintendent of the Montreal Board of Trade Building, and in 1900 he returned to the St. Lawrence Sugar Refineries as chief engineer, later being appointed general works manager.

Mr. York was a prominent Mason, and at the time of his death was a 32nd degree Mason, belonging to the Mount Moriah lodge, No. 38 A. F. and A. M.. Montreal. He had many other interests, and was a past-president of both the Verdun Protestant hospital and of the Homeopathic hospital, Montreal, being one of the founders of the latter institution. He was also Boy Scout Commissioner for the east-end of Montreal, as well as a member of the advisory board of the industrial branch of the Y.M.C.A.

Mr. York was a Member of the American Society of Mechanical Engineers. He joined The Engineering Institute of Canada as an Associate Member on April 19th, 1906, and was transferred to the class of Member on June 21st, 1921.

George William Thompson, M.E.I.C.

Deep regret is expressed in recording the death of George William Thompson, M.E.I.C., which occurred at Westmount, Que., on April 1st, 1930.

Mr. Thompson was born at Belleville, Ontario, on August 11th, 1877, and received his education at the Belleville High School and the Ontario Business College.

In 1898-1899 he was engaged on electric wiring etc. with the Montreal Electric Company, and in 1899 returned to Belleville where he carried on a wiring contracting business for three years. In 1902-1904, Mr. Thompson was with the Lachine Hydraulic and Land Company as assistant to construction superintendent on overhead lines and underground conduits and cables. In 1904-1906 he was assistant to the construction superintendent on overhead lines and underground conduits and cables, both construction and maintenance work, with the Montreal Light, Heat and Power Company. In 1906-1908 he was engaged on the construction of electric light and incinerator plants for the city of Westmount for Messrs. Ross and Holgate, and in 1908-1913 Mr. Thompson carried on the

GEORGE WILLIAM THOMPSON, M.E.I.C.

work of superintendent of the Westmount light and power department, during which time he laid out and constructed complete underground conduit and ornamental street lighting systems. In 1913 Mr. Thompson was appointed general manager of the city of Westmount, which position he held up to the time of his death.

Mr. Thompson joined The Institute as a Member in 1921.

PERSONALS

C. H. Pigot, S.E.I.C., has joined the staff of the Beauharnois Construction Company at Beauharnois, Que. Mr. Pigot graduated from McGill University in 1926 with the degree of B.Sc.

H. P. Rust, M.E.I.C., has become connected with Cramp-Morris Industrials, Inc., of Philadelphia. Mr. Rust was formerly with Messrs. Harper and Taylor, engineers, of the same city.

Ernest China, A.M.E.I.C., who since 1922 has been assistant engineer with the Highways Department of Saskatchewan, at Regina, Sask., has been appointed district engineer for the same department at Weyburn, Sask.

J. W. MacDonald, A.M.E.I.C., who since 1928 has been chief engineer with the International Petroleum Company at Talara, Peru, S.A., has now returned to this country and is with Imperial Oil Refineries Ltd., at Sarnia, Ont.

Harold F. Abbott, S.E.I.C., who was formerly in the office of R. G. Gage, M.E.I.C., Canadian National Railways, Montreal, is now with the Beauharnois Construction Company at Beauharnois, Que. Mr. Abbott graduated from McGill University in 1928 with the degree of B.Sc.

Captain E. H. Harrison, M.E.I.C., of the Anglo Persian Oil Company Ltd., Abadan, Persian Gulf, has returned to England on leave, and for the next five months will be located at Oxford. Captain Harrison was engaged on engineering work in Manitoba and British Columbia for some time prior to going overseas in 1915.

R. H. Findlay, A.M.E.I.C., who was formerly with the Dominion Bridge Company Ltd., at Lachine, Que., is now mechanical engineer with the Riverside Iron Works Ltd., Calgary, Alta., which firm was taken over by the Dominion Bridge Company in 1929.

N. R. Crump, S.E.I.C., who since June 1929 has been with the Canadian Pacific Railway Company, is now night roundhouse foreman at Sutherland, Sask. He was former fitter in the Weston shops at Winnipeg, Man. Mr. Crump graduated from Purdue University at Lafayette, Indiana, in June 1929, with the degree of B.Sc. in mechanical engineering.

H. T. Melling, A.M.E.I.C., formerly with the city of Edmonton, Alta., and the city of Regina, Sask., light and power departments, also Canadian representative for Messrs. Willans and Robinson, Ltd., of England, is now located in New York, N.Y. and is connected with the engineering department of the New York Edison Company, on the inspection and construction of their new East River station.

Major E. L. M. Burns, A.M.E.I.C., is now district engineer officer for Military District No. 5, Quebec, Que. Major Burns is a graduate of the Royal Military College, Kingston, of the year 1915, and spent three years on active service during the late war. He has just returned from Quetta, India, where, for the past two years, he has been attending the Staff College.

S. B. Wass, A.M.E.I.C., terminal engineer with the Canadian National Railways, who was transferred from Toronto to Montreal at the beginning of the current year, has been appointed terminal engineer at Montreal, with jurisdiction over the railway's development in Montreal, including the construction of new lines, grade separations and all operations with the exception of the new passenger terminal itself.

H. A. Mackenzie, M.E.I.C., formerly chief engineer of the mechanical engineering department of the Jamma and Kashmir government at Baramulla, India, is now with the Paterson Engineering Company (India) Ltd., at Calcutta, India. Mr. Mackenzie has been in India since 1907, having gone to that country as assistant superintendent of dredging for the Jamma and Kashmir government; he was made superintendent in 1909.

F. V. Seibert, M.E.I.C., is now connected with the Canadian National Railways, being superintendent of the Department of Natural Resources, Manitoba and Saskatchewan, and is located at Winnipeg, Man. Mr. Seibert, who graduated from the University of Toronto in 1912, with the degree of B.A.Sc., was formerly supervisory mining engineer with the Department of the Interior, at Ottawa, Ont.

W. S. E. Morrison, A.M.E.I.C., Lieutenant-Commander (E) R.C.N. (retired) is now service engineer with the Foster-Wheeler Corporation of New York, N.Y. Commander Morrison was for some time located at the R.C.N. Barracks at Esquimalt, B.C. and was promoted to Lieutenant Commander (E) and appointed to the Canadian destroyer Champlain in 1928. In 1929 he was connected with the Combustion Engineering Corporation Ltd., Montreal.

C. E. Fraser, A.M.E.I.C., formerly township engineer of Birchcliff, Toronto, Ont., is now engineer for the McNamara Construction Company, Ltd. at Toronto, Ont. Mr. Fraser graduated from Queen's University 1916 with the degree of B.Sc., and from 1916 to 1919 was overseas with the Canadian Engineers, being demobilized with the rank of Captain. From 1919 to 1922 Mr. Fraser was assistant engineer of the county road department of the united counties of Stormont, Dundas and Glengarry, Ont.

P. E. Cooper, A.M.E.I.C., a member of the staff of the Canadian International Paper Company, has been transferred from Dalhousie, N.B. to Gatineau, Que., where he is resident engineer. Mr. Cooper, who graduated from McGill University in 1923, with the degree of B.Sc., has been with the Canadian International Paper Company for several years. Following graduation he was for three years with the Singer Manufacturing Company.

H. R. McClymont, A.M.E.I.C., formerly electrical and mechanical engineer and principal assistant with Messrs. Kerry and Chace, Ltd., Toronto, is now on the staff of McMaster-Jacob Engineering Company, Ltd., Toronto. Mr. McClymont came to this country in 1911 from England, and until 1916 was engaged with Siemens Company of Canada, as chief construction engineer for western division and later for all Canadian territory. Mr. McClymont has been with Messrs. Kerry and Chace since 1916.

E. G. Ryley, A.M.E.I.C., has been appointed general sales manager of the Truscon Steel Company of Canada, Ltd., Walkerville, Ont. Mr. Ryley received his degree of B.Sc. from McGill University in 1914, and since graduating has been associated with the above company in various capacities, except for the time spent on war service. Following the war Mr. Ryley rejoined the company as manager at Calgary, and has progressed rapidly to his present position.

E. L. Baillie, Jr.E.I.C. is at present on the staff of the Imperial Oil, Limited, at Halifax, N.S. Mr. Baillie graduated from the Nova Scotia Technical College in 1926 with the degree of B.Sc., and was at one time professor of mathematics and later professor of engineering at the St. Francois Xavier College, Antigonish, N.S. He joined the staff of the Nova Scotia Power Commission at Halifax in July 1929, and in November of the same year became a member of the staff of the Department of Highways, in the same city.

J. A. Creaser, A.M.E.I.C., has joined the staff of the National Cement Company, at Montreal, Que. Mr. Creaser graduated from McGill University in 1914 with the degree of B.Sc. and in May of the same year became attached to Kennedy Bros., of Montreal, as chief foreman on water works and sewerage installation. Mr. Creaser was overseas with the Canadian Expeditionary Forces from 1915 to 1919, being a staff captain of the 3rd brigade of Canadian Engineers from June 1918 to the time of demobilization. From 1919 to the present time he has been construction engineer with the Canada Cement Company.

T. S. Scott, M.E.I.C., who since 1922 has been with the city of Niagara Falls, Ont., as city engineer and later as city manager, has resigned that position to become town engineer of Port Colborne, Ont. Mr. Scott graduated from Queen's University with the degrees of B.A. and B.Sc., and for a time was professor of civil engineering at that university. In 1924, rather than accept his resignation, the city council of Niagara Falls gave Mr. Scott a leave of absence in order that he would be free to take charge of the development of a tract of land some 25 miles square in area, lying south of St. Petersburg, Florida.

J. F. Plow, Jr.E.I.C., has been appointed assistant to R. J. Durley, M.E.I.C., general secretary of The Institute, at Montreal, Que. Mr. Plow graduated from the Royal Military College at Kingston, Ont., in 1921, and in 1921-22 was a student at McGill University in civil engineering. From 1922 to 1925 he was vice-president of B. Plow and Company, Ltd., manufacturing stationers and printers. From 1926 to the present time Mr. Plow has been with Price Brothers and Company, Ltd., at Riverbend, Que., being first in charge of the records department, and since 1927, assistant engineer in the mechanical department.

J. F. Plow, Jr.E.I.C.

W. H. DeBlois, m.e.i.c., who since 1924 has been manager of the chemical division of the Mond Nickel Company Ltd., Montreal, Que., is now with Canadian Industries, Ltd., at Toronto, Ont. Mr. DeBlois graduated from McGill University in 1901 with the degree of B.Sc. and following graduation was, until 1903, head chemist of the Nichols Chemical Company at Capelton, Que., and from 1903 to 1908 was with the General Chemical Company, as assistant superintendent at Camden, N.J., superintendent at Pulaski, Va., and assistant superintendent at Edgewater, N.J., and Bayonne, N.J. From 1908 to 1924 Mr. DeBlois was superintendent of the Nichols Chemical Company at Sulphide, Ont., and from 1924 to date he has held the position which he has recently resigned.

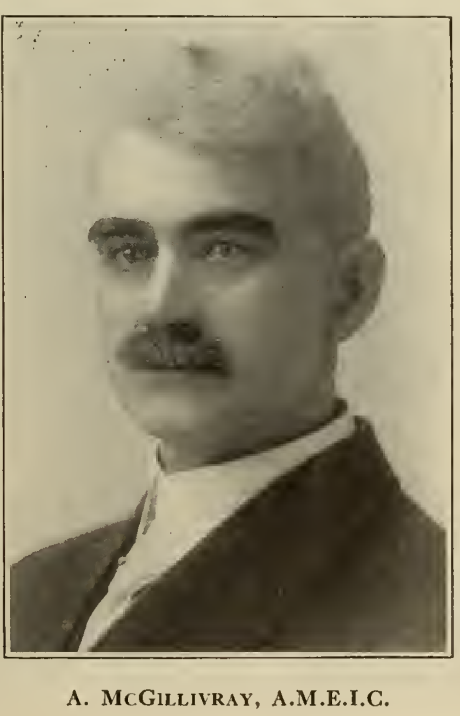
A. McGillivray, a.m.e.i.c., has been appointed Deputy-Minister of Public Works of Manitoba. Mr. McGillivray, who was formerly Highway Commissioner, Department of Public Works, Winnipeg, has been associated with the provincial public works of the government of Manitoba for the past twenty-five years, at first on land drainage work, and for the last sixteen years on good roads work as highway commissioner and chairman of the Good Roads Board. Mr. McGillivray was previously engaged in railway work, having been on location and construction with the Canadian Pacific Railway in British Columbia and with the Canadian Northern Railway in Manitoba. He takes considerable interest in Institute affairs, and in addition to acting as chairman of the Winnipeg Branch, also represented that Branch on the Council for the years 1927 and 1928.

R. S. Baker, a.m.e.i.c. is in private practice as a consulting engineer on bleacheries, equipment and methods, and is located at Ottawa, Ont. Mr. Baker was formerly with Messrs. Alex. Fleck, Ltd., Ottawa, Ont. Following his service overseas Mr. Baker was appointed engineer with the Wayagamack Pulp and Paper Company at Three Rivers, at which time he was engaged on construction work in connection with the woods operation. He was for a time located at Smooth Rock Falls, Ont., with the Mattagami Pulp and Paper Company, Ltd., on the construction of a hundred-ton bleaching plant for the company, and later joined the staff of the Riordon Pulp Corporation at Temiskaming, Ont. as research engineer. Mr. Baker later became mechanical research engineer for the Canadian International Paper Company at Temiskaming.

F. C. Green, m.e.i.c., has been appointed surveyor-general of British Columbia. Mr. Green is a native of Saint John, N.B., where he was gold medalist at the Saint John Grammar School. After graduation in 1893 from the University of New Brunswick with the degrees of B.A. and C.E., Mr. Green spent some years as resident engineer on railway construction in New Brunswick, and the state of Maine, going to British Columbia in 1897, where as senior partner in the firm of Green Bros., Burden and Company, he has since been engaged in a general engineering and surveying practice. Mr. Green has twice filled the important position of president of the Corporation of British Columbia Land Surveyors, and acted for many years on their executive, during which time he was associated with the drafting of various acts in which the profession was particularly interested. Mr. Green has always been actively interested in Institute affairs, and was chairman of the Victoria Branch in 1924, and in 1926 represented that Branch on the Council of The Institute.

G. H. Burbidge, m.e.i.c., formerly senior assistant engineer of the Department of Public Works, at Port Arthur, Ont., has been appointed acting district engineer. Mr. Burbidge graduated from the University of Toronto in 1905 with the degree of B.A., and from McGill University in 1909 with the degree of B.Sc. From June 1909 to September 1910, Mr. Burbidge was assistant topographer with the Geological Survey of Canada, and from September 1910 to June 1911 he was a demonstrator in the surveying department at McGill University. From June to December 1911 he was engaged on the subdividing of townsites for a Manitoba land surveyor. In January 1912 he entered the service of the Department of Public Works of Canada, as assistant engineer. In 1916-1917 Mr. Burbidge was a lieutenant with the 120th city of Hamilton Battalion, and with the Canadian Engineers. Returning to the Department in 1917, he was appointed district engineer for the district of Manitoba.

E. S. Miles, a.m.e.i.c., was recently appointed resident manager for the tunnel division of the Rayner Construction Ltd., Toronto, contractors for the intake tunnel and clear water tunnel in connection with the duplicate water supply system for the city of Toronto. Mr. Miles graduated from



A. McGillivray, A.M.E.I.C.

the University of New Brunswick in 1904, and in September of that year he entered the service of the Department of Public Works, being engaged for three years on a survey of the Georgian bay canal. From May 1906 to May 1907 he was first assistant engineer on the Georgian bay canal survey, in charge of a field party doing general survey work. From 1907 to 1910 Mr. Miles was engineer in charge of construction of the St. Andrews lock and dam on the Red river and in 1911 he was appointed supervising engineer for the department at Ottawa. Mr. Miles left the department to become resident engineer for O'Brien, Doheny, Quinlan and Robertson on Section 3 of the Welland ship canal, but early in 1918 all contracts were cancelled on account of the war and work suspended until early the following year. In 1918 Mr. Miles became manager of the Matane Lumber and Development Company, Matane, Que., but returned to the Welland ship canal in 1921. In 1924 he became engineer for A. W. Robertson Ltd., general contractors, on Section 8 of the Welland ship canal, at Port Colborne, Ont., and has been with that company up to the present time.

E. A. Cleveland, M.E.I.C., commissioner of the Greater Vancouver Water Board, and H. B. Muckleston, M.E.I.C., consulting engineer, Vancouver, have been appointed by the Vancouver city council to investigate the power possibilities of the Cheakamus watershed.

Mr. Cleveland was born at Alma, N.B., in 1874, and received his engineering education at the University of Washington, where he was a special student during 1907. He was first engaged on railway location work in New Brunswick, but since 1890 has been located in British Columbia where he has had extensive experience in engineering works. Mr. Cleveland resigned as comptroller of water rights for the province of British Columbia in 1926, to become commissioner of the Greater Vancouver Water Board. He is also chairman of the Vancouver and Districts Joint Sewerage and Drainage Board.

Mr. Muckleston was born at Kingston, Ont., in 1873, and was educated at Trinity College School, Port Hope, Ont., and the Royal Military College, Kingston, graduating from the latter institution in 1894. Mr. Muckleston was for a number of years in the employ of the Canadian Pacific Railway Company, and later was chief engineer of the Lethbridge Northern Irrigation District at Lethbridge, Alta. Early in 1924 Mr. Muckleston entered private practice as a consulting engineer in Vancouver, and later in the same year he became affiliated with Dr. J. A. L. Waddell, M.E.I.C., of New York city, on the design and supervision of construction of bridges in Alberta and British Columbia.

K. B. Thornton, M.E.I.C., appointed General Manager Montreal Tramways Company

K. B. Thornton, M.E.I.C., formerly assistant general manager of the Montreal Tramways Company, was recently appointed general manager of the Company. In 1893 Mr. Thornton was connected with the Royal Electric Company and the Montreal Light, Heat and Power Company, and for twelve years was intimately associated with the construction, operation and other engineering details of the power systems of these two companies. From 1905 to 1911, he was with the operating department of J. G. White and Company of New York, occupying the following positions: 1905-06, resident engineer and manager, Nassau Light and Power Company, Roslyn, L.I., N.Y.; 1906, assistant manager, operating department, J. G. White and Company, New York city; 1908-09, resident engineer and acting manager, Portland Electric Company and affiliated companies, Portland, Maine; in 1910 he was appointed advisory engineer to the Canadian Light and Power Company, Montreal, and the following year became chief engineer and general manager of that company, and also of the Montreal Public Service Corporation, in this capacity having full charge of the operating organization of both companies, and of all design for new construction and plant extension. Mr. Thornton also acted as consulting engineer to the Montreal Tramways Company. In January 1925, he was appointed assistant general manager of the Montreal Tramways Company.

K. B. Thornton, M.E.I.C.

Mr. Thornton joined The Institute as a Student on January 4th, 1894, and was transferred to Associate Member on March 16th, 1899, and to Member on November 23rd, 1920. During the years 1921-22 and 23 he was on the Council of the Institute and was vice-president representing Zone C in 1925-1926.

ELECTIONS AND TRANSFERS

At the meeting of Council held on April 11th, 1930, the following elections and transfers were effected:

Member

GENTLES, Allan Summerhayes, B.Sc., (McGill Univ.), manager, Pacific Division, Dominion Bridge Company, Limited, Vancouver, B.C.

Associate Members

COOKE, Norman Logan, B.Sc., (N.S. Tech. Coll.), principal, St. Patrick's Mechanic Science School, Halifax, N.S.

CRASE, George H., B.C.E., (Univ. of Michigan), district sales manager, Horton Steel Works, Ltd., Toronto, Ont.

CUMMING, James Deans, B.A.Sc., (Univ. of Toronto), manager and owner, General Wrecking Company, Detroit, Mich.

FARMER, Rupert Whitley, B.Sc., (McGill Univ.), engr., Montreal Light, Heat & Power Cons., Montreal, Que.

HAWTHORNE, Donald J., Sterling Clock Company, Inc., La Salle, Ill.

STUART, Kenneth, Major, D.S.O., M.C., asst. director of military intelligence, National Defence Headquarters, Ottawa, Ont.

Juniors

BARNETT, Henry Edgar, B.Sc., M.Sc., (Univ. of London), test dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

HUMPHRIES, George Edward, engrg. staff, Riter Conley Co., Pittsburgh, Pa.

POTTINGER, Alexander, B.A.Sc., (Univ. of B.C.), elect'l. dftsman., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

SHERWOOD, Charles Max, B.S. in C.E., (Rose Polytech. Inst.), asst. engr., Can. Engrg. & Contracting Co. Ltd., Hamilton, Ont.

WILLIAMS, Edward Clifford, (City and Guilds of London), students' test course, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Transferred from the class of Associate Member to that of Member

FORD-SMITH, Percy, president and gen. mgr., Ford-Smith Machine Co. Ltd., Hamilton, Ont.

REDFERN, Wesley Blaine, B.A.Sc., (Univ. of Toronto), vice-pres. and sec. treas., James, Proctor & Redfern, Ltd., Toronto, Ont.

WILSON, John S., B.A.Sc., (Univ. of Toronto), gen. mgr., Dryden Paper Co. Ltd., Dryden, Ont.

Transferred from the class of Junior to that of Associate Member

DOWNES, Michael Augustine, B.Sc., (McGill Univ.), asst. engr., Technical Service, City of Montreal, Que.

MITCHELL, Frank Leslie, B.Sc., (McGill Univ.), Abitibi Power & Paper Co. Ltd., 80 University Avenue, Toronto, Ont.

POWELL, Morley Vincent, B.A.Sc., (Univ. of Toronto), Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

TOOKER, Guy Langrishe, asst. engr., roads dept., engrg. dept., City Hall, Vancouver, B.C.

Transferred from the class of Student to that of Associate Member

BINNS, George Frederick, B.Sc., (McGill Univ.), asst. factory engr., Imperial Tobacco Company of Canada, Ltd., Montreal, Que.

BUZZELL, Henry Walter, B.Sc., (McGill Univ.), bridge designer, Harrington & Cortelyou, consltg. engrs., Kansas City, Mo.

JOHNSON, William James, B.Sc., (McGill Univ.), res. engr., at Halifax, N.S., for John S. Metcalf Co. Ltd., Montreal, Que.

KATZ, Morris, B.Sc., M.Sc., Ph.D., (McGill Univ.), chemist for National Research Council of Canada re Trail Smelter Smoke Investigation, Northport, Wash.

Transferred from the class of Student to that of Junior

BLACKMORE, Cyril Leslie, B.Sc., (McGill Univ.), elect'l. engr., Deer Lake power house extension, International Power & Paper Company, Deer Lake, Nfld.

JONES, J. H. Mowbray, B.A.Sc., (Univ. of Toronto), res. engr., Mersey Paper Co. Ltd., Liverpool, N.S.

OLEKSHY, Mike Dmytro, (Univ. of Alta.), instr'man., Alberta Main Highways, Edmonton, Alta.

Transferred from the class of Student to that of Affiliate

MATSON, Bruce Cook, B.A.Sc., (Univ. of Toronto), engr., Innerkip Lime & Stone Co., Woodstock Ont., and sales engr., Maloney Supply Co., Toronto, Ont.

Students admitted

AYER, Thomas Haliburton, (Undergrad., N.S. Tech. Coll.), 22 Harvey Street, Halifax, N.S.

BAKER, John Arthur, (Undergrad., Univ. of B.C.), R.R. No. 1, Eburne, B.C.

BARCLAY, Guy, (Undergrad., Univ. of B.C.), Sugar Lake, via Lumby, B.C.

CAMPLONG, Lloyd William, quantity engr., Fraser Brace Engineering Co. Ltd., Copper Cliff, Ont.

COSSER, Walter Geoffrey, (Undergrad., McGill Univ.), 3592 University St., Montreal, Que.

CRASTER, James Edmund, (Undergrad., Univ. of B.C.), Vernon, B.C.

DAYNES, Joseph Henry, B.Sc., (A.C.G.I.), test work, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

DOHERTY, Thomas Harry, (Undergrad., Univ. of B.C.), 309-12th St. East, North Vancouver, B.C.

DUNHAM, Charles Burton, (Undergrad., Univ. of B.C.), 4205-11th Ave. West, Vancouver, B.C.

FRASER, Ralph Percy, (Undergrad., Univ. of Man.), 107 Tache Ave., Norwood, Man.

GONZALEZ, George Albert, (Undergrad., McGill Univ.), 435 Grosvenor Ave., Westmount, Que.

GONZALEZ, Luis Carlos, (Undergrad., McGill Univ.), 435 Grosvenor Ave., Westmount, Que.

HANLY, John Bruce, (Undergrad., Univ. of Toronto), 78 Grosvenor St., Toronto, Ont.

HRENNIKOFF, Alexander, (Undergrad., Univ. of B.C.), University of British Columbia, Vancouver, B.C.

JAGGER, Albert Edward, B.A., B.A.Sc., (Univ. of B.C.), Student, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

JOST, George Barber, (Undergrad., McGill Univ.), McGill University, Montreal, Que.

LAING, David Alexander Shearer, (Undergrad., McGill Univ.), 218 Redfern Ave., Westmount, Que.

LATTA, William S. B., (Undergrad., Univ. of B.C.), 4453-12th Ave. West, Vancouver, B.C.

LIND, Walter J., (Undergrad., Univ. of B.C.), 4509-9th Ave. West, Vancouver, B.C.

LOCKE, Charles William Evans, (Undergrad., Univ. of B.C.), 554 Rithet St., Victoria, B.C.

MACDONALD, Ernest Gordon, (Undergrad., Univ. of Man.), 89 Canora St., Winnipeg, Man.

MADSEN, Christy, (Undergrad., Univ. of B.C.), 1936-6th Ave. West, Vancouver, B.C.

MATHESON, John Gordon, B.A.Sc., (Univ. of Toronto), test dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

MEIKLE, James Barton Ross, (Undergrad., Univ. of Man.), 61 Kennedy St., Winnipeg, Man.

MELLOR, John Harold, (Undergrad., McGill Univ.), 619 Belmont Ave., Westmount, Que.

NESBITT, Lyman M., (Undergrad., Univ. of B.C.), 4453-12th Ave. West, Vancouver, B.C.

NICOLAISEN, Juncker Zelo, B.Sc., (Univ. of Durham), dftsman., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

SHIELS, Thomas, (Undergrad., Univ. of B.C.), 1761 Williams St., Vancouver, B.C.

SWANNELL, Lorne Forster, (Undergrad., Univ. of B.C.), 4715-4th Ave. West, Vancouver, B.C.

WHEATLEY, Eric Edmund, (Undergrad., McGill Univ.), 657 Belmont Ave., Westmount, Que.

Inaugural Meeting of the Aeronautical Section of the Montreal Branch

Tuesday, April 8th, marked the beginning of a new phase in The Institute's development, in the inaugural meeting of the newly formed Aeronautical Section. D. C. Tennant, M.E.I.C., chairman of the Branch, presided and after giving a short address dealing with the aims, objects and constitution of The Institute as a whole, introduced the chairman and vice-chairman, J. L. Busfield, M.E.I.C., and Prof. C. M. McKergow, M.E.I.C., respectively. Following a few remarks by Mr. Busfield, the Chairman then called on the speaker for the evening, J. A. Wilson, A.M.E.I.C., director of civil aviation in the Department of National Defence at Ottawa.

Mr. Wilson congratulated the members of the newly formed section on the step which had been taken and referred briefly to the interest taken by the various Branches of The Institute in aviation matters in the past. He then went on to stress the importance of engineering in all its branches to the continued progress of aviation. Some of the work already accomplished was referred to in the development of the Rolls Royce-Schneider cup engine; the lighter-than-air machines, R.100 and R.101; the modern air port; the mooring mast, etc.

The foundation of the new section was declared by Mr. Wilson to be a very happy incident, and with the support of the engineering profession, he felt that the development of aviation as a means of rapid transportation would make marked progress, and without taking anything from the other established methods of transport.

The following letter was received from G. J. Desbarats, M.E.I.C., Deputy Minister of National Defence, Ottawa:

> "Please extend to the Executive of the Montreal Branch of The Engineering Institute of Canada congratulations of this Department on the forming of an Aeronautical Section of The Institute in Montreal. The attitude of The Institute towards aviation has been invariably helpful and the formation of a special section in Montreal will bring The Institute into still closer touch with aeronautical engineering.
>
> The Department is very gratified to know that the growing importance of aeronautics is now being given official recognition and we will always be ready to assist the new branch in any way we can.
>
> May I, as one of the senior members of The Institute, who has always taken an active interest in its affairs and has also been closely connected with the administration of aviation for many years, express my personal good wishes and pleasure in the formation of the new branch."

A telegram, reading as follows, was also received from A. G. L. McNaughton, M.E.I.C., Chief of General Staff, Department of National Defence, Ottawa:—

> "Best wishes for success of aeronautical section Montreal Branch Enginering Institute of Canada in important work which it can carry out in keeping Canadian engineers in touch with developments in the air. Assure you full co-operation Officers National Defence Headquarters concerned in aviation matters."

Lt.-Commdr. A. Pressey, R.C.N., who is the officer in charge of mooring at the St. Hubert airdrome, spoke briefly on the problems encountered in mooring large dirigibles to their masts and explained in some detail the method followed in making them fast.

In conclusion F. C. Laberge, M.E.I.C., moved a very hearty vote of thanks to the speakers on behalf of the meeting.

De Laval Steam Turbine Company, Trenton, N.J., have just issued a new booklet entitled "Successful Canadian Pumping Stations." This booklet, containing twenty-eight pages, illustrates, describes and lists on a map Canadian pumping stations equipped with De Laval pumps.

Canadian Ingersoll-Rand Company, Ltd., have recently issued a new 38-page bulletin entitled "The Oil Electric Locomotive", which describes by general information, operating data and costs, graphs and drawings the Ingersoll-Rand oil electric locomotive. Copies will be gladly sent upon request to the Company at 10 Phillips Square, Montreal, Que.

BOOK REVIEWS

Flood Flows

A Study of Frequencies and Magnitudes

By Allen Hazen. John Wiley & Sons, New York, 1930, buckram, 9¼ x 5¾ in., 199 pp., figs., tables, $4.00.

This book will be welcomed by all hydraulic engineers, for it makes available to them the results of the experience, investigation and analyses of the question of flood flows by the well-known consulting engineering firm of Hazen & Whipple over a period of more than twenty years. "The object of the work," to quote the author, "is to gather in one compact presentation those methods previously published that seem most helpful, some of the basic data arranged in convenient form for reference; to add here and there some scraps of information not elsewhere easily obtainable; and to mix in a little of the author's philosophy in regard to the interpretation of the data and the application of the results."

Every hydraulic engineer is called upon at times to estimate flood flows in connection with works he is about to design. In many cases a review of the flow data for the stream and a study of all records of high water marks will provide the basis upon which to estimate the biggest flood of which there is evidence in the past, and the engineer will thereupon adopt designs providing a substantial factor of safety and will feel reasonably secure. While this method is entirely satisfactory when the consequences arising from an even greater flood than provided for will not be particularly serious, something a great deal more scientific is required when the cost of protection is high or when the consequences of failure will be disastrous. Any engineer can amplify this statement out of his own experience.

The book under review deals exhaustively with the whole question of flood estimation, and can be recommended as being of great interest to those engineers who are regularly dealing with problems of this kind. To the engineer suddenly confronted with the necessity of making a flood study, Mr. Hazen has provided most valuable guidance.

J. T. Johnston, M.E.I.C.,
Director, Dominion Water Power & Reclamation Service, Ottawa.

Wasser-Kraft-Jahrbuch 1928-29

Fourth Annual Volume Water Power Year Book; published by G. Hirth Verlag A. G., München, Herrnstrasse, 1929, cloth, 6 x 9 in., 487 pp., illus., diagrs., tables, R.M. 22.

The fourth volume of this well-known annual contains over thirty articles which naturally deal particularly with the European aspect of water power engineering. It is admirably prepared, and is well worth study by those sufficiently familiar with the German language.

The first section contains papers treating principally of the development and installation of water powers, and gives a description of the present position as regards hydro-electric power development in Austria, Italy, France, Norway, Finland, Iceland and Greece. These are followed by a series of articles on the legal and other regulations governing the development of water power in those European countries where this has been most complete, and there is a sketch of the various hydrographic institutions in Europe with a number of papers on hydrometric investigations and their relation to the design and operation of water power installations.

The third section of the book treats of technical problems relating to the development of water powers, and includes a very interesting and informative paper on the aesthetic considerations which should govern the designers of power station buildings in their relation to the natural beauties of the surrounding landscapes. The record of a series of measurements of the stresses in the material of the penstock of a power development working under a head of nearly 400 metres is of considerable interest.

The fourth and concluding section of the volume, dealing with turbine machinery, contains an excellent summary of the progress of turbine design in the United States and Canada up to 1929, a paper by a Swedish engineer on the erosion of turbine blades and an account of recent experimental work on the resistance of various materials to corrosion, all of which will repay study.

The cavitation problem is treated mathematically, and other theoretical papers relate to shaft-vibration and similar topics connected with turbine and governor design.

The whole volume gives an admirable presentation of the situation in Europe to-day as regards this important branch of engineering work.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- American Institute of Consulting Engineers, Inc.: Proceedings of the Annual Meeting Held January 13, 1930.
  Constitution and By-Laws and List of Members, March 1, 1930.
- Royal Society of Edinburgh: Proceedings, Vols. 49, part 4; 50, part 1.
- The Institution of Engineers, Australia: Transactions, Vol. 8, 1927.
- The Institution of Civil Engineers: Reports of Proceedings at Presentations of the Kelvin Medal.
- American Institute of Electrical Engineers: Year Book, 1930.

Reports, etc.

Dept. of Labour, Canada:
- Report of the Dept. of Labour for the Fiscal Year Ending March 31, 1929.
- Strikes and Lockouts in Canada and Other Countries, 1929.

Dept. of Mines, Canada:
- Report of the Dept. of Mines for the Fiscal Year ending March 31, 1929.
- Mica.

Dept. of Mines, Geological Survey, Canada:
- Memoir 155: Horton-Windsor District, Nova Scotia.

Dept. of the Interior, Geodetic Survey, Canada:
- Publication No. 24: Precise Levelling in British Columbia.

Natural Resources Intelligence Service, Canada:
- Natural Resources of Quebec. Revised edition.

Dominion of Canada:
- Report of the Public Archives for the Year 1929.

Dept. of Public Works and Labour, Quebec (Prov.):
- Workmen's Compensation Commission, Second Report, 1929.

Bureau of Standards, United States:
- Circular No. 378: Alphabetical Index and Numerical List of Federal Specifications Promulgated by the Federal Specifications Board.
- Circular No. 380: Architectural Acoustics.
- Misc. Pub'n No. 103: Weights and Measures References.
- Misc. Pub'n No. 105: Vertification Plan, Significance and Scope.
- Misc'n Pub'n No. 104: Testing Equipment for Large Capacity Scales for the Use of Weights and Measures Officials.
- Standards Yearbook, 1930.

Bureau of Mines, United States:
- Technical Paper 459: Effect of Sized Ore on Blast-Furnace Operation.
- Technical Paper 474: Accidents at Metallurgical Works in the United States During the Calendar Year 1928.

Geological Survey, United States:
- Monograph 55: The Titanotheras of Ancient Wyoming, Dakota, and Nebraska, Vols. 1 and 2.

National Electric Light Association:
- Underground Systems Committee, Engineering National Section: Report: Cable Operation.
- Prime Movers' Committee, Engineering National Section: Coal and Ash Handling.
- Accident Prevention Committee, Engineering National Section: Precautions to be Observed in the Operation of Portable Kenotron Test Sets.

Ohio State University:
- Engineering Experiment Station Bulletin No. 52: Single-Wire Transmission Lines for Short-Wave Antennas.

Technical Books, etc.

Purchased:
- Spon's Workshop Receipts for Manufacturers and Scientific Amateurs:
  - Vol. 1: Acetylene Lighting—Drying.
  - Vol. 2: Dyeing—Japanning.
  - Vol. 3: Jointing Pipes—Pumps.
  - Vol. 4: Rain Water—Wire Ropes.
- Canadian Almanac and Legal and Court Directory, 1930.

Presented by N. E. D. Sheppard, A.M.E.I.C.:
- Handbook of Some Engineering Works in Canada, 1904.
- Elements of Descriptive Geometry, 3rd ed., 1899, by J. B. Millar.
- Hydraulic Turbines, with a Chapter on Centrifugal Pumps, 1913, by R. L. Daugherty.
- Manual of Gurley Hydraulic Engineering Instruments, 1918, by W. and L. E. Gurley.
- Electrical Problems for Engineering Students, 1902, by Hooper and Wells.
- River Discharge, 4th ed., 1916, by Hoyt and Grover.
- Elements of Hydraulics, 1915, by S. E. Slocum.
- The Theory and Practice of Surveying, 17th ed., 1912, by Johnson and Smith.
- The Regulation of Rivers, 1914, by J. L. Van Ornum.

Presented by "Power" (McGraw-Hill Publishing Company):
Power's Practical Handbook, First edition.
Basic Combustion Engineering.

Presented by John Wiley & Sons:
Flood Flows: A Study of Frequencies and Magnitudes, by Allen Hazen.

Presented by Bolckow, Vaughan & Co., Ltd.:
[Souvenir] Thomas & Gilchrist, 1879-1929.

Presented by de Gaspe Beaubien, m.e.i.c.:
General Electric Review, Vols. 11-31, 1908-1928.
Electric Journal, Vols. 1-26, 1904-1929.

Presented by American Institute of Steel Construction, Inc.:
The Skyscraper: A Study in the Economic Height of Modern Office Buildings, by Clark and Kingston.

Presented by G. D. Crain, Jr., Publisher:
The Market Data Book.

Presented by Dominion Bridge Company, Ltd.:
Bound Copy, Reprint: The Montreal South Shore Bridge, Fabrication and Erection of the Superstructure, by L. R. Wilson.

BRANCH NEWS

Border Cities Branch

R. C. Leslie, A.M.E.I.C., Secretary-Treasurer.

(Reported by H. J. A. Chambers, S.E.I.C.)

The regular monthly meeting of the Border Cities Branch was held on February 14th.

Orville Rolfson, a.m.e.i.c., the chairman, introduced Prof. N. L. Badger, professor of chemical engineering at the University of Michigan, who addressed the meeting on the subject of "The Use of Diphenyl as a Heating Medium."

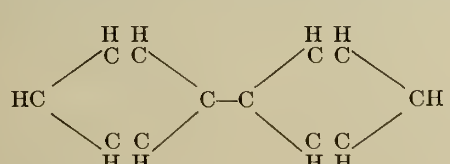
The speaker prefaced his address by a few remarks concerning the profession of the chemical engineer, defining the chemical engineer as one experienced in the design and operation of chemical plant or apparatus and concerned with the unit operations of evaporation, distillation, crystallization, crushing, drying, etc.

The speaker stated that the chemical engineer is not a composite chemist and mechanical engineer, but one who is definitely concerned in carrying out the unit operations of the chemical plant. The profession being young is not hampered by the empiricism of the older professions and consequently attacks its problems from an almost purely philosophic standpoint.

The development of diphenyl gave ample evidence of this attack. In 1917 the search for the ideal heat transference medium in the operation of evaporation was fostered by Socerson Evaporator Company of Chicago.

Of the many mediums for accomplishing this end, necessary vapour had proven hard to handle and extremely injurious to the health of workmen, direct heat was wasteful, and superheated steam had a low heat transference coefficient. The physical characteristics of the ideal medium had been decided upon, a substance possessing high latent heat, high heat transference coefficient, stability up to 800° F. and to operate as a saturated vapour with continuous performance, and non-injurious to health.

Four years ago diphenyl was selected for these tests. At that time it was a rare chemical used by the Eastman Company's research department at Rochester,—a colourless crystalline substance having the structural formula:—



Contrary to the usual behaviour of such large molecules, diphenyl did not break up when subjected to high temperatures.

In 1917 it retailed at $27.00 per pound. Subsequent researches and methods of manufacture have reduced this cost to $0.40 per pound. The bulk of the commercial market substance is produced by the Federal Phosphorus Company of Alliston, Alabama, and is made by passing benzol vapour over hot nickel gauze as a catalyst.

Of the many uses to which diphenyl may be put, the speaker cited the following commercial installations,—

Processing of lubricating oils.
Evaporation of caustic solutions.
Heating and processing of tars, asphalts, roofing papers, shingles, etc.
Replace direct coke fire under copper kettles in varnish and printers' ink manufactures.

All these uses are awaiting the design of the practical boiler in order to make them economically feasible and research is now being made to this end.

Research has been made in detail in the evaporation of caustic solutions. The design of the diphenyl boiler embodies torch welded joints inasmuch as the electric weld, though strong mechanically, is not tight since it includes scale, and diphenol acts as a reducer. Diphenol dissolves rubber and grease and hence pipe joints are designed with pump packing and are kept water-cooled. The caustic solution circulates in nickel pipes since it has a corrosive effect on unprotected iron.

Solid 99 per cent caustic is produced at a temperature of 725° F., which is greatly beyond the critical temperature of steam. Under similar circumstances, by using steam, only a 50 per cent solid solution could have been attained, the remainder of the process being carried out by direct fire would be slow and imperfect.

At atmospheric pressure the melting point of diphenyl is 159° F., the boiling point 499° F. and the critical temperature 980° F. The diphenol boiler is 65 per cent efficient and diphenyl has a heat transmission ability one hundred times greater than that of steam. The research programme contemplates using diphenyl as a fluid for prime movers. An installation would need no replacement, the losses are negligible, it operates in a closed system, the first cost is the last.

A lively discussion followed,—Messrs. Burns, Fletcher, Thoresen and Coulter taking part.

It was moved by F. Stevens, m.e.i.c., seconded by H. Thorne, m.e.i.c., that a hearty vote of thanks be conveyed to Prof. Badger.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.

J. R. Dunbar, A.M.E.I.C., Branch News Editor.

At a meeting held in the Hamilton Technical Institute on March 19th, 1930, R. E. Smythies, m.e.i.c., of the Lincoln Electric Co., Toronto, gave an address on "Recent Developments in Electric Arc Welding."

In opening, the speaker summed up the advantages of electric arc welding as a means of producing stronger, lighter and cheaper products than by the use of castings or rivetted work.

The first electric welder in Hamilton was installed in 1913 at Dominion Foundries.

Slides were shown illustrating direct connected motor generator welding sets, both single and double. In the case of the double type, one driving motor is placed in the centre, between two generators. These two generators can be used independently by two different operators, or may be paralleled by convenient switches, for use on heavy welding, up to about 600 amperes demand.

These welding outfits are supplied in portable style on trucks, or on stationary bedplates, as may be required. Gasoline engines may be used for driving, instead of electric motors, for use in the field. As might be expected, these welding equipments are constructed practically entirely of welded steel.

Slides were then shown of various classes of welded structures, both during construction and after completion, including domestic heating-boilers, high pressure stills, hydraulic power plant penstocks, long pipe lines for water or oil, the Detroit River tunnel, heavy machinery, structural steel buildings, etc., etc. Figures were given showing a two million dollar saving in constructing a 90-mile 5-foot diameter pipe line in California, in addition to the continuous saving due to the prevention of water leakage.

The penstocks at the Queenston plant were electric welded. Automatic welding machines are now in use on pipe lines, tanks, automobile rear axle housings and other forms of quantity production, thus reducing costs and making for uniform welding.

In heavy machine making, it frequently costs less to make the machine of parts welded together than the cost of development and pattern making alone would amount to in the case of making the parts of castings. As a rule welding eliminates practically all of the machining which would be necessary in the case of castings. In the case of a pedestal illustrated, made of welded steel to take the place of a cast iron one, the welded pedestal weighed 520 lbs. and cost $114.00 against the cast pedestal weighing 1,950 lbs. and costing $242.00.

Regarding the old objection to welded steel on the ground of lack of rigidity, the speaker assured the meeting that it could be made as rigid as castings, and still be lighter, cheaper and stronger.

Regarding the strength of welds, results of tests were shown, indicating that weld metal is stronger than the main body of steel. For example, where the steel had a strength of 60,000 lbs. the weld stood 70,000.

One factor in obtaining good uniform welds is the use of a flux, generally in the form of a coating around the welding rods. Another factor is the use of welding rods and current in proportion to the thickness of metal being welded.

Mr. Lumsden occupied the chair and Mr. Munson moved a vote of thanks to the speaker for his excellent address.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Lethbridge Branch was held in the Marquis hotel on March 29th, preceded by the usual dinner and musical programme which consisted of vocal solos by R. S. Rannard and Wm. Meldrum and orchestral selections by Morgan's orchestra.

The Secretary-Treasurer, Wm. Meldrum, A.M.E.I.C., read his report which showed a slight decrease in attendance and membership during the year.

The retiring chairman then announced the results of the elections for Chairman and Executive Committee as follows:

Chairman: C. S. Clendening, A.M.E.I.C.
Executive: R. Livingstone, M.E.I.C.
N. Marshall, M.E.I.C.
N. H. Bradley, A.M.E.I.C.
R. F. P. Bowman, S.E.I.C.

The newly-elected chairman, Mr. Clendening, then took the chair and introduced a general discussion on the policy of the Branch for the coming year, in which nearly all the members took part, and expressions of opinion were freely made which will be of value in determining the nature and extent of the year's activities.

Councillor G. N. Houston, M.E.I.C., gave a short talk in regard to some of the matters which have come before Council recently.

A vote of thanks to the retiring executive was then unanimously adopted after which the meeting adjourned.

London Branch

F. C. Ball, A.M.E.I.C., Secretary-Treasurer.
Jno. R. Rostron, A.M.E.I.C., Branch News Editor.

The February meeting of the Branch was held on the 26th in the Public Utilities Commission board room, twenty-four members and guests being present.

The speakers for the evening were W. G. Ure, A.M.E.I.C., city engineer of Woodstock, and F. W. Farncomb, M.E.I.C., London, their subjects being "Land Surveying in Western Ontario" and "Early Surveys in the District of London" respectively.

Mr. Ure in his opening remarks made a comparison between engineering and surveying. The former was a broad term which embodied so many branches and the latter was very definite. The qualifications required by the Ontario Land Surveyors Association were exclusive and thorough, both as to training, apprenticeship and final examination, the latter generally being considered "stiff." In western Ontario it is safe to say that the ratio of engineers to surveyors is about 10 to 1.

As to the employment of a qualified surveyor by an individual preparing a plan and description and duly registering it, the speaker thought it was well worth while. There was nothing to prevent the owner doing it himself, but experience had shown that trouble was likely to ensue when the other fellow on the other side of the boundary came along. He could point to a large number of defective descriptions in the Registry Office as a result of which many people were living on the wrong property and endless trouble, annoyance and expense was often the outcome.

In some of these cases the Statute of Limitations came into play which, while it gave no title to the land appropriated in error by one owner, it prevented the other owner taking action.

The speaker cited many amusing cases of the various complications which had arisen during his experience and he recommended the employment of a qualified surveyor if the prospective owner wished to preserve peace and harmony with his neighbours.

Two plans, were shown, the one illustrating what is known as the "single front" system and the other the "double front."

In the single front system the measurements of the lots were taken beginning at the town line and along the front of each concession road and the lot lines were run straight through from one concession road to the next and parallel to the town line. As it was impossible for two surveyors to make the same measurement for any distance over stumps, fallen trees, uneven ground, etc., and with the old style of link chains, jogs were inevitable at the intersection of the concession and side roads.

In the double front system, however, the measurements were taken along the centres of the concession roads and the lot lines were run in opposite directions, and parallel to, the town line half through the concessions, causing the jogs to take place at the blind line or centre of the concession.

The speaker concluded with some interesting remarks concerning the fees paid to the surveyors of those days (the Surveyor General himself only receiving 15/- (fifteen shillings) a day) and their methods of marking their lines and points by blazing trees and the use of wooden stakes and stumps.

Mr. F. W. Farncomb stated that the earliest survey of the London district, Middlesex, was first recorded by Governor Simcoe in 1793. The speaker traced the Governor's journey, starting from Niagara Falls on the 4th of February, 1793, through the southern part of western Ontario and finally to this district.

A note of additional interest was added to Mr. Farncomb's remarks by the fact that he had in his possession several diaries written by some of these pioneer surveyors (one of these being by Major Little-Hale) which were handed round for inspection and perusal. From these one learned that there was something else besides surveying to occupy the attention of the surveyors such as the Commissariat, sickness, etc. Some of these diaries gave somewhat of an insight into the trials and hardships as well as the accomplishments and achievements of these pioneer surveyors.

A description of the staff and compass used in those days was given. Mr. Farncomb also gave some interesting reminiscences of his own when he was engaged in surveying in Algonquin park in his younger days.

The city of London was surveyed by Colonel Burwell in 1828 and in 1853 city engineer Peters was instrumental in establishing stone monuments below the surfaces of the streets at the intersection of their centre lines. Many of these are in existence today and form the legal basis of all street lines etc., but on the other hand many of them have been removed and not replaced during excavation for sewers and other work.

Both speakers were much appreciated and an animated discussion followed each address. Cordial vote of thanks were accorded them.

Railway Construction Through the Yellowhead Pass

The regular monthly meeting was held on March 19th in the Public Utilities Commission board room and the chairman of the Branch, W. G. Ure, O.L.S., A.M.E.I.C., conducted the meeting, twenty-two members and guests being present.

W. R. Smith, A.M.E.I.C., vice-chairman of the Branch, was the speaker and his subject was "Railway Construction through the Yellowhead Pass." His address was illustrated with many views taken in this picturesque country.

Mr. Smith prefaced his remarks by stating that his paper contained an account of work, experiences and observations which came within the scope of a resident engineer. Out of ten years spent in railway construction work the three years spent in the vicinity of the Yellowhead remained in his memory as the most interesting. He also wished to acknowledge the courtesy of the Canadian National Railways to whom he was indebted for many of the views shown.

In November 1909 he was instructed to take a party of eight men and supplies to mile 80 of the Mountain Division—204 miles west of Edmonton—and carry out the duties of resident engineer and also to make any revisions of location necessary. They had their supplies loaded on five flat sleigh racks and it took them three weeks to chop their way through to their destination.

The work was constructed on a maximum grade of 4/10th of one percent, a maximum curvature of 6 degrees or radius of approximately 955 feet, also 0.02 was allowed for compensation in grade per degree of curve so that the grade on a 6° curve would be only 0.28.

Searle's spirals were used as easements on all curves over 2°.

Embankments were 16′ in width up to 18′—cuttings were 22′ in width allowing for shallow ditches 3′ in width by 1′ deep at each side. Rock cuttings were 20′ in width. Earth slopes were calculated at 1½ to 1 while rock quantities were figures at ¼ to 1 slope.

The first duty of a resident engineer is to see that the right-of-way is cleared and then run check levels and establish bench marks. Then pick up the location centre line and re-run the alignment according to the location map supplied. Curves must close at the tangent points to 3/10 of 1 foot otherwise they must be re-run and the errors found and corrected.

It is then the duty of the engineer to list all structures required, bridges, culverts etc., and send it in to the divisional engineer. In the meantime temporary wooden structures are employed which are afterwards filled in or removed.

In the meantime the instrument man is busy cross-sectioning cuts and fills and the evenings are spent calculating quantities.

In cross-sectioning the slope was often as steep as 60° and the method adopted for obtaining the horizontal distances was by calculating them from the measured distances along the slope by the medium of the trigonometrical functions of the vertical angles obtained by the use of an Abney hand level. To obtain these measured distances the rodman had to be lowered by a rope. In many cases this work was done above boiling rapids where a slip would be fatal.

It is often necessary to divert mountain streams by means of rock filled cribs and these diversions are sometimes a cause of much anxiety to the engineer.

Slope chaining by means of the Abney level with clinometer attachment was found to be speedy and accurate. The method was to give the sloped tape all the support possible and then read the actual vertical angle, sighting along the tape.

Temperature had to be taken into account when using the steel tape. In re-running curves it was possible the temperature might vary as much as 20° from the time it was first run.

The speaker said he wished to pay tribute to some of the older engineers who trod these trails in the seventies. The Yellowhead has an elevation of only 3,718 feet and is one of the lowest in the Rockies. The reason why Lord Strathcona and Sir Sanford Fleming did not make use of this wonderful pass when they were consolidating the provinces by the building of the C.P.R. is that they decided to keep near the boundary in order to hold the south country from the greed of the republic to the south.

At Moose lake on the British Columbia side of the pass a very old stump was found shaped in the form of a pyramid. On one of the blazed sides was the following inscription:

Party No. 15
Bench Mark No. 572—1873
Elev. 3418.25

and on the back of the stump—Sanford Fleming.

The elevation was only 10 feet different from ours and the location was not a foot off our centre line.

A hearty vote of thanks was accorded to the speaker.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

On the evening of February 6th, A. H. Harkness, M.E.I.C., of Toronto, described in some detail the structural and engineering problems connected with the construction of the Sun Life building on Dominion square, Montreal.

Some idea of the magnitude of the work was given by Mr. Harkness in the following statistical description. "The old portion of the building has a frontage of 144 feet on Metcalf street on the west, 139 feet on Mansfield street on the east and abuts on Dorchester street with a depth of 214 feet. The new portion extends to the north between Metcalf and Mansfield streets 284 feet, making the size of the entire building 214 feet by 429 feet.

"The building will be twenty-six storeys, including three duct floors and a pent house, above the ground floor, rising to a height of about 390 feet above the sidewalk level. There are three basements, the lowest one being 40 feet below the sidewalk level. The total floor area of the building, omitting duct and pent house floors, is approximately one million square feet or about twenty-three acres.

"The new portion is equipped with twenty-eight passenger elevators and one freight elevator in the central service area as well as a second freight elevator off the lane at the north. The building will have accommodation for about 10,000 employees. The general dining rooms or cafeterias will provide meals for 8,000, and practically the whole of the sixth floor is given over to this purpose. There are, in addition, seven dining rooms for different classes of employees. In the north wing there is an assembly hall 63 by 126 feet with gallery and stage, on the eighth floor, a basket-ball court or play room, 59 by 127 feet, on the eighth floor and bowling alleys on the tenth floor for men and women.

"The construction of the new part of the building is being carried out in three parts. The easternly half of the new extension up to the eighth floor was started during the summer of 1927 and is now nearly completed and partly occupied. The westerly half was started during the winter of 1928-29, and is now enclosed. The tower portion from the eighth floor is now started, the steel being erected to the thirteenth floor. It is expected to have the tower portion enclosed by next winter."

Mr. Harkness pointed out that as compared to some of the large buildings recently constructed or now being constructed in the United States, the structural engineering on the Sun Life building can not be considered as offering much out of the ordinary. There were, however, some problems in the offsetting of columns, the arrangement of the new steel framing in relation to that of the old section of the building, the reinforcing of these old columns and beams to take increased loads, the shoring up of old columns to take new bases and footings, that are not met with in entirely new buildings. Mr. Harkness discussed some of these difficulties, showing by means of slides and diagrams the ingenious methods used in overcoming them.

D. C. Tennant, M.E.I.C., of the Dominion Bridge Co. Ltd., added a few words to the remarks of Mr. Harkness. Confining himself to the problems relating to steelwork erection, he gave some figures of the steel tonnage in the building. The original section had 1,930 tons, the second 1,325, the large back portion 9,645, while the tower will have 6,100 tons. This added to the 840 tons in the power house on the east side of Mansfield street makes the total tonnage 19,840 tons.

F. P. Shearwood, M.E.I.C., occupied the chair and among those who took part in the discussion was Mr. Cook of the firm of Cook & Leitch, general contractors for the building.

Climatic Cycles

In a very interesting address before the Montreal Branch at their regular weekly meeting on March 6th, Mr. A. Strieff, consulting engineer of Jackson, Mich., demonstrated a method which he has developed of predicting stream flow and showed the apparent relationship that exists between climatic and sun-spot cycles.

In introducing his subject, Mr. Strieff gave a résumé of research work that has been devoted to the investigation of climatic changes and the theories that have been developed, many of which, as he pointed out, are highly controversial. There have been many attempts made to correlate meteorological data and the solar cycles but without satisfactory results and the conclusion has been that "because cycles in temperature, pressure and rainfall are largely obscured and surpassed in amplitude by local and momentary changes, they are of no practical use in meteorological work."

"This conclusion of practical meteorology has been transferred sine qua non to engineering, although the conditions are modified to such extent in hydrographic data that the situation is completely reversed. Here secular amplitudes occasionally surpass the amplitudes of local and momentary changes and, far from being obscured by the latter, are often visible by mere inspection of the record. On account of this more favorable proportion between the secular and the fortuitous momentary amplitudes the chances for a successful elimination of controversy are more favourable in the application of climatic sequences to hydraulic engineering than to weather service."

"Weather service deals largely with momentary values and changes. The task of hydraulic engineering is the control and conservation of water, hence it deals largely with cumulative values. Precipitation is collected on large drainage basins and partially runs off. Part of the runoff is accumulated in lakes and storage basins. The storage quantities and water elevations represent a repeated accumulation and by this cumulative process small secular differences, unimportant for weather service but sustained over long periods, become great and important effects."

Mr. Strieff first applied his method to the flow of the Ausable river in Michigan, records of which were available extending over a number of years, and found a remarkable correspondence between the curve he derived and the Bruckuer Cycle of Wolf Numbers. Since then he has applied his method to the flow curves of other rivers with uniformly satisfactory results. By means of a series of summations and differentiation he eliminates the fortuitous elements of the hydrographic record and obtains a smooth curve the trend of which is known and the future value of which can be estimated with remarkable accuracy.

Upon conclusion of Mr. Strieff's address, Mr. C. R. Reid of the Shawinigan Water & Power Company and Mr. Trimingham of the Southern Canada Power Company remarked that they have been following with a great deal of interest the work that Mr. Strieff has been doing and called attention to the value to hydro-electric companies of forecasting stream flow.

Upon motion of Prof. E. Brown, M.E.I.C., the Chairman thanked the speaker on behalf of the Branch.

Student Section

On Thursday, March 13th, two very excellent papers were presented before the Montreal Branch by the Student Section. The first was given by Mr. Arthur Piché, entitled "Welded Airplane Structures". Mr. Piché dealt with the various applications of welding in the construction of aeroplanes at the present time, at the same time tracing the developments of these applications and indicating the tremendous importance which this art now plays in the fabrication of present-day machines.

The second paper was given by Mr. Rolland Rouselle, the subject being "The Problems in Long Distance Telephones." At the conclusion of Mr. Rouselle's paper a special moving picture film was shown through the courtesy of the Bell Telephone Company of Canada.

Road Building

The Branch was addressed on March 20th by E. L. Miles, M.E.I.C., of Lindsay, Ont., engineer of highway development for the county of Victoria, on the subject of "Road Building." In his paper, Mr. Miles traced briefly the historical development of road building from earliest times extending back as much as one thousand years before the famous King Tut. In these ancient times, roads were made of stone and were very thick. Drainage was not thought of but excavations were made about four feet deep and five or six feet wide and filled with carefully sized stones. Frost conditions were of course unknown in the tropical regions then inhabited and traffic was slow. Furthermore the work was done by slaves at practically no cost to the governments so that while some of these roads exist to the present day their methods cannot be applied to our problems of modern road construction. Many of these problems have arisen out of the development of the motor car and highway construction is forced to keep pace with the latter from year to year.

Some indications of the extent of highway development in Canada were given in the figures presented by Mr. Miles. The total allotment of $20,000,000 given by the federal government under the Canada Highways Act of 1919 had all been paid to the provinces concerned by 1928 and of the 8,737 miles of road under agreement, 8,105 miles were actually built and 563 miles were under improvement. In this same connection the Ontario Highway system and the methods of financing same were explained.

In conclusion Mr. Miles dealt with the trend of highway construction indicating the points of traffic density at which improvements became necessary and recounting the many benefits both economic and social arising out of a properly organized system of highway development.

J. A. Lalonde, A.M.E.I.C., occupied the chair and H. S. Van Scoyoc, M.E.I.C., moved a hearty vote of thanks to the speaker for his very interesting paper.

North Toronto Sewage System

A very interesting paper on the North Toronto Sewage System was presented before the Branch by George Phelps, A.M.E.I.C., assistant city engineer of the City of Toronto, on March 27th.

The design and construction of the main trunk sewer were dealt with in considerable detail and slides were shown illustrating the various phases of the work as it progressed. The North Toronto system required approximately four years for its completion and cost in the neighbourhood of $10,000,000. The natural slope across the North

Toronto district is from northwest to southeast and several natural watercourses had to be incorporated in the system. These were carefully gauged for a number of years and studies of rainfall and runoff were also made, in order to obtain accurate data on which to base the design of the main trunks. Owing to the profile of the territory in question a great deal of the main trunk section had to be placed at considerable distances below the surface and as this involved tunnelling in wet sand and clay some very interesting engineering problems arose.

Practically all of this work was done in compressed air and in the beginning there were no governmental regulations covering such conditions. However, in a short time, proper rules were drawn up and full provision made for the proper handling of men under competent medical supervision. An age limit of 35 was set for all workers and under a pressure of 22 pounds a man was not allowed to work more than two 4-hour shifts per day.

The majority of the sewer construction was carried out in brick but a certain amount was done in concrete when it was found more economical to do so.

The sewage from the North Toronto system is being handled at present by old disposal plant but as it is out-of-date plans have been prepared for its replacement at an early date.

At the conclusion of Mr. Phelps' paper a considerable amount of discussion followed, Messrs. T. J. Lafrenière, M.E.I.C., W. S. Lea, M.E.I.C., J. G. Caron, A.M.E.I.C., and D. C. Tennant, M.E.I.C., taking part. The thanks of the meeting were conveyed to the speaker by Geo. R. MacLeod, M.E.I.C., who presided.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

"Canada, a Land of Opportunity" was the subject of an address delivered before the Branch on February 20th, by C. H. Wright, B.Sc., M.E.I.C., district manager and engineer of the Canadian General Electric Co., Halifax. The meeting was open to the public and was held in the City Hall, the Council Chamber being taxed to capacity. F. O. Condon, M.E.I.C., presided.

Mr. Wright's address dealt with the minerals, water powers, agricultural and forest products of Canada, and was a most instructive and comprehensive survey of the physical assets of the Dominion.

Perhaps the most interesting point stressed by the speaker was the fact that there is no section of Canada that has not been abundantly blessed by nature either in mineral resources or products of the soil. The ore deposits controlled by one Canadian Company alone, exceed in value those of the Saar valley, the economic and real cause of the great war.

A vote of thanks was tendered Mr. Wright on motion of G. C. Torrens, A.M.E.I.C., seconded by G. E. Smith, A.M.E.I.C.

Two motion pictures were then shown, first "The Iron Mule," a humorous take-off on the early steam locomotive, and, second "Power," showing the construction and operation of the recent developments in steam and oil-electric locomotives.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

At Niagara Falls on April 10th our members assembled to hear John Murphy, M.E.I.C., of Ottawa tell of his recent trip to the World Engineering Congress, Japan.

Mr. Murphy spoke briefly of the history of this interesting country, "Nippon, the Land of the Rising Sun"—as the Japanese call it.

In 1868, said Mr. Murphy, the doors of Japan had been finally opened to the world. Japanese students were scattered all over the universe. They attended high schools and universities. They took apprenticeship courses in great works of every conceivable character. These students, now mature experts in their respective spheres, are today the backbone of Japan's progressiveness. She is, so far as manufactured things are concerned, absolutely self-sufficient. Her initiative powers are illustrated in many power plants where, side by side, her own machines are in operation—exact duplicates of those first obtained in other countries.

Japan has a population of some 63,000,000 although her territory is only three times as great as the combined areas of Nova Scotia and New Brunswick. Since the era of modernization these people have acquired a feeling that they are perhaps a trifle superior to the rest of the world and were quite shocked when the United States prohibited further immigration.

Over-population, the need of finding work for the men and women, prevents the adoption of many labour-saving machines but where power is actually needed it is skilfully and economically employed. Fifty thousand horse power is used for pumping water to the rice fields. Japan's water power development totals 2,500,000 horse power—with as much more arranged for. There are steam plants aggregating 1,500,000 horse power. The largest hydro-electric development is in Korea—190,000 k.w.

Tokyo is a city of 2,500,000 population with a similar number within hailing distance. Since the earthquake it has been modernized in many respects with wide boulevards, fine stone and concrete buildings and some 527 bridges. $23,000,000 were spent on bridge construction within five years. Five hundred million dollars have been spent on the reconstruction of Tokyo, the national capital.

The Engineering Congress met between the dates of October 28th and November 10th, 1929, in the Parliament buildings in Tokyo. Including ladies, there were 300 delegates from the United States, 100 from the United Kingdom, and 4 from Canada. The total registration exceeded 3,000. Nine hundred papers were prepared and the organization which controlled the presentation of this enormous mass of knowledge was perfect.

Japanese "secretaries" had, in advance, made synopses of all the papers and had merged the synopses into "groups for discussion." The secretaries read their "reports" at the openings of the sessions and "discussions" followed. All the proceedings were in English. Occasionally a Japanese engineer used his native tongue and, then, his statement was translated into English. At no session attended by Mr. Murphy was any statement translated into Japanese although the chairmen always asked the audiences if they wished for a Japanese translation.

English is compulsory in the schools. The railway stations have their English names conspicuously posted. The traffic signs on the streets bear the words "stop" and "go"—in addition to the Japanese characters.

The four Canadian delegates sailed from Vancouver on October 17th of last year and were received with the utmost courtesy by the Japanese customs officials (who passed their luggage without any inspection) and by the Canadian diplomatic representative, the Hon. Herbert Marler, and Mr. James Langley, the Minister of Japan, and the Trade Commissioner, respectively.

Although not on the agenda, Mr. Murphy had brought with him some moving pictures depicting the formation of frazil ice and some of the remedial measures used in Canada. He was promptly given a place on the calendar. It appears that there are frequent ice troubles at Japanese northern power stations.

Three major resolutions were adopted at the Congress. First looking towards a world-wide organization or federation of engineers; secondly regarding government subsidies to control and remedy floor conditions; and thirdly, some united action for uniform and safe design or construction of dams and an investigation of their internal stresses and hydrostatic uplift.

The announcement by Mr. C. W. Stone of Schenectady that a new thyratron tube had recently been perfected which would transform a.c. to d.c. current, or vice versa at practically no loss and that it would revolutionize power transmission, created considerable interest. A trial with 20,000 volts, 100 amperes, resulted in an efficiency of 99.94 percent.

Many very beautiful lantern slides illustrated his talk. He also took the unusual but extremely thoughtful course of congratulating the lantern operator upon his skilful handling of these slides. The operator was overcome.

Harry M. King, M.E.I.C., and A. L. Mudge, M.E.I.C., both brother electricians, were allowed by Chairman Cameron to express the gratitude of the Branch.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

The Engineer and Industry

The place of the engineer, particularly the mining engineer, in industry and his contribution toward the welfare of the general public was the subject of a noon luncheon address by G. C. Bateman, secretary of the Ontario Mining Association, before the Ottawa Branch, on the April 10th at the Chateau Laurier.

The mining industry, stated Mr. Bateman, had been somewhat retarded of late but had by no means gone to pieces; it was basically too sound for that. This industry, in common with other basic industries, sometimes suffered from causes originating outside itself, relating to the disposition on the part of some to capitalize the cupidity and gullibility of the general public in their desire for large financial returns. In spite of what others may think or say, the mining industry does not depend for its advancement or enlargement upon the mining broker, but rather upon new discoveries, new areas being opened out and new developments. These have recently been all too few.

The broker, however, does have an important part. In this age of specialists his part should be that of a security merchant rather than that of a promoter. In the matter of the promotion of properties, also, mining is too big to cater to practices that cannot be approved; if the industry is to advance, higher standards in the matter of financing must prevail.

Mr. Bateman also gave it as his opinion that there are too few engineers who take part in public, municipal, and civic affairs. This is often due to the engineer's desire to concentrate upon his own particular job as the one important thing in life; or sometimes in the case of the impermanently placed engineer upon the diffidence he has in inserting himself into the affairs of the permanent residents of a community. As a result, municipalities have often suffered through a lack of most valuable aid that engineers could have given.

The mining engineer in the past has been looked upon as a roving individual but this has been gradually righting itself, partly on account of natural evolution, and partly on account of the develofment in many places of large propositions which have assured a longer life in their utilization. Big business is also coming to recognize more and more that engineers can fit into the administrative, as well as the purely technical, part of industrial organizations and engineers are accordingly beginning to find places as executive heads and upon boards of directors of large business firms, banks, public service corporations, etc.

The matter of research is also one which is taking a more and more important part in industry. In United States it has been stated that advancement along technical industrial lines has been due in a large part to the close contacts maintained between the technical schools and colleges and the large industries. This has unfortunately not been true to such a great extent in Canada, but the condition has been gradually righting itself in our own country. In this connection, the speaker touched upon the work of the Technical Service Council, an organization conceived by engineers and of which the director and secretary is an engineer.

Today, there is a greater diversification in the products of industry than formerly, so that less and less of the country's prosperity depends upon any one industry alone. It is well that this is so, as the effects of failure are thereby minimized in any one line as, for instance, in Canada at the present time in connection with the inadequate marketing of her wheat crop. However serious that may be, it is not as serious as it would have been a few years ago. The mining industry in Canada is, with the exception of agriculture, the leading industry in the country. In Ontario metals in excess of one billion dollars in value have been produced, and there is an assured future in sight for several times this amount. The annual production in Ontario is one hundred million dollars and in Canada over three hundred million dollars. In northern Ontario alone fifty million dollars a year is paid out in wages and in supplies and a lesser sum of twenty-seven million dollars in dividends.

The new spirit of confidence which slowly began to permeate Canada after the Great War did not originate solely through a realization of the possibilities of the thinly settled southern sections of Canada. There was associated with it a thought of the future possibilities of the vast area lying beyond the frontier. In a realization of those possibilities the engineer has taken and will continue to take a greater and greater part.

The life of the engineer, concluded the speaker, is truly one of romance and adventure. He goes out into the waste places and makes them productive. He brings to the development of the resources of a region his vast experience and by his contribution removes much of the drudgery, much of the human toil from labour, with the result that the world is made a much better place in which to live. He, with his wider vision and with the resources of science which are at his disposal, adds greatly to the sum of human happiness of the people of the world today.

The Technical Service Council

The work of the Technical Service Council in its endeavour to further the collaboration of science with industry and to stem the exodus of technically trained Canadians was outlined at a noon luncheon address at the Chateau Laurier on March 27th, by Lt.-Col. R. E. Smythe, B.A.Sc., D.S.O., M.C., director and secretary of that organization. The chairman, John McLeish, M.E.I.C., presided.

Col. Smythe in his opening remarks stated that the Technical Service Council was so far an experiment only, intended to cover a period of about three years in its endeavour to see what can be done toward bridging the gap between industry and education. The amount estimated as necessary to cover the expenses of the organization for this period of time was subscribed by a number of Canadian industries, to whom an appeal was made. When it has been expended, the matter will come up for further arrangement, if the experiment will then appear to have justified itself. Regarding this latter, there would seem, however, to be little doubt.

The Council has four objects: first, to retain for Canada young Canadians educated along technical and scientific lines; second, to bring graduates of universities and technical institutions into practical contact with Canadian industry; third, to submit to universities the recommendations of industry concerning scientific courses; and fourth, to aid industry in their technical and scientific employment problems.

In commenting upon the efforts put forward by the Council in conformity with these objects, the lecturer quoted a number of interesting figures relating to the subject. Thus, of the entire class who graduated in 1923 from the faculty of applied science of the University of Toronto, some 240 strong, there were 24 per cent who left Canada. In 1925, there were 27 per cent, and in 1926, there were over 20 per cent. Also, from a census taken five years after graduation of the technically trained graduates from another university there were 25 per cent in professional work, 41 per cent in the general industrial field, 16 per cent in commercial life, 4.5 per cent in financial pursuits and the rest in governmental and other types of work.

During the past two decades or so a great change has come over the engineering profession. Then it was the usual thing for graduates in civil engineering from technical universities to equal the total number of graduates in all other engineering branches. At the present time the graduates in civil engineering are only about 21 per cent of the total. Those in mechanical engineering average about 35 per cent, in electrical engineering 21 per cent, in chemical engineering 14 per cent, in mining 8 per cent and in metallurgical work, 3 per cent.

At the close of Col. Smythe's talk, a short period was taken up in discussion.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.

Ball and Roller Bearings

An address on the above subject was given before the Branch on March 27th, 1930, by Mr. Runge, general superintendent of the S. K. F. Company. The speaker was introduced by V. S. Foster, A.M.E.I.C., chairman for this meeting.

He first outlined the development of the S. K. F. Company which now has 24,000 employees and factories in many countries.

The prime requisite in the manufacture of anti-friction bearings is extremely pure material, and nearly all the steel in S. K. F. bearings is made from Swedish iron, well known for its high quality.

Mr. Runge described and illustrated by slides the various types and forms of S. K. F. bearings and their application, and then proceeded to cover in detail the manufacturing processes.

In the manufacture of balls the material used is steel containing approximately one per cent carbon and chromium content is .40 to 1.60 per cent. The use of chromium produces more uniform hardening. The first operation in the manufacture of balls is cold pressing or cold heading as it is more commonly known. The material is fed into the machine from wire coils, cut off the desired size and the machine is capable of making 350 balls per minute ranging from ½ to ⅜ inches in diameter. Balls over one inch diameter are hot pressed and it is very important to have the correct annealing in the wire. Slugs are cut off and fed into a furnace then come through automatically and are placed in the dies.

Following this process is the normalizing or annealing operation. Balls then go through the filing machine which like all other machines in the factory is of special design made specially by the S. K. F. Company for their own particular needs.

Going through another machine the balls are roughed up to an accuracy of 5 to 6 thousandths of an inch, after which they are placed in tumbling barrels containing water and emery. They now begin to approach some degree of accuracy and absolute roundness. The lining used for these barrels is rubber which was found most suitable after many tests with felt, wood and steel. The next stage in the manufacture is to the grinding machine composed of a very fine abrasive wheel. Another grinding after this in a slower machine is undertaken and the secret of accuracy is that the balls go through this operation so many times.

After grinding comes the hardening process; the balls are placed in special gas furnaces going in at the cold end and gradually working their way through to the maximum temperature after which they are immersed in a water tank for quenching. After quenching it is very necessary to draw back in oil at 350 deg. C. to relieve strains. Then back to the tumbling barrels for eight hours to take off the carbonised surface of the ball, then again to the grinding machine, for twelve to twenty hours of slow grinding under heavy pressure. The ball comes from this machine with an accuracy plus or minus of ½-10,000th part of an inch.

Balls are then inspected for surface finish by specially trained girls who look for fine cracks, soft spots and surface marks. The girls wear gloves so that the balls are not marked by the moisture of the hands, thus ensuring proper inspection.

The manufacture of the rings was also shown on the screen and conformed in the main to that adopted in the manufacture of balls. After hardening the rings are tested on a special magnetic machine to guarantee uniform hardness. The tester is similar to a radio set and is very satisfactory.

About 28 per cent of the factory employees are inspectors. Cleanliness observed in all operations in the manufacture of ball bearings is a remarkable feature. All slides bore out the speaker's statement in this respect and in the final inspection department all the employees are attired in white uniforms while the air is all filtered and changed every five minutes.

Before packing bearings are immersed in filtered oil and wrapped in grease paper prior to being placed in stock.

A vote of thanks was accorded the speaker by Ross L. Dobbin, M.E.I.C., who voiced the opinion of the gathering by commenting on the excellence of the address.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
Archie B. Crealock, A.M.E.I.C., Branch News Editor.

On the evening of Thursday, February 20th, 1930, the regular meeting of the Toronto Branch was held in the mining building of the University of Toronto. The speaker of the evening was Mr. A. W. Sime, technical engineer of the International Petroleum Company, who delivered a talk on "The Petroleum Industry."

Mr. Sime's lecture was indeed a very interesting one as he described the ramifications and the varied contacts of the petroleum industry and the indispensable part played by the engineer in the growth of this industry and the tremendous possibilities for his future activity. So embracing is the industry that the widest possible definition of the word "engineer" is necessary as every possibly type of practical man; every shade and grade of engineering trained man; as well as the geologist; the surveyor; the designing and erecting engineer be he civil, mechanical, electric or hydraulic; the chemist; the chemical engineer and the technical man who studies application of products are all found within the industry.

Mr. Sime outlined the beginning of the industry and the great development that has taken place all within the space of a lifetime—three score years and ten. Following on he described the various operations in their logical sequence, viz.—search, production, transportation, refining, distillation and application. In the search for oil Mr. Sime drew an interesting picture as he stated that the search for oil paralleled the search for other of nature's riches found in the ground, notably the search for gold with its possible accidental discovery, the rushes to a particular locality, the tremendous activity and the feverish excitement. The search for oil leads the prospector to work in mountainous regions, in dense tropical jungles, amid the palm groves, or on arid deserts of the south or the snowy plains of the north. In general the discovery of oil has been of spontaneous generation but here and there have been examples of more ordered, efficient and calculated search. In other words some fields bear the marks of the engineer. The men who blaze the trail are the geologists without whom no large modern producing company could hope to succeed. The geologist decides the location, advises as to the amount of preliminary work to be done, directs the sinking of the test holes. If the field to be tested is in an inaccessible part of the world the burden then falls largely on the surveying, constructional and mechanical engineers. The metallurgical engineer and the designing engineer are called upon when drilling starts as drilling apparatus and steels have to be used in holes that are at times from 6,000 to 8,000 feet in depth. The transmission of power in the rotary system through a 4½-inch pipe to the cutting edge at these great depths calls for intensive study and research work. The same is true of the cable tool method where the heavy bits are alternately raised and suddenly lowered to chew their way through by percussion. Following this Mr. Sime proceeded to describe the other troubles in drilling, the actual striking of gas or oil when pressures at times as high as 3,500 pounds per square inch are encountered. The next problem described was that of temporary storage reservoirs and the reduction of waste in storage and transportation as well as the removal of saline water which is some times found with the oil.

The transportation of the oil to the refinery is one of the greatest importance. The most common methods are pipe line, ocean going tank steamer or railroad tank car. For pipe line transportation it is necessary to make reconnaissance surveys of available routes and detailed estimates of the cost. With all the legal and engineering detail it corresponds to the construction of a new railroad. Mr. Sime stated that on this continent there are approaching 100,000 miles of pipe line from 4 inches to 12 inches in diameter forming a veritable network on the map. The relay pumping stations are usually located from 30 to 40 miles apart and pressures as high as 800 to 900 pounds are used for pumping purposes. The volume of oil carried by pipe lines runs much more than half a billion barrels per year, some of which is moved only a few miles while a large quantity is pumped 1,700 miles from oil field to refinery. The sea-going oil tanker is of modern design and equipment and the tonnage runs up to 25,000 tons, with ability to discharge her cargo of over 100,000 barrels and be away inside of 24 hours.

The refinery was next described by Mr. Sime. The refining process to express it in as few words as possible. is one of separation and purification. In the refining process they are always striving for higher yields, for closer uniformity of product and higher quality. All these have kept the refining engineer inventive, resourceful and extremely busy. At the conclusion of his address Mr. Sime showed a series of pictures describing the various activities of the industry.

A very hearty vote of thanks was tendered to the speaker for his interesting address.

Meeting of March 6th.

"Signaling, Its Relation to Speed and Safety of Railroad Operation" was the title of an interesting talk which was delivered on Thursday, March 6th, 1930, to the members of the Toronto Branch of The Engineering Institute by Mr. S. J. Turreff, assistant resident manager of the Union Switch and Signal Company of St. Louis, Mo.

In his lecture Mr. Turreff first dealt with the reasons which led up to signaling, the most modern branch of the railway field and then dealt with the purpose which it serves in American transportation. As always "necessity became the mother of invention" and the growth of signal systems began due to the undesirability and expense of stopping trains to permit trainmen to throw switches or flag crossing lines. The first signal systems were those consisting of a series of levers from which wire or pipe lines extended to switch operating mechanisms and fixed wayside signals. As time went on telegraph train orders and time tables were used exclusively for the spacing of trains. Following this came the automatic block signal which was made possible through the invention of the track circuit by Dr. William Robinson in 1879. The purpose served by the automatic block branch of signaling is to permit the operation of a greater number of trains within a given territory with as great a degree of safety as possible, when depending entirely upon the human element operating the train. Later developments in the signaling art have been developments of the general principles previously established by the interlocking and automatic systems, and always with similar objectives.

Continuing, Mr. Turreff gave a detailed description of the various systems in use to-day including cab signals and train control, centralized train directing system and electro-pneumatic car retarder in use in hump yard operation.

Following the lecture motion pictures were shown which illustrated clearly the two systems receiving the greatest attention from railroad officers to-day, namely, the centralized train directing system and the electro-pneumatic car retarder system.

Mr. Turreff's address and the motion pictures were thoroughly enjoyed by all and a vote of thanks was tendered to the speaker for his address and the showing of the pictures.

Annual Meeting

The annual business meeting of the Toronto Branch was held on the evening of Thursday, April 3rd, and was attended by a goodly number of the Branch members. In the absence of T. Taylor, M.E.I.C., the chair was occupied by L. W. Wynne-Roberts, A.M.E.I.C. The minutes of the last annual meeting were read and duly adopted. Following this the reports of the chairmen of the various committees were received. From these it was evident that the Toronto Branch is exceedingly active and that the membership is growing. J. W. Falkner, A.M.E.I.C., and L. A. Badgley, A.M.E.I.C., who were appointed auditors, reported that the books were in excellent condition. The scrutineers, Messrs. McMaster, Ferris and Dunbar, having completed the counting of the ballots, submitted their report to the chairman who announced the following members elected.

Chairman	J. J. Traill. M.E.I.C. (acclamation)
Vice-Chairman	C. S. L. Hertzberg, M.E.I.C.
Secretary-Treasurer	J. J. Spence, A.M.E.I.C.
Executive Committee	J. W. Falkner, A.M.E.I.C. (2 years)
	F. B. Goedike, A.M.E.I.C. (2 years)
	A. B. Crealock, A.M.E.I.C. (2 years)
	G. H. Davis, M.E.I.C. (1 year)

Mr. McCarthy then escorted Mr. Traill to the chair and in his remarks Mr. Traill thanked the members for their support. He stated that though it was customary to discontinue the meetings at this time, he was arranging for one more meeting in the month of April which he believed would prove of genuine interest and that further information would be sent to all members as soon as details were completed. The meeting closed with a vote of thanks to the auditors and scrutineers.

Joint Meeting

On the evening of Thursday March 20th, 1930, the Toronto Branch of The Engineering Institute of Canada held a joint meeting with the Association of Professional Engineers of the Province of Ontario. The meeting was an open one and ladies were invited. The speaker was Mr. B. R. Value, executive engineer representing Messrs. Parsons, Klapp, Brinckerhoff and Douglas, consulting engineers, Detroit, Michigan. The subject of Mr. Value's address was "The Design and Construction of the Detroit and Canada Tunnel." That the subject was a very interesting one was evidenced by the splendid turnout and all expectations were fulfilled as Mr. Value's lecture was most intresting and was thoroughly appreciated by all present.

Saint John Branch

E. J. Owens, A.M.E.I.C., Secretary-Treasurer.

Picturing a prosperous future for Canada in general and for the Maritime provinces in particular, C. H. Wright, M.E.I.C., president of the Halifax Board of Trade, addressed a meeting under the auspices of the Saint John Branch, Engineering Institute of Canada, in the Board of Trade rooms, March 20th. W. J. Johnston, A.M.E.I.C., chairman of the Branch presided, and there was a large attendance.

Mr. Wright gave much first hand information concerning different parts of the Dominion. During the last three years he had made two trips to western Canada.

Saint John, he said, along with Halifax, was among the greatest ports of Canada, and he predicted a prosperous future for both. The Dominion was second in the world in water power development per capita, with 9,000,000 horse power or one horse power per person, with possibilities for 33,000,000 horse power more. In the development of this additional power there would be a necessary expenditure of $90,-000,000, according to the pace set during the last two years. This water power development was saving 100,000 tons of coal daily for Canada, and the speaker mentioned the advantages of water power particularly in Ontario and Quebec, where there is no coal found.

Referring to mineral developments in Canada he pointed out that Canada took first place in the production of nickel and asbestos, second place in cobalt, third place in gold and silver, fourth place in lead and copper and sixth place in zinc. In connection with zinc half the total zinc produced in Canada went to Japan, which country consumed three per cent of the world's supply. There had been seven and a half billion dollars worth of minerals discovered in Canada which amounted to $700.00 per capita, and at present Canada's mineral production amounted to $5,000,000 each week with Canadian mineral production rapidly increasing.

In agriculture the Dominion had produced $1,000,000,000 annually, and the speaker mentioned the great wheat pool of western Canada, which he claimed was doing a business of $1,000,000 daily, and next to the Dominion government was doing the largest business in Canada.

He also touched on the annual income from forestry products, logs, firewood, pulpwood and pulp and paper, which totalled $400,000,000 annually.

Canada takes second place in export and world trade per capita, and he pointed out that of the agricultural products, Canadians were consuming 99 per cent of their egg production, 93 per cent of the bacon production, 95 per cent of the poultry production, 97 per cent of the lamb production, 99 per cent of the cheese production and 85 per cent of the beef production.

After speaking of the resources of British Columbia, Mr. Wright considered the Prairie provinces, pointing out that in Alberta, Saskatchewan and Manitoba the production of wheat had amounted to 270,000,000 bushels last year. The Peace river district with its 47,000,000 acres of rich black soil, and present population of 60,000 people, which was growing at the rate of 20,000 annually. In 1929 new homesteads taken up numbered 5,000 in this district, and the motor licenses for the same year numbered 2,500. He predicted that in 10 years this district would be capable of producing 100,000,000 bushels of wheat annually, if there was a demand in the world for such a large increased production.

Dealing with Nova Scotia, he stated the coal and steel industry was as important to that province as the pulp and newsprint industries were to New Brunswick. In touching on the various industries of the sister province he made particular mention of the apple production of the Annapolis valley and the fishing, the newsprint and tourist industries, pointing out their individual importance to the economic welfare of the province. Speaking of the province of Prince Edward Island he told of the potato growers there receiving an increase of $5,000,000 for their potato production last year.

Of New Brunswick he told of an increase of $7,476,000 in 1929 field crops over 1928, and of the great strides being made by the pulp and newsprint industry with still greater development to follow. In this connection the whole northern part of the province had been converted from a land of stagnation to a land of marked activity by the paper industry development there.

Referring to the tourist revenue received by New Brunswick, Mr. Wright asserted that good roads and more good hotels would result in the $15,000,000 revenue received last year being doubled in the next few years. In conclusion he pointed out that the Canadian National Railways in 1929 spent $2,500,000 on capital expenditure in the Maritimes, and $30,000,000 on regular maintenance and operation, while the Canadian Pacific Railway had spent $2,500,000 on capital expenditures. The C.N.R., he said, had left with the British Empire Steel Corporation in 1929, $14,000,000, and the C.P.R., $4,750,000. In the last 18 years the C.P.R. has given Besco $50,000,000 worth of business. This, he said, is what transportation means to the Maritime provinces.

Mr. Wright was complimented on his address by F. M. Sclanders, commissioner of the Saint John Board of Trade, who briefly touched on conditions in the Maritime provinces as well as in western Canada, where he had spent many years.

A vote of thanks, moved by F. P. Vaughan, M.E.I.C., and seconded by G. G. Murdoch, M.E.I.C., was extended to the speaker by the chairman.

Joint Meeting

A joint meeting of the Saint John Branch of The Engineering Institute of Canada and the University of New Brunswick Engineering Society was held in Fredericton on April 4th.

H. L. Campbell, President of the University of New Brunswick Engineering Society, welcomed the guests and then turned the meeting over to W. J. Johnston, A.M.E.I.C., who spoke for a few minutes on the aims and objects of The Engineering Institute of Canada. He then introduced the speaker of the evening, F. P. Vaughan, M.E.I.C., who read a paper on "High Potential and High Frequency Apparatus" and also did a number of experiments. The apparatus used in this connection was later donated to the University of New Brunswick by Mr. Vaughan.

He stated that while the production of high potential and high frequency currents for the use of condenser discharge is not new, they are rapidly becoming of commercial importance and are used very extensively today in wireless telegraphy and telephony, the testing of high voltage insulators and lightning arresters, the production of ozone and nitrogen, X-ray work, high frequency furnaces, the electro culture of plants, and when properly used and applied to electro therapeutics have produced some remarkable results.

Alternating currents met with in commercial use are of relatively low frequency. When the frequency is from 1,000 to 100,000 they are called high frequency currents and when the frequency rises to a million or so they are called electric oscillations.

We are concerned with an alternating current of very high frequency which consists of separate groups of alternating currents, each group beginning with the same amplitude but damping down more or less rapidly to zero and after a short period of time beginning again. These are known as damped electric oscillations. The rate at which the amplitude dies away in each train is called damping. A train of very few oscillations is called a highly damped train and over 100 a feebly damped train.

Until quite recently there were but three practical methods by which high frequency currents could be generated. One of these methods employed an alternating current generator of special construction, having a very large number of stator pole pieces and the rotor drives at a very high rate of speed, 10,000 to 20,000 r.p.m. The maximum frequency obtainable by this method is about 100,000 cycles per second and includes machines of this type developed by Nikola Tesla, R. A. Fessenden and E. F. W. Alexanderson, whose latest machine is rated at 200 k.w., the rotor of which weighs 3½ tons and has a speed of 2,100 r.p.m., the whole machine weighing 12 tons and has a frequency of 22,000 cycles per second. The results to be obtained by this method are by means of a very extensive machine although they undoubtedly possess great advantages in radio telephony.

Another type of high frequency alternator, operating on the principle of electrical resonance, has been developed by Dr. Goldschmidt, which generates radio currents at frequencies from 30,000 to 75,000 cycles per second.

The second method is by means of the direct current arc, when an ordinary arc is shunted by a suitable inductance and capacity, sustained oscillations are set up in the circuit. This method produces a persistent or undamped wave and has been successfully developed by Duddell and Poulsen and is used successfully for wireless telegraphy and telephony.

The latest development for the generation of undamped oscillations is the thermionic vacuum valves, such as the General Electric Company pliotron oscillators, being a highly exhausted two or three element valve of enlarged dimensions.

The third and most well-known method of producing high frequency currents, due to Lord Kelvin, but better known by the experiments of Nikola Tesla, is by the discharge of a condenser, the same being charged to a high potential and discharged through a circuit having inductance and low resistance, a train of oscillations being set up at every discharge of the condensers. It is necessary to arrange the circuit for the production of the trains of damped electric oscillations by condenser discharges so that the inductive circuit is in service with the condenser. This usually consists of a transformer containing no iron, called an air core transformer. Two circuits are wound one over the other and high insulated from each other. One of these is called the ordinary, the other the secondary. The primary circuit is arranged in series with a condenser and spark gap, this being the circuit in which the oscillations are set up by the discharge of the condenser. The oscillations in the primary induce other oscillations in the secondary, and if the secondary has a greater number of turns than the primary the secondary voltage will be greater than the primary in the following ratio. If the two circuits, that is the primary and secondary, are more or less widely separated or loosely coupled and tuned in resonance, the damping being negligible, the ratio of transformation is determined entirely by the capacities in the two circuits, but when the circuits are close together or closely coupled, but not tuned in resonance, the ratio is determined by the relative number of turns in the two circuits.

Current is applied to the apparatus at a voltage of 110 volts. This first passes through a variable inductance, which is in series with the primary of the transformer and in some cases serves to limit the current supplied. The transformer consists of a core type transformer having a primary and secondary wound on each leg. The primary of 110 volts supplied to the primary is stepped up to ten or twelve thousand volts, due to the difference in the ratio of the number of turns on the two coils. The secondary circuit is hunted with a variable condenser which is in series with a spark gap and the primary of the oscillations increasing to many thousands of volts.

The discharge across the spark gap is practically a short circuit across the secondary terminals of the transformer and if this arc is not suppressed or broken up, there will not be a true oscillatory discharge in the condenser circuit or at best only a weak one, for the reason that as the arc discharge holds, the secondary terminals of the transformer are reduced in voltage and not until the arc is destroyed that the spark gap can build up a sufficient difference of potential to give a fresh charge to the condenser. The inductance and capacity of the secondary systems also influence the number of discharges obtainable during an alternation. The less the inductance and capacity of the condensers connected to any given oscillator, the greater the number of discharges obtainable per second and likewise if the inductance and capacity of an oscillator be reduced, the rate of sparking will be increased. When the gap is long more energy is stored up in the condenser but as it is only charged once or twice per half cycle the total available energy may be less than when a short gap is used. With a short gap the charging and discharging takes place many more times per half cycle although not as much energy is stored up in each charge. The length of the spark gap is determined by the type of service required. If we require long sparks from the secondary of the high frequency transformer or oscillator, the spark gap in the condenser circuit should be long; but when a high effective current is required the gap should be short. If, however, the gap is made too short, a flaming arc will occur in place of a long bright spark and no oscillations or only weak ones are set up for the reasons as stated before. On account of the exceedingly high frequency of the oscillatory discharge of the condenser the inductive effects are remarkable, considering the small quantity of electricity stored in the condenser.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting

The thirteenth annual meeting of the Branch was celebrated by a banquet at the Kitchener hotel, Regina, on the evening of March 21st, 1930. H. R. Mackenzie, A.M.E.I.C., Chairman of the Branch, presided over the gathering which numbered thirty-eight.

The Chairman opened the meeting by proposing a toast to The King, after which the following guests were introduced:— J. B. Hamilton, a former member of The Institute and formerly of Estevan, Sask., H. B. Brehaut, A.M.E.I.C., now of Regina, but until recently with the C.N.R. at Saskatoon, Sask., E. S. Carpenter, a graduate in engineering from the University of Saskatchewan and son of H. S. Carpenter, M.E.I.C., W. G. Dyer, B. W. Sewell, and Dr. J. S. Huff, Commissioner of Education for Saskatchewan.

J. R. C. Macredie, M.E.I.C., of Moose Jaw, Sask., sent his regrets at his inability to attend the meeting.

The report of the Legislation Committee was presented by the Chairman of that committee, P. C. Perry, A.M.E.I.C. The report indicates that the Engineers Bill now before the Legislature of Saskatchewan has reached the final stages and is expected to receive its final reading soon. The thanks of the meeting were tendered Mr. Perry and his committee, also H. R. Mackenzie, A.M.E.I.C., Chairman of the Branch, and to Hon. A. C. Stewart, Minister of Highways, and Mr. G. Bennett, M.L.A., for their efforts in bringing this Bill to the present stage.

The report of the Papers and Library Committee was presented by the Chairman of that Committee, Stewart Young, A.M.E.I.C. The meeting passed a vote of thanks to this committee for the excellent work which they had performed during the past year.

The report of the Executive Committee was presented by the Secretary-Treasurer, R. W. E. Loucks, A.M.E.I.C. This report shows the Branch to be in a healthy condition with a total membership approximately the same as for last year.

The scrutineers Messrs. Harry Jones, S.E.I.C., and G. G. Fitzgerald, A.M.E.I.C., reported the election of officers as follows:—

Chairman—Prof. W. G. Worcester, M.E.I.C., University of Saskatchewan, Saskatoon, Sask.
Vice-Chairman—D. A. R. McCannel, M.E.I.C., City Commissioner, Regina, Sask.
Executive—(2 years)—
J. M. Campbell, A.M.E.I.C., Moose Jaw.
D. A. Smith, A.M.E.I.C., Regina.
R. A. Spencer, A.M.E.I.C., Saskatoon.
Nominating Committee—
R. N. Blackburn, M.E.I.C. (Chairman), Regina.
A. M. Macgillivray, A.M.E.I.C., Saskatoon.
H. R. Mackenzie, A.M.E.I.C., Regina.
H. McIvor Weir, M.E.I.C., Saskatoon.
G. M. Williams, A.M.E.I.C., Saskatoon.

Messrs. O. Inkster, A.M.E.I.C., and C. D. Lill, A.M.E.I.C., were elected as auditors for the ensuing year.

H. S. Carpenter, M.E.I.C., on behalf of the Branch presented a gold membership badge to M. B. Weekes, M.E.I.C., a past Chairman, in token of their appreciation of his services to the Branch. Mr. Weekes suitably thanked the Branch for the action taken.

J. R. Reid, A.M.E.I.C., who is now living in Regina was introduced to the meeting and spoke briefly. Messrs. H. G. Phillips and W. E. Denley, A.M.E.I.C., spoke on behalf of the highway engineers who will shortly be leaving Regina to take charge of the newly organized districts in the province.

The business of the meeting was interspersed by songs rendered by Mr. Forbes Roberts accompanied by Mr. Dickenson.

Address By Dr. J. S. Huff

Dr. J. S. Huff, Commissioner of Education for the Province of Saskatchewan, gave a very interesting address on the new curricula for secondary or high schools. He stated at the outset that this was his first public utterance outlining the scope of the new curricula now in course of preparation by educational experts of the province, covering 'teen age children and which it is hoped will be ready for introduction into the schools by September 1931.

In framing the curricula Dr. Huff stated that the social and economic needs of the individual as they are interpreted by the experts will be the sole basis of fixing the various courses of study, regardless of anything that has been or now is in existence.

He stated that there should be no break in a child's 12 year course of study taking him through the public and secondary schools, but that the first six years of his course should train him to speak, read, and write English with accuracy and precision and with some degree of fluency and that he should have mastered the number relations necessary in the ordinary business of life. In the following three years the individual should have an opportunity of expanding into fields of observation and scientific record that have to do with the common professions of the people of the province.

The new curricula will be founded on three basic principles: the development in the pupils of health and happiness, the economic and social efficiency including citizenship and character training, and recreation or the employment of leisure hours for the enrichment of life. In the secondary schools the child should have an added opportunity to explore possible life vocations, and for this purpose courses have been designed relating them to the needs and environment of the child. Agriculture, the basic industry of the province, will be given prominence in the new course of study, which will also include studies in geology and those subjects related to the development of the natural resources of the province.

In the new curricula plans have been made for preparing the pupils for the vocations of life under four headings:—

1. For entrance to teacher training schools.
2. For entrance to technical schools.
3. For entrance to university arts courses.
4. For entrance to business and commerce.

In all these courses the number of subjects will be materially reduced from the number now prescribed. As the pupil advances he will be given more optional subjects and fewer compulsory ones. Provision will be made to allow bright pupils to combine two courses, such as the teacher training course and university matriculation.

Dr. Huff concluded his address by stating that the framing of the new curricula is a scientific matter and must be founded on public opinion. He made a plea to the engineers of the province to aid the department in cultivating public opinion in harmony with the scientific plans of the experts.

In the discussion which followed the engineers voiced their approval of the new curricula which they felt would place our schools on a much higher plane than in the past.

Report of Executive Committee

To the members of the Saskatchewan Branch, The Engineering Institute of Canada:

Your Executive Committee respectfully submits the following report covering the conditions of the Branch and its operation during the past year:

The membership is 118 as compared with 121 reported at last annual meeting, and is made up as follows:—

Honorary Members	1
Members	16
Associate Members	78
Juniors	6
Students	10
Affiliates	2
Branch Affiliates	5
Total	118

The Executive held seven meetings for the transaction of Branch affairs. There were six regular meetings of the Branch and one special meeting—this latter taking the form of a dinner dance to which the ladies were invited. Ladies night proved to be an enjoyable and highly successful event.

Our Councillor, D. A. R. McCannel, A.M.E.I.C., attended the Plenary Meeting of Council at Montreal in October last, and gave the Branch a full report of matters dealt with at that meeting.

Special matters referred to the Executive were dealt with by that Committee and in some cases by the Branch at the regular meetings. As you are aware, the Executive passes upon and makes recommendations on all applicants for admission and transfer within Saskatchewan, and a number of these were dealt with. The question of securing legislation incorporating the engineers in Saskatchewan has been one of the important events of the year. This matter has been handled mainly by the Legislation Committee.

In May 1928, H. S. Carpenter, M.E.I.C., was elected to the senate of the University of Saskatchewan for a term of three years as a representative of the Saskatchewan Branch of The Engineering Institute of Canada. The privilege of having a representative from this Branch on the senate was granted on the request of the Branch Executive.

We are honoured in having Prof. C. J. Mackenzie, M.E.I.C., Dean of Engineering at the University of Saskatchewan, as Vice-President of Zone A for another year. Dean Mackenzie has served on several important committees of The Institute during the past year.

The annual scholarship of $50.00 offered by the Branch to the most deserving student in the graduating class in engineering at the University of Saskatchewan was awarded to Mr. B. P. Scull of Saskatoon, Sask.

The average attendance at the Branch meetings has been 34, exactly the same as for last year. Each meeting has been preceded by a banquet. The programme, as arranged by the Papers and Library Committee, has resulted in considerable interest on the part of all members in attendance. Your Executive is highly satisfied with the general interest displayed in the affairs of the Branch.

Attached hereto is the financial statement for the year, showing revenue and expenditure, also assets and liabilities. This statement has been examined by your auditors. Although no Branch assessments have been levied since 1925 the assets show a surplus over liabilities of $615.63 being an increase of $4.89 over the surplus shown last year. Accounts payable this year are $18.56 as against $21.84 last year. Branch News produced a revenue of $36.98. The meetings have been practically self-sustaining.

On behalf of the Executive,
R. W. E. Loucks, A.M.E.I.C., *Secretary-Treasurer.*

Financial Statement 1929-30

Revenue

On hand from 1929	$255.07	
Headquarters rebates	280.05	
Branch dues	18.00	
Branch News	36.98	
		$590.10

Expenditure

Office expenses	$ 52.39	
Meeting expenses	73.10	
Honorarium	130.00	
Scholarship	50.00	
Sundries	30.90	
Bank balance	253.71	
		$590.10

Assets

Bank balance	$253.71	
Est'd. Headquarters rebates 1930	271.20	
Est'd. Headquarters arrears	99.28	
Est'd. Branch Dues 1930	10.00	
Furniture and library	50.00	
		$684.19

Liabilities

Scholarship for 1930	$ 50.00	
Accounts payable	18.56	
Surplus	615.63	
		$684.19

This is to certify that we, your auditors, have examined the books and vouchers of the Saskatchewan Branch, The Engineering Institute of Canada, and believe the above statement represents the correct financial position of the Branch.

(Signed) David D. Low, Jr.E.I.C.
W. H. Hastings, A.M.E.I.C.
Auditors.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting of the Sault Ste. Marie Branch was held in the Y.W.C.A. rooms on March 28th. A. M. Wilson, Jr.E.I.C., of the lands department of the Algoma Central Railway, read a paper on "The Construction of the Michipicoten Coal Dock."

In introducing his subject Mr. Wilson gave a brief account of the reasons for building a coal dock at Michipicoten. Paper mills, railways and mining operations are large consumers of coal in the districts of Algoma, Cochrane, the western part of Sudbury and the eastern part of Thunder bay district. To provide cheaper transportation for this coal which is brought by boat from the northeastern United States the Algoma Central Railway decided to develop the already partly developed Michipicoten harbour as a coal dock. This greatly reduces the rail haul as previously this coal had to be transshipped at Sault Ste. Marie.

Michipicoten harbour was developed originally about 1900, to serve the iron mines and is connected to the main line of the railway by a branch. The old dock was demolished in 1928 and in the winter of 1928 and 1929 a survey of the harbour was made, soundings being taken through the ice. Rock was found at depths of from 22 to 55 feet. It was then decided to build wooden cribs to be sunk five feet below the dredged channel. These cribs, and the space immediately behind them, were filled with iron ore waste which was obtained from a nearby source. The remainder of the fill, an area about 300 feet wide and 500 feet long and triangular in shape, was filled with gravel obtained from a high bank alongside the track about seven miles distant. The dock top was built on a continuous line along the top of the cribs and tracks laid on the raised fill behind the dock front. On the runways of the coal bridge 100-lb. C.P.R. section rail was laid. The coal bridge is a rope trolley steam operated type, the framework being of rugged steel construction. It is designed to unload stock, reclaim and load out bituminous coal at the rate of 500 net tons per hour.

A vote of thanks was tendered Mr. Wilson by Messrs. A. H. Russell, A.M.E.I.C., and W. S. Wilson, A.M.E.I.C.

Following Mr. Wilson's paper L. F. Harza, M.E.I.C., consulting engineer of Chicago, who is associated with the Algoma District Power Company, gave a talk on "The History of Dam Construction" or "Types of Dams." Mr. Harza illustrated his talk with blackboard sketches.

Earth, loose rock, masonry, and the largest concrete dams are of the gravity type. Earth dams well packed and containing some clay are as tight or tighter than concrete dams. It is now customary to put drain pipes in the lower toe to take care of any seepage. They are built as high as 250 feet.

Hydraulic filled earth dams originated west of the Rockies. Properly constructed the hydraulic-filled gives the tightest dam known.

In rock-filled dams the main fill consists of rock. A masonry wall is put on the face and this topped with a concrete slap. This type is used where it is hard to get concrete material.

Lately several new types of dams are being designed to compete with the gravity dam in order to cheapen the cost. Such a one is the Coolidge dam, a modified multiple arch dam, called a dome dam. Difficulties arise due to shrinkage, setting and compression which all tend to shorten the arches which factors all have to be taken care of in the design.

A vote of thanks was tendered Mr. Harza by F. Smallwood, M.E.I.C., seconded by all present.

Victoria Branch

K. M. Chadwick, M.E.I.C., Secretary-Treasurer.

On Friday, March 28th, The Victoria Branch of The Engineering Institute of Canada held a most successful dinner and smoking concert at Hamsterley Lake Side (near Elk lake), when some forty members and guests were present. The chair was occupied by Patrick Philip, M.E.I.C., ably supported by the Honourable F. P. Burden, Minister of Lands, J. E. Griffith, M.E.I.C., Deputy Minister of Railways, and J. P. Forde, M.E.I.C., district engineer of the Dominion Public Works.

Mr. Philip referred to the activities of the profession, laying stress on the desirability of the amalgamation of The Engineering Institute with the various provincial societies of the Professional Engineers, on which problem committees of both organizations are now engaged.

He paid a compliment to the committee responsible for such a successful evening and recommended that a similar gathering should be held quarterly each year. This success was attributed chiefly to I. C. Barltrop, A.M.E.I.C., O. W. Smith, M.E.I.C., H. F. Bourne, A.M.E.I.C., Chairman of the local Branch, and K. M. Chadwick M.E.I.C., Secretary of the local Branch.

Following Mr. Philip's speech Bob Webb led the gathering in community singing. Hon. F. P. Burden proposed the toast of "The Profession," and spoke of the need of the engineer in the development of the country. He also reviewed the work of the many and varied branches of engineering which members of the profession were called upon to undertake.

J. P. Forde, M.E.I.C., spoke of the good work done during the late government's regime by Hon. Messrs. Pattulio and Sutherland, late Minister of Lands and Minister of Public Works, in raising the status of the profession in the public mind, which good work was being carried on by the present ministers, Hon. F.P. Burden and Hon. N. S. Lougheed.

An excellent musical programme and sketch followed, the efforts of Messrs. Bob Webb, Frank Allwood and G. Ingledew being much appreciated. Musical accompaniment was ably provided by Percy Fletcher. A most enjoyable evening was terminated by the singing of "Auld Lang Syne."

The Steel Company of Canada, Limited has just issued a new booklet, which contains 12 pages with illustrations, explaining the advantages of "Stelco Scale Free Pipe."

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

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CHIEF ENGINEER, twenty years industrial construction, production and operation. Structures, equipment, steam, hydro. Experienced in conferences, preliminaries, organizing, preparing plans, estimates, specifications, negotiation contracts. Apply to Box No. 36-W.

CIVIL AND MECHANICAL ENGINEER, aggressive practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mill, desires change. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

CIVIL ENGINEER, graduate '15, with railroad, roads and municipal experience, desires spare time work in evenings and Saturday afternoons. Speaks French and English. Neat draughtsman. Apply to Box No. 55-W.

MECHANICAL ENGINEER, with twenty years experience in design, construction, sales and management desires position of an engineering, commercial or executive nature. College graduate, M.E.I.C., M.A.S.M.E., M.P.E.Q., and formerly chief engineer. Apply to Box No. 92-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal exgineering, construction work, inspection, estimating. Opening sought with architects as reinforced concrete designer and engineer; other opening considered. Toronto-Hamilton area preferred. Apply to Box No. 107-W.

CIVIL ENGINEER, graduate '26, with fair knowledge of French. Experience as instrumentman on surveys, maintenance engineer on railway construction, and resident engineer on railway construction. Available at once. Apply to Box No. 149-W.

CIVIL ENGINEER, B.Sc., Jr.E.I.C., with general engineering experience in construction, estimating, draughting, preliminary designing and building maintenance, desires position with opportunities. At present employed as buildings supervisor in public utility company. Available on short notice. Apply to Box No. 173-W.

ENGINEER, with over twenty years experience with leading industrial and construction companies in Canada with wide and varied experience in the construction, engineering and mechanical field, desires position as supervisor, estimator, or general superintendent of construction company. Age 51, married, bilinguist, A.M.E.I.C. Apply to Box No. 196-W.

ELECTRICAL ENGINEER, B.Sc., E.E., A.M.E.I.C., Canadian, age 29, single, graduate Canadian university 1924. Have been with large power company in U.S.A. since graduation, ten months on sub-stations, remainder of time on design, construction and operation of overhead and underground distribution and transmission system. At present employed by same company. Would like return to Canada. Available on reasonable notice. Apply to Box 236-W.

Situations Wanted

CIVIL ENGINEER. A.M.E.I.C., graduate, R.P.E.P.Q. Twenty years experience surveying and construction hydro-electric, railways, and paper mills, desires position. Will go anywhere if terms satisfactory. Apply to Box No. 294-W.

CIVIL ENGINEER, B.A., B.Sc., with six years experience on surveys; layout and construction of hydro-electric works; design of highway bridges and construction of highways; desires position as assistant engineer on design and construction of reinforced concrete and steel structures. Available on short notice. Location immaterial. Apply to Box No. 301-W.

INDUSTRIAL ENGINEER, thirty-five years of age, graduate of a well-known university, twelve years experience in design, construction, maintenance and changes in production methods in industrial plants, including several years in pulp and paper industry in complete charge in large mills of all engineering, maintenances, and development work; still engaged; desires to establish new connection. Apply to Box No. 320-W.

CIVIL ENGINEER, B.A.Sc., A.M.E.I.C., M.P.E.O., age 37, desires a permanent position as chief draughtsman or plant engineer, preferably in Toronto or district. Seventeen years experience with consulting engineers on industrial, structural and railway work, hydro-electric plants and pulp and paper mills. Some mechanical and electrical experience. Apply to Box No. 332-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country; twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Province. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, B.Sc., fifteen years experience, including surveying, construction, mining and tunnelling. Available at once. Will go anywhere, but prefer Eastern Canada. Apply to Box No. 346-W.

CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Apply to Box No. 352-W.

SUPERINTENDENT, competent electrical superintendent, wishes position with large industrial or power supply company. New construction programme preferred. Experienced in engineering, designing and electrical construction of power houses, sub-stations and industrial control work. Available on short notice. Apply to Box No. 353-W.

ELECTRICAL ENGINEER, graduate McGill Univ. Experience, draughting, checking, short wave radio research, radio operating (ship and shore), demonstrating, electrical measurements and radio laboratories, department electrical engineering; at present demonstrating physics department. Desires position with opportunities, preferably radio work. Location immaterial. Apply to Box No. 356-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., is open for engagement. Twenty-four years general experience both as engineer and as contractor. Has specialized in the construction of wharves, dams, foundations, etc. Apply to Box No. 358-W.

ELECTRICAL ENGINEER, graduate N.S.T.C., Halifax, 29 years of age, two years experience in power transmission and distribution with a large power company in province of Quebec, two years electric test and inspection, W.E. and Mfg. Co., East Pittsburgh, Pa., one year electrical maintenance in large mill. Experience with telephone transmission, substation layout, electrical installation and layout for factories. At present employed. Apply Box No. 361-W.

MINING ENGINEER, graduate, age 32, A.M.E.I.C., ten years experience in design, construction, erection and maintenance of paper mill and mine buildings and machinery. Several years on hydro-electric work in charge of surveys and investigation; desires permanent connection with mining or paper company. Apply to Box No. 362-W.

MECHANICAL ENGINEER, B.A.Sc., Univ. of Toronto 21, A.M.E.I.C., married. Pulp and paper mill maintenance experience: draughting, layout of buildings, machinery and piping, mechanical design. Also experienced in reinforced concrete and steel building design and construction work. Desires position of permanency in plant engineering or maintenance work with reliable organization offering opportunities for advancement. Apply to Box No. 370-W.

CONSTRUCTION SUPERINTENDENT, with twenty-five years experience on hydro-power developments, paper mills and general building construction. Apply to Box No. 372-W.

ELECTRICAL ENGINEER, B.Sc. '23, A.M.E.I.C., experience, estimating pole line, cable and wire layouts, supervising estimates, in charge of cost inventory and appraisal work, in charge of draughting, records and budget control work, instructing engineering principles. Seven years with one company. Four years instructing in electrical engineering at evening classes, desires position along the above lines with opportunities. Best of references. Apply to Box No. 376-W.

STRUCTURAL DRAUGHTSMAN, age 31, well educated, with experience in designing and supervision, desires a change of position and location. Preferably north western Canada. Apply to Box No. 378-W.

CONSTRUCTION ENGINEER, Canadian, speaking and writing French and English, A.M.E.I.C., P.E.Q. Twenty years experience in water power development, roadway, water and sewer works, as engineer in charge or superintendent, desires position. Available on short notice. Apply to Box No. 380-W.

GRADUATE ENGINEER, N.S. Tech. Coll., age 25, desires permanent position with industrial concern. Since graduation has spent two years apprenticeship with Can. Westinghouse Co. Apply to Box No. 382-W.

COST ACCOUNTANT, graduate civil engineer who has specialized in construction costs, desires new connection. Especially familiar with hydro-electric and paper mill construction accounting, including preparation of cost statements, installation of stores and time-keeping systems, etc. Apply to Box No. 389-W.

Situations Vacant

ENGINEER, wide awake and progressive, preferably technically trained man with several years sales experience, familiar with sanitary requirements of municipal and industrial water systems. Submit with application complete details of education and positions held to date. Apply to Box No. 505-V.

DRAUGHTSMEN. Experienced in A.C. and D.C. machines, switchboard wiring diagrams and station arrangements, industrial control apparatus. State age, experience in detail, and salary expected. Location, central Ontario. Apply to Box 506-V.

RECENT GRADUATE, in electrical or mechanical engineering, for general industrial work. Work part in office and part in the plant. Must be competent to do transit work and levelling in connection with laying out new building sites. Location, Northern Quebec. Apply to Box No. 508-V.

MECHANICAL DRAUGHTSMAN wanted, with good technical training and acquainted with heavy duty cranes, regulating gates, movable bridges, etc. Not over 30 years of age. Apply, giving full personal particulars and salary expected, to Box No. 509-V.

MECHANICAL ENGINEER, graduate with three or four years experience in industrial plant maintenance, for metallurgical plant in province of Quebec. Permanent connection for right applicant. Please give complete information. Apply to Box 516-V.

DRAUGHTSMAN, with experience in laying out and designing strutural work, preferably with some mechanical experience. Location near Montreal. Apply at once to Box No. 517-V.

RECENT GRADUATE, to assist in office of inspection company. Location Montreal. Apply to Box No. 522-V.

CHIEF DRAUGHTSMAN, Canadian college graduate, with varied experience as to draughting room routines as applied to both civil and mechanical engineering with a good deal of experience in working with tradesmen and salesmen relative to general engineering problems. Apply to Box No. 523-V.

MECHANICAL ENGINEER,—A well known automobile manufacturing company has an opening for a mechanical engineer with several years experience. Automobile experience not necessary. The work is in the engineering department on production, and offers an excellent opportunity for advancement. Apply to Box No. 524-V.

ELECTRICAL ENGINEER, graduate in electrical engineering, good draughtsman, for planning of mechanical equipment in industrial buildings, some experience preferred State age, experience, references, and enclose sample of drawings. Apply to Box No. 525-V.

DESIGNING DRAUGHTSMAN. — Excellent opening for right man with large newsprint company, centrally located. Apply, stating age, experience and salary expected, to Box No. 527-V.

CHIEF OF PARTY—Competent, experienced chief of party wanted for reservoir flow line survey in northern Quebec. Should be able to speak both French and English. Please give full particulars as to age, experience and references in first letter. Apply to Box No. 529-V.

RESEARCH ENGINEER, graduate of recognized university; age not over 35; at least two years experience in research in connection with synthetic resins; able to read and write English, French and German; preferably one with a thorough knowledge of timber, lumber and veneers. Apply to Box No. 531-V.

MECHANICAL ENGINEER, graduate, with from two to five years experience, for a large industrial company with headquarters in Montreal. Apply, giving full particulars as to experience, to Box No. 535-V.

ELECTRICAL ENGINEER, recent graduate. One who has taken General Electric or Westinghouse students' course. Apply to Box No. 536-V.

CIVIL ENGINEER, graduate, with from one to five years experience in construction and maintenance for a large industrial company with headquarters in Montreal. Apply, giving full particulars, to Box No. 537-V.

INSTRUMENTMAN, on railway surveys and construction work for an industrial company in northern Quebec. Apply to Box No. 539-V.

OFFICE ENGINEER, required for an industrial company in northern Quebec, for general engineering work. Apply to Box No. 540-V.

MECHANICAL ENGINEER, with four or five years experience for plant maintenance. Canadian, graduate engineer. Apply to Box No. 541-V.

WATERWORKS ENGINEER, with experience on the design of filtration plants. Please state experience and salary expected in first application. Interviews will be arranged with suitable applicants. Apply to Box No. 543-V.

DESIGNING ENGINEERS.—Two assistant designing engineers with structural designing experience on filtration plants preferred. Please state experience and salary expected in first application. Interviews · will be arranged with suitable applicants. Apply to Box No. 544-V.

CHEMICAL ENGINEER, experienced man preferably with college training as chemical engineer, desired to form and organize a control department in a large paper mill. This position will offer great opportunities for the right man. Previous training or experience in research work or control essential. Please state particulars of education, experience, together with salary required. Apply to Box 545-V.

STEAM POWER ENGINEER. Young man with college training and experience in handling of steam power desired to fill permanent position with a large and progressive paper company. Previous experience in analysis and investigation of production and distribution of steam essential. Must be agreeable to start at a reasonable salary. This position offers splendid opportunities with favourable chance for advancement. State particulars, history and salary desired. Apply to Box No. 546-V.

PAINT AND VARNISH FORMULATOR. Wanted at Montreal experienced industrial paint and varnish formulator. Should possess a science degree from a reputable university, and be thoroughly trained and experienced in the matching, formulation and manufacture of industrial railway paint and varnish products, preferably one of three or four years experience as general superintendent of a large railway paint and varnish manufacturing concern. Salary $5,000. Age limit 55 years. Married. Transportation advanced. Permanent position. Apply to Box No. 547-V.

TOWN ENGINEER, for town in Maritime Provinces. Please give full details of experience and salary required. Apply to Box No. 548-V.

Preliminary Notice

of Applications for Admission and for Transfer

April 22nd, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in June 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ASHFORD—ARTHUR GEORGE, of Montreal, Que., Born at Newport, Monmouthshire, England, Oct. 21st, 1879; Educ., 1897-1906, Newport Technical Institute; 1906-10, civil engrg. asst., Alexandra Docks and Railway, Newport, Eng.; 1910-15, senior transitman, C.P.R.; 1915-19, overseas., Can. Engrs., Capt.; 1921-24, contractors chief engr. on highway and bridge constrn., Bristol, England; 1924-26, contractors chief engr. i/c constrn. of New Racecourse, Chepstow, England; Mar. 1927, transitman, divn. engr's office, Toronto, and from Jan. 1928 to date, bridge dept., C.P.R., Montreal, reinforced concrete design and detailing, largely on Toronto Terminal.

References: P. B. Motley, L. R. Thomson, A. R. Ketterson, A. R. Sprenger, L. H. Laffoley, S. Blumenthal, A. C. Mackenzie.

BREED—CHARLES B., of 32 Harvard Street, Newtonville, Mass., Born at Lynn, Mass., Nov. 28th, 1875; Educ., B.S. in Civil Engrg., Mass. Inst. Tech., 1897; 1894-98, subordinate positions in surveying parties on Boston & Maine R.R., Boston & Albany R.R. and City of Lynn; 1898-1908, in capacity of chief of party, engrg. inspr. and res. engr. on surveys and elimination of grade crossing at Newton, Mass., on Boston & Albany R.R.; dredging work, Mass. Harbour and Land Commn., engrg. inspr. on Weston Aqueduct, Metropolitan Water Board of Boston; land layouts for landscape architect; sewer constrn., street paving, masonry structures, design and supervision, res. engr. of large earth corewall dam, Walden Pond, Lynn, Mass.; 1909-16, of firm of Barrows & Breed, consltg. engrs., Boston, Mass.; 1916-30, consltg. engr., with office at 6 Beacon Street, Boston, Mass. Design, supervision, reports, etc., on many large projects for municipalities, Public Service Commissions, Street Railways, Railroads, etc., etc. At present, professor of railway and highway transportation, in charge of all railway and highway engineering and transportation courses at Mass. Inst. Technology, and in practice as consulting engr., including consltg. engr. on Lucerne-in-Quebec Project at Montebello, Que.

References: F. H. Fay, R. S. Weston, H. P. Eddy, F. A. Barbour, R. DeL. French, C. R. Coutlee.

BRUMBY—WALTER WILLIAM, of Peterborough, Ont., Born at Te Aroha, New Zealand, Mar. 16th, 1899; Educ., Auckland Univ., N.Z., 1920 and 1925. 1923-26, Sturrock's School of Engineering, N.Z. Final Elect'l. Engrg. Cert., City and Guilds of London Inst., 1928; 1918-22, four years ap'ticeship with National Electrical & Engineering Co., New Zealand; 1922-24, power station constrn. work, Auckland Electric Power Board, N.Z.; 1924-28, shift engr., in main generating station and substations for same Board; 1928 (July-Sept.), constrn. engr., Can. Westinghouse Co., Vancouver, B.C.; 1928-29, in charge of constrn., B.C. Electric Railway Co., Victoria, B.C.; At present, engrg. student, Canadian General Electric Co. Ltd., Peterborough, Ont.

References: L. DeW. Magie, A. B. Gates, B. L. Barns, W. E. Ross, V. S. Foster, W. M. Cruthers.

COBBOLD—ROBERT JAMES, of Peterborough, Ont., Born at Childe-Cokeford, Blandford, Dorset, England, Dec. 31st, 1901; Educ., 1926-29, City and Guilds Engineering College, London. A.C.G.I., 1929; 1919-24, 5 years indentured apprentice, electrical contractors, London, Eng.; 1924-26, in charge of work for firm with whom apprenticed; At present, students test course, Canadian General Electric Co. Ltd., Peterboro, Ont.

References: L. DeW. Magie, B. L. Barns, V. S. Foster, W. M. Cruthers, W. E. Ross.

FERGUSON—WILLIAM PATTERSON, of Sydney, N.S., Born at Ottawa, Ont., Jan. 13th, 1899; Educ., B.Sc., McGill Univ., 1924; 1916-22 (summers), surveying, International Boundary and Geod. Survey of Canada; 1923 (summer), coal mining, Crows Nest Pass; 1924 to date, with Peacock Bros. Ltd., as follows: 1925, i/c Toronto office; 1926, mech'l. dept., and 1927-28, mining dept., Montreal; 1928 to date, i/c Sydney office. Work included, supervision of install'n. of power plant, paper mill and mining equipment, consisting of pumps. regulators, instruments, speed reducers, compressors, ventilating fans, côal cutters, conveyors, motors, transformers, etc.

References: J. A. Fraser, S. C. Mifflen, A. L. Hay, E. L. Martheleur, F. T. Peacock, E. Brown.

GAULD, George Alexander, of Hamilton, Ont., Born at Hamilton, Sept. 16th, 1905; Educ., 2 years Hamilton Technical School; During ap'tice course, attended Ham. Tech. Sch. one morning and one evening a week for four years; 1922-28, mach. ap'tice course, Canadian Westinghouse Company, Hamilton; 1928 to date, with Otis-Fensom Elevator Co. Ltd., Hamilton. (1928, improver, and at present installing, adjusting, etc., electric elevators).

References: W. D. Black, W. F. McLaren, C. B. Brown, Jr., W. J. W. Reid, A. V. Gale.

JONES—ARTHUR R., of 296 Frederick Avenue, Peterborough, Ont., Born at Donalda, Alta., Sept. 7th, 1905; Educ., B.Sc. (E.E.), Univ. of Alta., 1928; 1928, surveying and plant erection; 1929 to date, test dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

References: C. A. Robb, W. M. Cruthers, L. DeW. Magie, A. B. Gates, W. E. Ross, R. S. L. Wilson.

KAYSER—NICHOLAS JAMES, of Montreal, Que., Born at Little Suamico, Wis., April 1st, 1885; Educ., B.Sc. in Gen. Engrg., Univ. of Wis., 1910; 1911 to date, with Fraser Brace Engineering Company as follows: 1911-24, constrn. engr., work including 1st and 2nd Cedars developments, Hell Gate Bridge Floors, N.Y. and New York Harbour Dry Dock Co.; 1925 to date, on design and constrn. of various hydro-electric projects, including development at Deer Lake, Nfld., Three Rivers Paper Mill for International Paper Co., and other developments for same company, and at present in charge of design and constrn. Churchill River Power Co. development, constrn. and partial design of Ontario Refining Co. refinery at Copper Cliff, Ont., preparing engr. reports, prelim. investigations, etc. as director of company.

References: J. H. Brace, J. L. Busfield, G. C. Clarke, J. B. D'Aeth, C. E. Fraser, W. S. Lea, J. A. McCrory, G. R. MacLeod, S. Svenningson.

MORRISON—GEORGE HAWLEY, of Grand Mere, Que., Born at Amherst, N.S., May 26th, 1904; Educ., B.Sc. (Mech.), N.S. Tech. Coll., 1925; Private study; 2 summers, highway constrn. in N.S.; 1 summer, mtce. dept., of power house, Shaw. Water & Power Co., Shawinigan Falls; 1925, with Fraser Brace Engrg. Co., on constrn. of addition to paper mills of Can. Int. Paper Co. at Three Rivers; 1926, students eng. course, Gen. Elec. Co., at Lynn, Mass.; 1927, instr'man. on addition to hydro-electric plant at St. Margaret's Bay, for N.S. Power Commn., Halifax, N.S.; 1927 to date, asst. woods engr., Laurentide Division, Canada Power & Paper Corpn., Grand Mere, Que.

References: F. R. Faulkner, H. S. Johnston, W. F. McKnight, R. P. Freeman.

McCALL—THOMAS LOCKHART, of Sydney, N.S., Born at Largs, Ayrshire, Scotland, Oct. 7th, 1885; Educ., 1903-07, Heriot Watt College; British 1st Class Colliery Manager's Cert.; 1903-07, ap'ticed to mining engr., Edinburgh, Scotland; 1907-10, practical work in various collieries in Scotland and Wales; 1910-14, asst. to managing director, Ormiston Coal Company; 1914-20, general manager, Malayan Collieries, Malay Peninsula; 1921-29, mining engr. for Acadia Coal Co., Ltd., and Cumberland Railway & Coal Co.; 1929 to date, chief mining engr., British Empire Steel Corpn., Ltd., Sydney, N.S.

References: D. H. McDougall, A. P. Theurkauf, A. L. Hay, J. S. Whyte, W. C. Risley, C. H. Wright.

PYLE—JOHN, of Verdun, Que., Born at Weedon, Bucks., England, Feb. 23rd, 1903; Educ., 1919-24, Basingstoke Tech. School. Grad. Inst.M.E. (Has passed all exams. or their equivalent for A.M.Inst. M.E.); 1919-24, ap'tice, John I. Thornycroft & Co. Ltd., Basingstoke, England; 1924-26, service mgr., Toronto, and 1926 to date, works mgr., Montreal, Thornycroft (Canada) Limited.

References: H. Kennedy, W. J. LeClair, L. R. Thomson, R. A. Ross, J. B. Challies.

TAMPLIN—HAROLD L., of Port Colborne, Ont., Born at London, England, Jan. 3rd, 1899; Educ., 1919-21, 2 years app. science, Acadia Univ.; 1917-19, overseas. Lieut., R.A.F.; 1920-22 (summers), surveying and dfting, Can. Car & Foundry Co. Ltd., Amherst, N.S., also constrn. work in N. Ont.; 1922-23, dftsman., Office Specialty Mfg. Co., Newmarket, Ont.; 1923-26,dftsman. and asst. to chief engr., Delora Smelting & Refining Co., Delora, Ont., under chief engr. and i/c of design, estimating, field work and inspn. of constrn.; May 1926 to date, engrg. and designing dftsman., International Nickel Co. of Canada, Port Colborne, Ont. Also with same company at Copper Cliff, Ont. Work in connection with development of Frood Mine, new Copper Cliff smelter, and expansion of the Port Colborne Refinery.

References: R. L. Peek, R. H. Harcourt, E. P. Murphy, F. L. Haviland, C. S. Millard, A. Sutherland.

VICKERS—HAROLD, of Trail, B.C., Born at Liverpool, England, Oct. 30th, 1882; Educ., 1910-13, Liverpool Univ.; A.M.Inst.M.E. 1st Class Board of Trade Cert.; 1898-1903, ap'ticeship, Victory Web. Printing Mfg. Co., Liverpool; 1903-04, machinist, Cammell Laird & Co., Birkenhead and Mersey Docks and Harbour Board; 1904-10, marine engr., mercantile foreign service; 1910-13, dftsman., Cammell Laird & Co.; 1913-15, boiler inspr., National Boiler & General Insce. Co., Manchester; 1915-20, supt., National Ordnance Factory, Nottingham, Cammell Laird & Co., managers 1920-22, ship mgr., H. Grayson Ltd., Liverpool; 1922-24, production engr., Victory Kidder Mfg. Co., Birkenhead; 1925 to date, dftsman., Cons. Mining & Smelting Company, Trail, B.C.

References: B. R. Warden, A. B. Ritchie A. E. Wright, B. T. O'Grady, C. R. Whittemore.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

BURNS—ROBERT HENRY, of 268 Pim Street, Sault Ste Marie, Ont., Born at Watertown, N.Y., May 1st, 1895; Educ., 1916-18, 2 years civil engrg., Clarkson College of Technology, Potsdam, N.Y. 1919-20, 3rd year civil engrg. course, Queen's Univ.; Summers: 1915, N.Y. State highway dept.; 1916, shell inspr., N.Y. Air Brake Co.; 1917, rodman, engrg. dept., N.Y.C. Rly.; 1918-19, mach. mate, battleship, U.S.S. Ohio; 1919 (Feb.-Oct.), rodman, engrg. dept., N.Y.C. Rly.; 1920 (2 mos.), instr'man., on surveys, water power sites, Black River Regulating Board, Watertown, N.Y.; 1920-21, constrn. inspr. and field engr., 1921-22, dftsman and engr., and 1922, transitman, hydro-development survey, in Northern Ontario, for Spanish River Pulp & Paper Mills Ltd.; 1923-24, mech. engr. and dftsman., and from 1925 to date, res. engr., in charge of all mtce., development and constrn. work at the Lake Superior Paper Company, Sault Ste Marie, Ont.

References: H. A. Morey, G. H. Kohl, L. R. Brown, J. W. LeB. Ross, J. H. Jenkinson, F. Smallwood.

CHVILIVITZKY—JAKOV, of Montreal, Que., Born at Orsha, Russia, Nov. 28th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1928; 1914-15, rly. location surveying in Russia; 1915-20 with Russian Army, 1918-20, on engrg. work; 1928 (Apr.-Nov.), drawing and design with G. L. Wallace, A.M.E.I.C., Toronto; 1928-29, design for Frank Barber & Associates, Toronto; 1928-29, demonstrator, Univ. of Toronto; April 1929 to date, designing, engr., Truscon Steel Company, Montreal. Design and detailing of reinforced concrete structures.

References: J. Portas, G. L. Wallace, F. Barber, C. R. Young, J. J. Spence, W. B. Dunbar.

JOHNSTON—CLIFFORD MILTON, of Ottawa, Ont., Born at Parry-Sound, Ont., Sept. 13th, 1896; Educ., B.Sc., Queen's Univ., 1920; 1914 (summer), operator, Parry Sound Hydro-Electric Plant; 1915 (5 mos.), wireman, Can. Explosives, Ltd.; 1916 (5 mos.), elect'n., Can. Explosives Ltd.; 1917-18, overseas, C.E.F.; 1919 (summer), asst. i/c mech'l. process of pulp base research for explosives, Can. Explosives Ltd.; In March 1920, with H. R. Welch, B.Sc., organized the partnership of Welch & Johnston, offering specialized technical service for internal combustion engines. Later appointed special service representatives for specialized technical lines of General Motors and Electric Auto-Lite. These connections followed by many others including British firms for commercial and aircraft magnetic equipment. At present, vice-president and sec. treas., Welch & Johnston Ltd., Ottawa, Ont.

References: A. K. Hay, C. M. Pitts, T. O. Whillans, W. A. Steel, A. M. Grant, C. E. Baltzer, J. Murphy.

COOKE—NORMAN MELVILLE, of Ottawa, Ont., Born at Kingston, Ont., July 27th, 1890; Educ., B.Sc., Queen's Univ., 1921; 1920-27, asst. county engr., Cornwall, Ont.; 1927 to date, district municipal engineer, Dept. Public Highways, Ontario, Ottawa, Ont.

References: A. K. Hay, W. Huber, W. J. Moore, J. A. P. Marshall, W. H. Keith.

McMULKIN—A. FRANK, of 229 Harvard Avenue, Montreal, Que., Born at Saint John, N.B., Aug. 20th, 1888; Educ., 1907-08, Mount Allison Univ.; 1908-11, rodman, 1911-14, dftsman., N.T. Rly.; 1915-16, dftsman., City of Saint John; 1916-19, instr'man., Q. & S. Rly.; 1919-20, dftsman., G.T.R. Arbitration; 1920-22, asst. engr., Dept. Rlys. and Canals; 1922-23, i/c surveying party, Quebec Roads Dept.; 1923-27, instr'man., and 1927 to date, asst. engr., C.N.R., Montreal; at present on Montreal Terminal Development.

References: S. B. Wass, S. E. Oliver, A. Dick, F. F. Clarke, A. S. Gunn.

PARKE—CHARLES SAGER, of Cleveland, Ohio., Born at Hamilton, Ont., Feb. 24th, 1897; Educ., B.Sc., McGill Univ. 1918. 1918-19, overseas., Lieut., Can. Engrs.; 1919 to date, with the Harshaw Chemical Company, in charge of engineering work, first at the Cleveland plant, and for the last five years or more for the entire company. In this latter period carried on a constrn. programme which entailed expenditure of upwards of a million dollars.

References:—H. U. Hart, J. W. Tyrrell, H. A. Crombie, C. M. McKergow, A. R. Roberts.

PLOW—JOHN FOSS, of Montreal, Que., Born at St. Albans, Vt., July 20th, 1900; Educ., Grad., R.M.C., 1921. 1921-22, app. science, civil engrg., McGill Univ.; 1922-25, vice-pres., B. Plow & Co. Ltd., printers, Montreal; 1926-27, i/c records dept., and 1928 to Mar. 1930, asst. to mech. supt., i/c steam plants, also mech'l. dfting and design, Price Bros. & Co. Ltd., Riverbend, Que.; at present, Assistant to the Secretary, The Engineering Institute of Canada, Montreal, Que.

References: W. G. Mitchell, C. N. Shanly, A. A. MacDiarmid, N. D. Paine, G. F. Layne, N. F. McCaghey, D. J. Emrey.

SCHERMERHORN—HENRY LEWIS, of Cornwall, Ont., Born at Twp. of Richmond, County of Lennox, Ont.; May 2nd, 1895; Educ., 2 years, Queen's Univ.; 1919-22, rodman and levelman, 1922-26, instr'man., 1926 to date, district engr. of Municipal Roads District No. 13, Dept. Public Highways of Ontario.

References: R. M. Smith, A. A. Smith, G. Hogarth, W. F. Noonan, J. B. Wilkinson.

WELCH—HENRY R., of Ottawa, Ont., Born at Ottawa, July 19th, 1892; Educ., B.Sc., Queen's Univ., 1918; 1906-08, dfting, testing and special repairs, Hull Electric Rly.; 1909 (6 mos.), inspn. and test of field equipment (telegraph) for Petewawa Military Camp; 1909 (6 mos.), i/c power house for Chapleau Electric Light & Power Co.; 1909-13, scientific lighting and electric heating with Ottawa Electric Co.; 1915 (6 mos.), munition mfg. and testing, National Mfg. Co.; 1916-17, check and gauge inspn., Imperial Ministry of Munitions; 1914-15, design and erection of steel and concrete bldgs., Lester, Welch & Blyth, Ottawa; 1918-19, overseas. Lieut., Can. Engrs.; in March 1920, with C. M. Johnston, B.Sc., organized the partnership of Welch & Johnston, offering specialized technical service for internal combustion engines. Later appointed special service representatives for specialized technical lines of General Motors and Electric Auto-Lite. These connections followed by many others including British firms for commercial and aircraft magnetic equipment. At present, President, Welch & Johnston Limited, Ottawa, Ont.

References: C. M. Pitt, T. O. Whillans, J. Murphy, W. A. Steel, A. K. Hay, C. E. Baltzer, A. M. Grant.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

ARMSTRONG—LAWRENCE HENRY, of Madrid, Spain., Born at Montreal, Que., Nov. 7th, 1899; Educ., B.Sc. (E.E.), McGill Univ., 1922. Three years at Oxford Univ. as Rhodes Scholar from Prov. of Quebec; 1919-20 (summers), radio telegraph operator, Canadian Marconi Co.; 1921 (summer), Can. Govt. Radio Dept., on mtce. of 25 kw arc station at Barrington Passage, N.S.; etc.; 1922 (summer), Can. Govt. Radio Test Labs., Ottawa; 1924 (summer), radio inspn. dept., Peel-Conner Telephone Works, Coventry, England; Sept. 1925, general office, International Telephone & Telegraph Corpn., New York. Nov. 1925 to Oct. 1926, Cuban Telephone Co., Havana, Cuba, on trans. mtce. of toll lines, etc.; Nov. 1926 to date, with Compania Telefonica Nacional de Espana as follows; transmission dept. on toll line and cable testing and voice-frequency repeaters; May 1927, transferred to mtce. dept., i/c mtce. routines and testing of toll lines, voice-frequency repeaters and all toll office equipment for Spain; 1928, retd. to transmission dept., on carrier frequency telephone systems; Jan. 1930 to date, radio section of transmission dept., i/c general operation of Madrid-Buenos Ayres radio telephone link, including all testing and mtce. and a large amount of experimental work. (The Cuban Telephone Co. and the C.T.N.E. are both subsidiaries of the International Telephone & Telegraph Corpn., New York.)

References: H. M. MacKay, C. V. Christie, E. G. Burr, E. Brown, C. M. McKergow.

FOX—JOHN H., of 37 Macdonell Avenue, Toronto 3, Ont., Born at Toronto, Ont., May 24th, 1903; Educ., B.A.Sc., Univ. of Toronto, 1927; 1923 (summer), with Weddell & Saunders, gen. contractors, Toronto; May 1924 to Aug. 1925, inventory, and outside plant engr's office, Bell Telephone Company of Canada, Toronto; 1926 (summer), with Walter Lehner, consltg. engr., Mt. Clemens, Mich.; 1927 (summer), detailer, Can. Bridge Co., Walkerville, Ont.; 1927-28, demonstrator, hydraulics lab., Univ. of Toronto; May 1928 to date, asst. engr. on steam power plant and heating, design, install'n., etc., C. A. Dunham Co. Ltd., Toronto, Ont.

References: C. R. Young, T. R. Loudon, G. L. Wiggs, R. E. Smythe, E. A. Allcut.

LYONS—GERALD STANLEY, of 790 Melrose Avenue, Montreal, Que., Born at Montreal, Aug. 9th, 1899; Educ., B.Sc., Queen's Univ., 1924; 1924 to date, with Bell Telephone Company of Canada as follows: 1924-25, student engr., 1925-29, asst. field engr., and at present, toll cable engr., (partial responsibility for engrg. toll cable projects), Quebec Division Plant, Montreal, Que.

References: V. C. Jones, W. H. Slinn, J. A. Loy, G. M. Hudson, W. L. Malcolm.

McINTOSH—JOHN CAMERON, of Notre Dame du Laus ,Que., Born at Vankleek Hill, Ont., Oct. 26th, 1897; Educ., B.Sc., Queen's Univ., 1925; 1918-20, rodman and instr'man., on mill bldg. constrn. at Temiskaming, Que.; 1925-26, instr'man., Welland Ship Canal; 1926-27, field engr. on mill bldg. constrn., Brompton Pulp & Paper Co., Bromptonville, Que.; 1927-28, chief of party, on field surveys etc., Can. International Paper Co.; 1928 to date, asst. to res. engr. on constrn. of Cedar Rapids storage dam on Lièvre River.

References: A. Macphail, W. L. Malcolm, O. O. Lefebvre, L. A. Dubreuil, J. A. H. Henderson, H. S. Ferguson, H. H. Snyder.

MUELLER—EMIL KARL, of 130 Avenue Road, Toronto, Ont., Born at Hamilton, Ont., May 30th, 1902; Educ., B.A.Sc., Univ. of Toronto, 1924; 1923 (summer), records and dfting., distribution dept., Toronto Hydro-Electric System; 1923 (Aug.-Oct.), inspr. and dftsman., Etobicoke Twp. engr., on sidewalks; 1924 to date, with Bell Telephone Company of Canada as follows: 1924-26, student engr., 1926 (Jan.-June), asst. district plant engr., 1926 to date, district plant engr., plant dept., Toronto. Responsible for the preparation of estimates of cost, plans and specifications, and for the inspection of construction or reconstruction of outside telephone plant.

References: W. L. Sagar, T. R. Loudon, C. R. Young, A. M. Reid, D. T. Welsh, J. J. Spence.

SCADDING—SIMCOE CRAWFORD, of Montreal, Que., Born at Columbia, S.C., U.S.A., May 23rd, 1901; Educ., B.A.Sc., Univ. of Toronto, 1922; 1914 (5 mos.), machine shop, Goodyear Rubber & Tire Co.,; 1916 (5 mos.), trans. line supervision, Chippawa-Queenston Canal; 1915 and 1921 (10 mos.), surveys, Speight & Van Nostrand, Toronto; 1922-23, demonstrator, elect'l. engrg., Univ. of Toronto; 1923-27, statistical asst., 1928-29, asst. statistician, and from Jan. 1930 to date, statistician, Bell Telephone Company of Canada, Montreal, Que.

References: R. V. Macauley, L. R. Thomson, H. G. Thompson, H. E. McCrudden, N. E. D. Sheppard.

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Hydraulic Fill on the Ghost Power Development

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In the hydro-electric development on the Bow river, which was recently completed for the Calgary Power Company, over one-half of the length of the dam is made up of earth fill.

The concrete portions of the dam and the power house are of practically standard design and did not present any serious difficulties in construction.

The two earth fill portions of the dam, owing to some novelty in their design and the methods of construction, may be of some interest.

The development is known as the "Ghost Power Development" to distinguish it from other water power developments of the Calgary Power Company on the Bow river. It is located at the junction of the Ghost river with the Bow, about 35 miles west of Calgary, Alta.

As the total length of the dam is 4,840 feet it was not practicable to make a plan of the dam for reproduction, but an aerial photograph, shown as figure No. 1, will give a general idea of the dam and show the relation of the two earth fills to the concrete portions of the dam.

The storage basin extends about 8 miles up the Bow river and 3 miles up the Ghost. It is called "Lake Gaherty."

The dam consists of four main parts. On the right of the view can be seen the "north earth fill," about 740 feet in length, which forms the north end of the dam and the tie-in to the north bank of the Bow river. The concrete emergency sluiceway and the intake dam are in the old bed of the Bow and are about 928 feet long. In the centre can be seen the "south earth fill" forming that portion of the dam between the intake dam and the main sluiceway. This earth fill is about 2,020 feet long. The south end of the dam consists of the main sluiceway and the spillway.

The location of the power house can be seen. There are two main units of 18,000 h.p. with a penstock installed for the future addition of another unit of the same capacity. There is also a station service unit of 1,450 h.p.

The maximum head is 108 feet, with a possible draw-down of 35 feet in the storage basin.

The two earth fills were distinctly separate as to source of material, type of construction, and the pumping and hydraulic equipment.

The "north earth fill" was a semi-hydraulic, or puddle, earth fill, and the "south earth fill" an hydraulic fill dam.

The construction camp and the gravel pits are in the foreground and the main line of the Canadian Pacific Railway on the left side of the view.

North Earth Fill

The method or type of construction to be used to tie in the north end of the dam to the north bank of the Bow river was quite a problem. The location of the concrete portion of the dam was fixed by the location of the rock in the bed of the Bow river.

The extension of the main concrete dam, or a concrete wall into the bank, was not economically possible owing to the distance it would have been necessary to go, and the excessive depth of the excavation required.

Some consideration was given to the idea of merely trimming the east bank of the Ghost river and covering the prepared slope with precast concrete slabs, put in place by being strung on wires on the bank and designed to interlock.

The bedrock was of lenticular sandstone, sloping down to the west, or upstream, at an inclination of about 18°. The rock was covered with a layer of hard blue clay varying in thickness from three to ten feet. Over this the bank was of compact fine sand of very uniform size and covered with an overburden of gravel about ten feet in thickness. The elevation of the top of the clay band ran from 3,839 to 3,850, and the top of the bank was about 3,950.

The top of the clay could be very clearly followed along the bank owing to the numerous small springs and the moisture showing at this level.

No trace of sand or gravel was found in the clay and it was very hard and impervious.

After tests of the sand from the bank for stability etc. had been made it was decided to excavate the bank down to the impervious clay band by hydraulic methods. A semi-hydraulic fill would then be raised from the end of the concrete dam for a distance of 740 feet up the Ghost river. The plan of the dam as designed is shown as figure No. 2.

The dam is of full section at the south end until the downstream face merges into the north bank of the Bow. From there on the dam forms a blanket over the bank of the Ghost river.

A trench had been dug to bedrock from the end of the concrete dam, partly as an exploratory trench and also to

Figure No. 1.—Aerial Photograph of Dam showing Relation of Two Earth Fills to Concrete Portions of Dam.

be used in case it were found necessary to extend the concrete wall into the bank. This trench was filled with concrete and can be seen in figure No. 2. This core wall was surrounded by the deposited clay core and improved the sealing at the junction between the earth fill and the concrete dam. A 4-inch tile pipe drain with open joints was laid along the downstream face of the wall.

A channel was dug for the diversion of the flow of the Ghost river to the west side. Two cofferdams were built, one at the top of the original channel to divert the flow into the diversion channel and the other at the lower end of the channel to retain as much as possible of the material sluiced out of the bank.

The pumping equipment was installed on the upstream crib for the preliminary excavation work and was later moved to the Bow river for the hydraulic fill.

It consisted of two 10-inch by 10-inch centrifugal pumps, direct connected to 300 h.p., 1,800 r.p.m., 2,200 v., 3-phase motors.

These two pumps supplied water to the monitors through a 14-inch pipe line. The pipe line was of flanged iron pipe of number 10 gauge where the pipe line was in a more or less permanent location. The lines which had to be moved frequently were of number 12 gauge slipjoint pipe. Burlap was used in the joints and the leakage was almost negligible.

The hydraulic excavation was started at the south end of the dam in order that the depositing of the clay core might start as soon as possible, using the old Calgary-Banff highway. The excavation was done with one monitor and was carried down to bedrock on each side of the concrete core wall, and then to the clay band for a distance of 75 feet from the end of the concrete dam.

The monitor was then moved to the north end of the cut and the excavation to the full section was carried from there to the first cut. A view of the hydraulic excavation at the north end is shown in figure No. 3. The pump house can be seen on the left and the diversion channel in the foreground. The original channel of the Ghost river is under the sluiced sand near the far bank. About 65 per cent of the material sluiced out of the bank was retained within the limits of the dam.

It was difficult to maintain the required slope of $1\frac{1}{2}$ to 1 on the side of the cut. The sand stood nearly vertical and was very compact. Some trimming had to be done by machine and hand after the hydraulic work was finished. The sand ran very freely and filled the old channel and part of the diversion channel, the top of the sluiced material being very nearly level across the Ghost basin. The overburden from the top of the bank remained in the cut.

While the hydraulic excavation was being done the clay core was deposited around the concrete core wall at the south end and a gravel levee was dumped by trucks along the upstream toe of the dam. This gravel levee was over the old channel of the Ghost and helped to retain a considerable quantity of the sluiced material.

When the hydraulic excavation had been completed a trench of an average width of 30 feet was dug through the gravel and sand remaining in the cut. This trench was for the clay core base and was dug down to the clay band. At the north end of the fill it was necessary to sheet the sides of this trench as there was a depression in the clay base and the water percolating through the bank collected

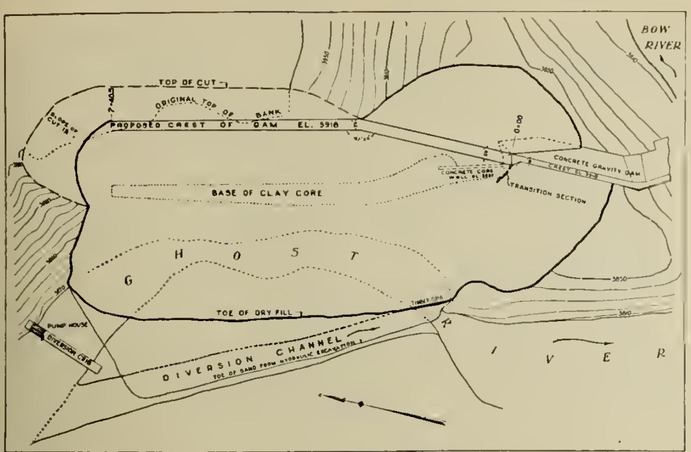

Figure No. 2.—Plan of North Earth Fill.

there. A good contact between the clay core and the clay band was made over the length of the dam, and great importance was given to ensuring that the base was clean and was the surface of the main clay bed before the clay core was deposited.

The height of each lift of the clay core was between 6 to 8 feet up to elevation 3865. Above this elevation the clay was still deposited in low lifts on the portion of the dam between the concrete dam and the north bank of the Bow river. Along the bank of the Ghost the clay was dumped from the top of the bank.

As the clay core was being deposited by trucks gravel levees were being raised along the upstream face. One monitor was installed at each end of the fill and material washed down into the dam between the gravel levees and the clay core. A flume was used to convey this material over the clay core at the south end.

The raising of the gravel levees could not keep pace with the hydraulic fill. Small levees to retain the sluiced material were thrown up by dragline. The material was sluiced down from the top of the bank and baffle boards were used along the face of the clay core to prevent any of the clay being washed out.

Figure No. 4 shows the "north earth fill" about three-quarters completed. The storage pond is rising and the dragline on the bank is excavating clay and loading trucks at one of the clay pits. Most of the clay from this pit was dumped in front of the monitor at the south end of the fill and sluiced down with the material from the bank.

In the cross-sections of the completed dam, shown in figure No. 5, it will be noted that the dam was raised considerably higher than the original design, particularly as shown on sections 5+00 and 7+00. This was done by throwing down a portion of the top of the bank by dragline to allow for any settlement of the fill. The clay core is also higher than the original design, mainly on account of the clay being dumped from the top of the bank.

The areas of the hydraulic fill as shown are smaller than the actual areas covered. The water and the finer sluiced material percolated through the gravel along the face of the clay core and the resultant puddled material formed areas larger than as shown.

At the commencement of the work the amount of clay suitable for the core which could be obtained within any economical distance of the work appeared very small. Another deposit of clay was discovered, however, and the amount finally obtained was quite sufficient. The pits were ploughed and the trucks loaded by scrapers from overhead platforms and by draglines. The best of the material was picked as far as possible.

A general analysis of the east bank of the Ghost and two of the clay pits is given below:

Classification	Diameter MM	Percentage by weight		
		Bank	Pit No. 2	Pit No. 4
Fine gravel......	5.0 – 1.0	0.3	0.3	0.0
Coarse sand.....	1.0 – 0.5	1.0	0.6	0.3
Med. sand.......	0.5 – 0.25	12.9	2.2	0.4
Fine sand.......	0.25 – 0.10	61.0	11.4	2.6
Very fine sand...	0.10 – 0.05	14.8	26.9	8.2
Silt............	0.05 – 0.005	3.5	36.5	39.4
Clay............	0.005 –	6.5	22.1	49.1

There was some delay to the hydraulic work on account of a sudden rising of the Bow river in June. This had no serious effect, although the pumps and motors on the crib were covered with about ten feet of water for about two days. The "megger" showed no resistance between the windings and the stator of the induction motors. They were dried out in two days by means of a compressed air dryer made on the job. This drier had been designed and made to dry out one of the 4,000 kv.a. transformers in the temporary substation which had been soaked with water from a broken cooling coil.

South Earth Fill

It is difficult to classify the "south earth fill" as a semi-hydraulic or a full hydraulic fill dam. It is really a true hydraulic fill with a gravel blanket on each face.

A plan and profile of the dam is given in figure No. 6. It will be seen that the centre line of the fill is not a straight line. This location of the dam, as well as that of the concrete dams at both ends, was determined by the location of the bedrock found by test pits.

The ends of the concrete dams at the junction with the fill were of special design to form transition sections. At the north end of the fill an entrance was provided to the tunnel in the main concrete dam. A ladderway ran down from the top of the dam and was covered with precast semi-circular concrete blocks. These blocks were 8 inches in height and were put in place as the earth fill was raised.

The level of the pool in the hydraulic fill was regulated by the flow of water over the blocks into the tunnel. This waste water was carried down the tunnel in a trough at the side of the walkway, and discharged into the river through a temporary opening in the upstream face of the dam.

This method of regulating the pool was used for the north half of the fill until the dam was about half completed when the remainder of the blocks were put in place and the waste pipes installed in the fill were used.

At the north end of the fill a timber crib, loaded with rock from the excavation of the power house site, was built

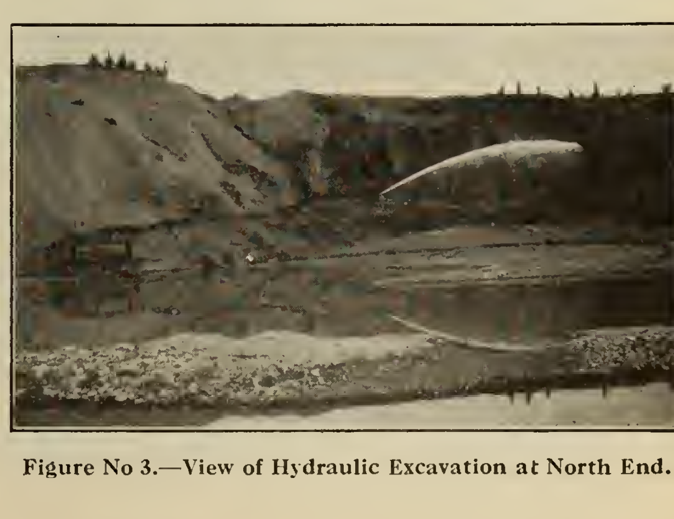

Figure No 3.—View of Hydraulic Excavation at North End.

Figure No. 4.—View of North Earth Fill about Three-quarters Completed.

to prevent the possibility of the upstream toe of the fill sliding into the river at this point.

The hydraulic plant was built on each side of a ridge which ran through the centre of the dam. The plant was in two separate units to take advantage of the high ground for the flow of the material to the pumps. These were known as the north and south units.

The pumps for the supply of water for the sluicing and pumping of the material were installed on a crib in the Bow river. This crib formed part of the cofferdam necessary for the construction of the intake dam and the power house.

The equipment consisted of:

Four 10 inch by 10 inch centrifugal pumps direct connected to 125 h.p., 1,200 r.p.m., 2,200 v., 3-phase motors.

The water was pumped through a 24-inch wood stave pipe line to the plant. This pipe line was 1,400 feet in length and was brought to the top of the bank from the pump house on a grade of 50 per cent and from there to the plant on a trestle with a grade of 3 per cent. The static head on the pipe was 60 feet.

The saddles supporting the pipe on the trestle were lubricated with soft soap for expansion of the line and the south end was free. No trouble was experienced with this line after the wooden joints had swollen.

Two pressure pumps were connected to the clear water line to provide water for the monitors. These pumps were 12 inch by 10 inch centrifugal pumps driven by 300 h.p., 1,800 r.p.m., 2,200 v., 3-phase motors, starting direct from the line.

The pressure pipes to the monitors were 6-inch diameter flanged cast steel pipe. The pressure used varied from 75 lbs. per sq. inch to 125 lbs. per sq. inch.

The tracks from the clay pits to the plant can be seen on the downstream berm of the south half of the dam. The gravel fill had been brought up to this elevation before the installation of the pumping equipment was completed and served to carry the tracks across the low ground. A double track was laid as far as the plant and then single tracks branched to each unit.

A plan of the south unit of the plant is shown in figure No. 7. The unloading track for the clay trains was carried on a trestle along the side of the hogboxes at a height of 12 feet above the floor. This track was extended past the end of the hogboxes to allow the empties to be pushed past the hogbox in the case of being unloaded on one hogbox only. A platform for the men unloading the trains ran the length of the unit.

The material for the hydraulic fill was obtained from two clay pits situated about 5,000 feet southwest of the plant. These pits were located by an extensive series of test pits dug over the valley of the Bow and the hills on the south side of the valley. The clay was chosen for its high standard of imperviousness as determined by tests made in Washington. The formation consisted of about eight feet of granulated clay over beds of solid blue and yellow clay. The amount of gravel found in the clay pits was thought to be too low for the formation of the beaches in the fill, and a gravel pit was located close to the clay pits to make up this deficiency. This pit was never used as it was found that the clay was not broken up in passing through the screens and pumps and formed a large percentage of the beaches.

The clay pits were one above another on a side hill and were excavated by two 2¼-yard steam shovels. Owing to the hardness of the clay it was necessary to shoot the banks ahead of the shovels. This difficulty did not extend for the full length of the pits and, after the best of the material had been taken, the original pits were abandoned for two other pits at the foot of the hill where a more easily handled good quality clay was found.

An analysis of the clay is given below:

Size MM	Percentage by weight
5.000 – 1.000	2.4
1.000 – .500	3.4
.500 – .250	3.6
.250 – .100	8.3
.100 – .050	22.1
.050 – .005	32.9
.005 – .000	27.3

Six trains of 12 cars each of two cubic yards capacity were used and they were routed to the two units to keep the supply of material on the hogboxes as uniform as possible.

As will be seen in figure No. 7, the hogboxes were divided in two parts by a partition down the centre. The floors were sloped from the sides to the centre, and the centre formed a trough sloping down to the outlet to the screens.

The monitors shown were size 2 hydraulic Giants about six feet in length. The nozzles used were 2¼, 2 and 1½ inch diameter, depending upon the nature of the material being received. These did not have to be changed very often. In the event of a block in the entrance to the screens the monitors could be directed into the waste pipes shown. This did away with the necessity of closing the valves on the pipe lines when the openings had to be cleared of large clay lumps.

The material was kept moving as uniformly as possible in order to maintain uniform operation of the dredge pumps. This required a certain amount of skill on the part of the operators, and the monitor men became quite proficient.

A plan of the pump house is shown in this figure. The description of the pumping equipment is also given. The

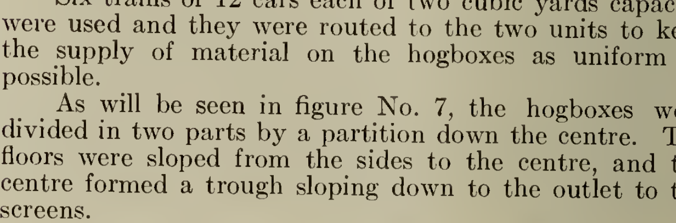

Figure No. 5.—Sections of North Earth Fill.

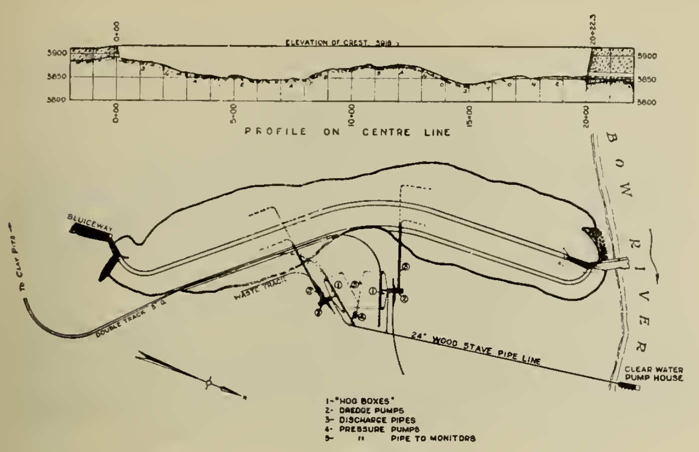

Figure No. 6.—South Earth Fill and Hydraulic Plant.

dredge pumps were for 140 feet head and a capacity of 3,000 gals. per minute.

The two pipes carrying the material into the dam were 10-inch diameter cast steel flanged dredge pipe. The flanged portion of the pipe line was carried about halfway up the fill and the remainder was laid with the same size slip-joint pipe. The flanged pipes were turned through 90° every 12,000 cubic yards of pumped material. This lengthened the life of the pipe and only a few lengths had to be replaced during a life of about 100,000 cubic yards each.

The waste tracks are shown passing over the discharge pipes. This view is of the south unit, on the other unit the tracks were clear of the pipe lines.

Some special tools for speeding up the joining and uncoupling of the slip joint pipes were designed and made on the job.

A section through one of the hogboxes is shown in figure No. 8. This shows the general arrangement of the equipment. The material was dumped from the trestle on the floor of the hogbox and the capacity of the hogbox was sufficient for about three hours run, in case of trouble at the clay pits or with the trains.

The floor of the south unit was made of concrete. Large boulders were available on the site from the excavation for the sumps and were laid close together with a flat face up. These were laid in a lean mixture of concrete and mortar poured over them. The mortar wore away very quickly but there was no further apparent signs of wear.

The floor of the north unit was of 2-inch plank protected with ¼-inch steel plates.

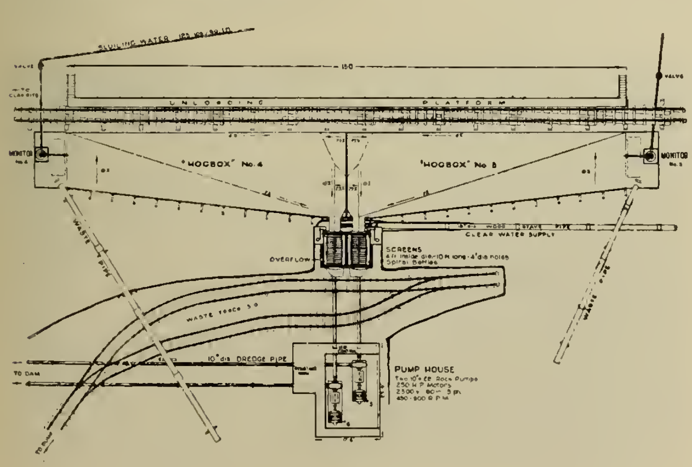

Figure No. 7.—Hydraulic Fill Plant—South Unit.

The operation was not of sufficient duration to determine which floor was the more economical. No repairs to the floors or walls were necessary during the work.

On both units the walls were of 2-inch plank protected at the ends near the outlet to the screens with ¼-inch steel plates.

A screen of wire netting was erected along the top of the walls to prevent small pebbles being thrown over by the water. It would have necessitated heavy bracing to raise the walls and these screens were quite efficient.

The outlets to the screens were of ¼-inch plate and made in semi-circular form with a flat bottom. The inside edges were turned up inside the hogbox and spiked to the walls. There was very little trouble with these.

The screens were of the revolving type and were inclined ¼ inch to the foot. This slope was adopted after some trial as the best slope depended upon the nature of the material. The screens were driven at a speed of 7 r.p.m. by 7½ h.p., 1,200 r.p.m. motors through reduction gears. The overall length of the screens was 10 feet, with 6 feet effective for the screening, and an inside diameter of 4 feet. The perforations were originally 6½ inches in diameter. This was reduced to 4 inches as the material was very solid and there were more large lumps coming into the dam than were required for the beaches. It was also thought that some of the trouble experienced with the pumps, of which more later, was caused by the large proportion of boulders and clay lumps.

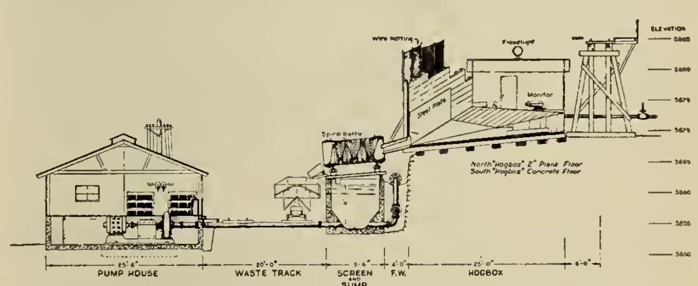

Figure No. 8.—Section of Hydraulic Fill Plant.

There was another development in the screens which proved very efficient. This was the spiral baffles shown inside the screen. These were made by cutting circular segments, 8 inches wide, out of ½-inch steel plate and welding the ends of the pieces together. The outside diameter of the baffle was calculated to give an interval between the plates when installed in the screen, of about 24 inches.

The made up baffle was simply drawn out like a spring and pulled into the screen. The tendency to close up held the plates firmly against the inside of the screen and further strengthening was given by angles rivetted to the screen at each end and in the centre of the baffle. These baffles lasted out the job.

The material rejected from the screens was dumped into cars through small chutes. This material was used to build levees along the banks of a new channel for the spillway water.

The screened material fell into the sumps below the screens. These sumps were of concrete with the bottom and sides protected by ¼-inch steel plates. The inside dimension of each sump was 8 feet x 6 feet with a depth of 7 feet to the centre of the pipes. The clear water pipe line came in at the back of the sump at the bottom, and the amount of water was regulated by a valve on this line.

The suction pipes to the pumps were 10-inch diameter flanged cast steel pipe and were immediately opposite the clear water pipes.

Figure No. 9.—View of North Unit.

An opening was cut in the side of the sump at the top, the bottom of the opening being 6 feet above the centre line of the pipes. This opening could be seen from the operating platform in the pump house and the water was regulated so that it was kept nearly level with this opening.

Only one pump is shown in the figure to avoid confusion. The racks at the back of the pump house are the resistance grids to control the speed of the motors, and the controller is shown on the platform at the right of the pump house. These controllers were drum switch speed regulators.

Two separate 2,200-volt lines were run from the substation to each pump house. This was to avoid both pumps being shut down on account of trouble on one of the lines.

A length of 18-inch wood stave pipe about 16 feet long was attached to the clear water line and stood nearly vertical over the pipe. This relieved the pipe line of any danger due to high pressure or the vacuum which might be caused by the shut down of the clear water pumps. It took the place of a relief valve on the pipe line, and, as it could be seen from the pressure pump house, it enabled the operator to regulate his valves on the pressure line when the water was low due to any trouble at the clear water pumps.

In figure No. 9 is shown a view of the north unit. This shows the pump house and a train dumping on one of the hogboxes. It will be noted that this train is dumping on one half of the unit only and the empties are out on the extension of the trestle.

A picture of the sluicing operations in the hogbox is shown in figure No. 10. This shows the operator, or monitor man, sluicing down the material with a monitor. It was taken at the commencement of the operations and there are several features which were later installed not shown. Such as the wire netting screen along the top of the walls and the steel plates on the walls and floor of the hogbox.

The screens are shown in figure No. 11. Only one unit was operating when this picture was taken and the spiral baffles can be seen in the screens. The screens and the operating mechanism were all housed in and the gears and rollers protected by metal covers.

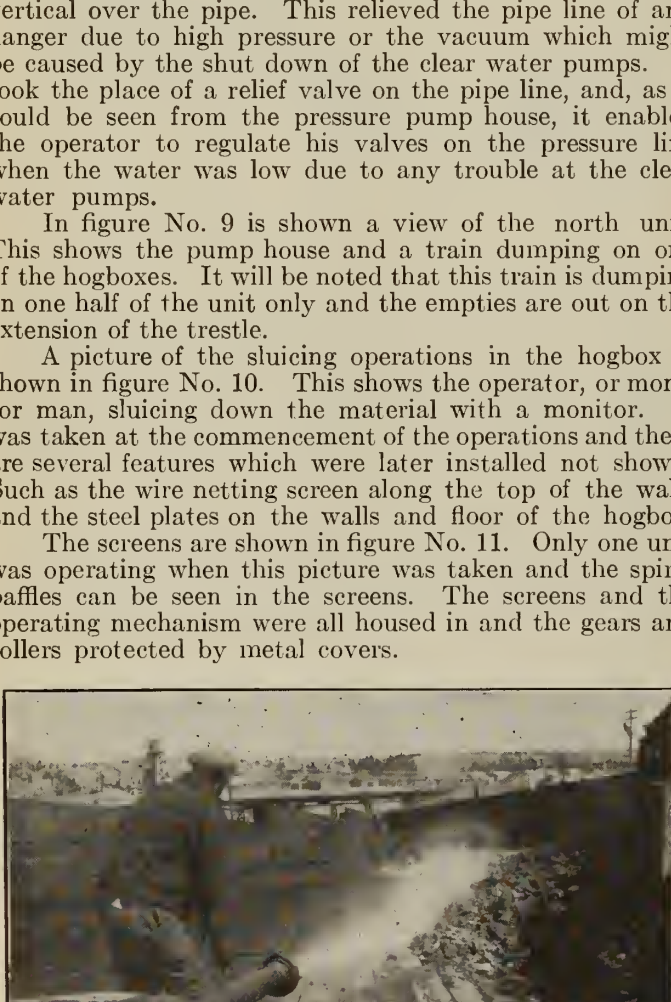

Figure No. 10.—Sluicing Operations in Hog box—Earth Fill Dam.

The operator in the pump house can see the operation of the screens and the level of the water in the sumps from the window and he kept a report sheet on which was entered every half hour, the vacuum on the intake pipes, the pressure on the discharge pipes, the amperes on the motors, and the height of water in the sumps. Other items were also entered on these sheets such as, the cause of delays, the number of cars received during each shift and the elevation of the core pool. This information was all entered up and forms a very complete record of the work.

All the equipment operated satisfactorily with the exception of the dredge pumps with which some trouble was experienced. This equipment was all new and had been made expressly for this work. In figure No. 12 is shown one of the original pump casings. These casings were circular with circular volute and had no liners.

This casing had pumped only 7,660 cubic yards of material when a large crack developed at right angles to the shaft and at the bottom of the casing above the discharge. This crack was welded and when the pump had run another 1,430 cubic yards another crack developed along the same line at the top of the casing. Rods were then bent around the outside of the casing and welded as shown.

Figure No. 11.—View of Screens.

All the casings received with the pumps and the spares cracked in the same manner. New casings were cast in Calgary to our own design from scrap car wheels.

One of these casings ran to the end of the work and was still in good condition after a duty of 59,140 cubic yards pumped. Two of the casings wore through at the bottom after pumping about 45,000 cubic yards each, and these were built up. None of the casings cast in Calgary showed any signs of cracks.

At the same time the impellers, or runners, on the pumps were showing some weakness. The impellers received with the pumps showed an average life of about 4,000 cubic yards. The rule then was to run the impellers for about 3,000 cubic yards, or until the vanes showed about 3 inches worn off, and then replace them. The worn impellers were then built up in Calgary and used again.

The breakage of an impeller causes a great deal of delay, as the pump line is full of material and has to be taken apart to be cleaned out.

All these impellers were three port impellers and a two port impeller was tried out. This only ran 4,100 cubic yards when the operation of the pump became very bad, vibration was set up, probably due to uneven wear on the vanes.

The makers had a man on the work testing the operation of the pumps to determine if possible the cause of the

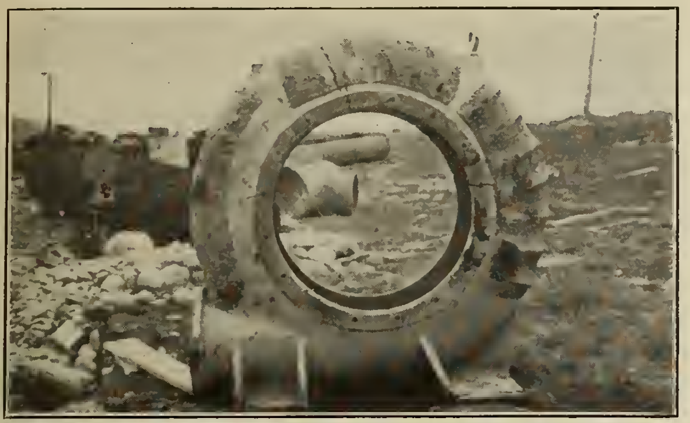

Figure. No. 12.—View of Original Pump Casing.

breakages. They could not find anything wrong and the pressures were very conservative. The maximum pressure on the discharge pipe at the highest lift was only 55 lbs. per square inch and the load on the motors about 150 h.p.

It is understood that a pump casing and impeller will wear faster when pumping small percentages of solid matter than when pumping a high percentage.

The maximum rate obtained with this material was 74.5 cubic yards and the average rate was 49.8 cubic yards per pump hour. This is equivalent to an average percentage of solid matter of 5 per cent. On a four hour test, with good material in the hogboxes and the pumps operating against a head of 45 feet, the average was 112 cubic yards per pump hour, or about 11 per cent solid.

Of course, these figures are of little value on account of the impossibility of determining the average speed at which the pumps were run. The average consistency was probably about 9 per cent.

The inclination of the outside face of the vanes was very flat. This face followed the radius of the circular ends of the impellers for about one-half the length of the vane and then turned down toward the centre at an angle of about 80°.

It was thought that the trouble, both in the casings and the impellers, might be caused by material being jammed between the impeller and the casing by these flat vanes.

Impellers were cast in Calgary to the design of the Foundation Company. The inside wearing edge was strengthened by the insertion of a piece of steel plate. This was held in place by welding as shown in the figure.

The new impellers proved very good, the average life was 41,300 cubic yards.

Figure No. 13.—Impeller.

There was another improvement, probably due to the change in the design of the impellers. The original impellers were frequently blocked by long stones. There were no stone blockages after the new impellers were installed.

The re-design of the impellers is also thought to have had a considerable effect on the life of the new casings as they were installed at about the same time.

The method of raising the dam is shown in the upper drawing on figure No. 14. The dredge pumps are shown on the right with the pipe lines to the dam. One pipe from each unit was carried across the fill in a light temporary trestle. These trestles were built about 8 feet in height and as the fill was raised new trestles were erected on top of them.

A plank bridge was kept over the pipe lines for the trucks depositing gravel in the downstream levee.

The dam was originally intended to be entirely hydraulic fill. Owing to the shortness of the season in which hydraulic work could be done, gravel levees were deposited by trucks during the winter preceding the commencement of the hydraulic work.

The hydraulic fill was brought to the top of the upstream levee and above this small levees were raised to retain the pumped material. These small levees were made with 3 feet by 15 feet planks on edge and backed with clay from the beaches.

It was later decided to continue the raising of the gravel beaches by trucks, and these were brought to the top of the fill on each face.

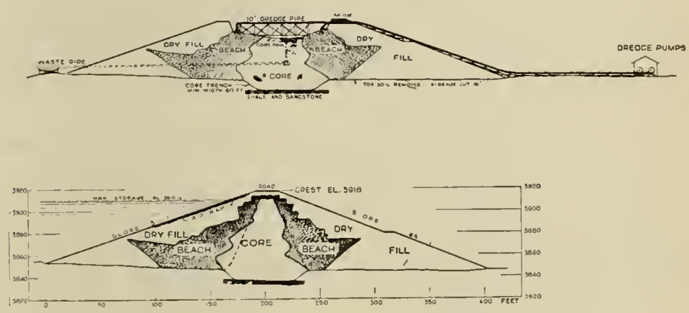

Figure No. 14.—Sections of South Earth Fill.

The discharge pipes were run along the inside edge of the gravel fill, and were 10-inch diameter slip joint pipe. There was no indication of any leakage of the core pool water through the beaches and the gravel levees.

The water in the clay core and the beaches appeared to be given up through the surface. Small springs could be seen on the beaches and also on the clay core when the core pool was low.

The overflow pipes were 14 feet in diameter and in two foot lengths. The pipe was held in a concrete block with a discharge pipe line running out through the upstream face of the dam, in order that the fines in suspension in the water might settle in the comparatively still water above the dam.

To raise the pool additional lengths of pipe were added to the vertical pipe line. Every alternate length was of a diameter to fit closely inside the other, so that each added length raised the water level one foot.

Three overflow pipes were installed and there was no trouble with any of them.

The lower drawing in figure No. 14 shows the dam as completed. The ground under the base was stripped to an average depth of 18 inches and a trench was dug along the centre line for the core base. The trench was excavated to bedrock and was equal in width to the height of the dam at any point, with a maximum width of 60 feet.

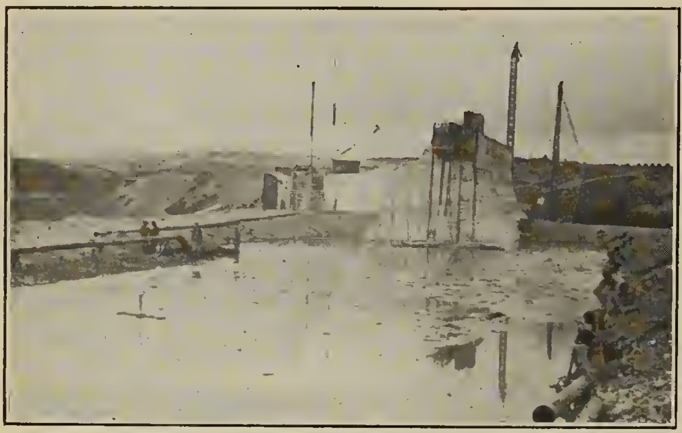

Figure No. 15.—View of Discharge Pipe in Dam and Core Pool.

The width of the core at any height was maintained to equal the remaining height of the dam as closely as possible.

The control of the width of the core depended a great deal on the percentage of fines in the pumped material. This, of course, had to be about 25 per cent more than that necessary for the theoretical width of the core as a certain proportion would remain in the beaches.

A record of the outline of the clay core was kept by examination of the fill on each lift. The edge was considered to be where there was no trace of gravel or any lumps of clay. This was not a definite line as the fine material extended into the beaches, and it was considered that the beaches, being made up to a large extent of clay lumps with this fine material forming a binder, were as impervious as the clay core.

A view of the discharge pipes in the dam and the core pool is shown in figure No. 15.

Some of the pressure cells, which were installed to measure the pressure in the clay core, can be seen on the concrete transition section in the background. Also the semi-circular segments over the ladderway into the tunnel in the dam can be seen.

A view of the fill from the north end is given in figure No. 16. The small float near the centre of the clay core is attached to a 6-inch diameter iron ball which was used to give some indication of the consolidation of the clay core by the amount of penetration over a period of several days. This test was of little value as a wet core would support the ball almost indefinitely after the initial penetration. The float indicated, to some extent any shifting of the core.

The last of the fill was done in the dry with trucks.

Clay was dumped on top of the wet hydraulic clay fill and sides brought up with gravel.

Rip-rap was placed along the upstream face of the fill to protect the face from ice.

The average lift of the dam was 3.4 feet per week, and the maximum for one week was 5.5 feet. The maximum yardage pumped in 24 hours was 4,035 cubic yards.

The wastage amounted to 16.5 per cent, and this was partly due to the clay from the first pits being nearly unbreakable.

In figure No. 17 are given the results of tests made to determine the consolidation of the clay core. The installation of seven "Goldbeck" pressure cells on the concrete transition section at the north end of the fill are shown on the right.

The cell is a flat circular box of 5½ inches in diameter. The top of the box makes contact with a button inside the cell. This cover is a thin diaphragm. A short pipe of ⅛ inch diameter provides an opening at the side of the cell, and an insulated wire passes through this pipe and is connected to the button which is insulated from the casing of the cell.

The cells were mounted with two pipes leading to the top of the concrete dam and an extension to the wire passed through one of the pipes to the top. Short lengths of pipe were left at the end of the pipes below the cells to catch any scale from the pipe lines.

Five of the cells were mounted with the faces nearly vertical and the other two with the faces horizontal.

Another two cells were placed at the middle of the dam, and the results from these were similar to the ones shown.

The air line was connected to one of the pipes and the other was left open. Air was blown through the pipes and the cell to remove any condensation in the pipes which might affect the contact of the diaphragm cover with the button. One pipe was then closed at the top and the air pressure put on the cell until the contact was broken. The pressure was read at this instant, and some of the results are shown on the diagrams.

It will be seen that at the commencement of the fill the pressures are very nearly equal to the equivalent hydrostatic pressure and then gradually become greater. The relation of the vertical pressures to the lateral gives an indication of the consolidation of the core. The vertical pressures increased more rapidly than the lateral and this difference was quite marked for some time. Then the vertical pressures remained nearly the same at all heights of the dam and the lateral pressures continued to increase until, as shown on the last diagram, they were almost equal to the vertical pressures.

It was considered that this was due to the clay having become so consolidated that the readings did not show the pressures due to the static head. The clay was so solid that the pressures shown were those needed to raise the diaphragm forming the cover of the cells by compressing the clay the five-ten thousandth of an inch required to break the contact with the button.

It can be seen that the equivalent hydrostatic pressure on the last diagram is nearly the same as the pressures read in the core. This is due to the clay pressures remaining nearly constant although the head was increasing. The equivalent hydrostatic head does not seem to be of any value as an indication of the consolidation of the core in this case.

Some tests were made by sounding with a length of one-inch pipe in the clay core. No definite idea of the consolidation of the core could be obtained by this means.

Figure No. 16.—View of Fill from North End.

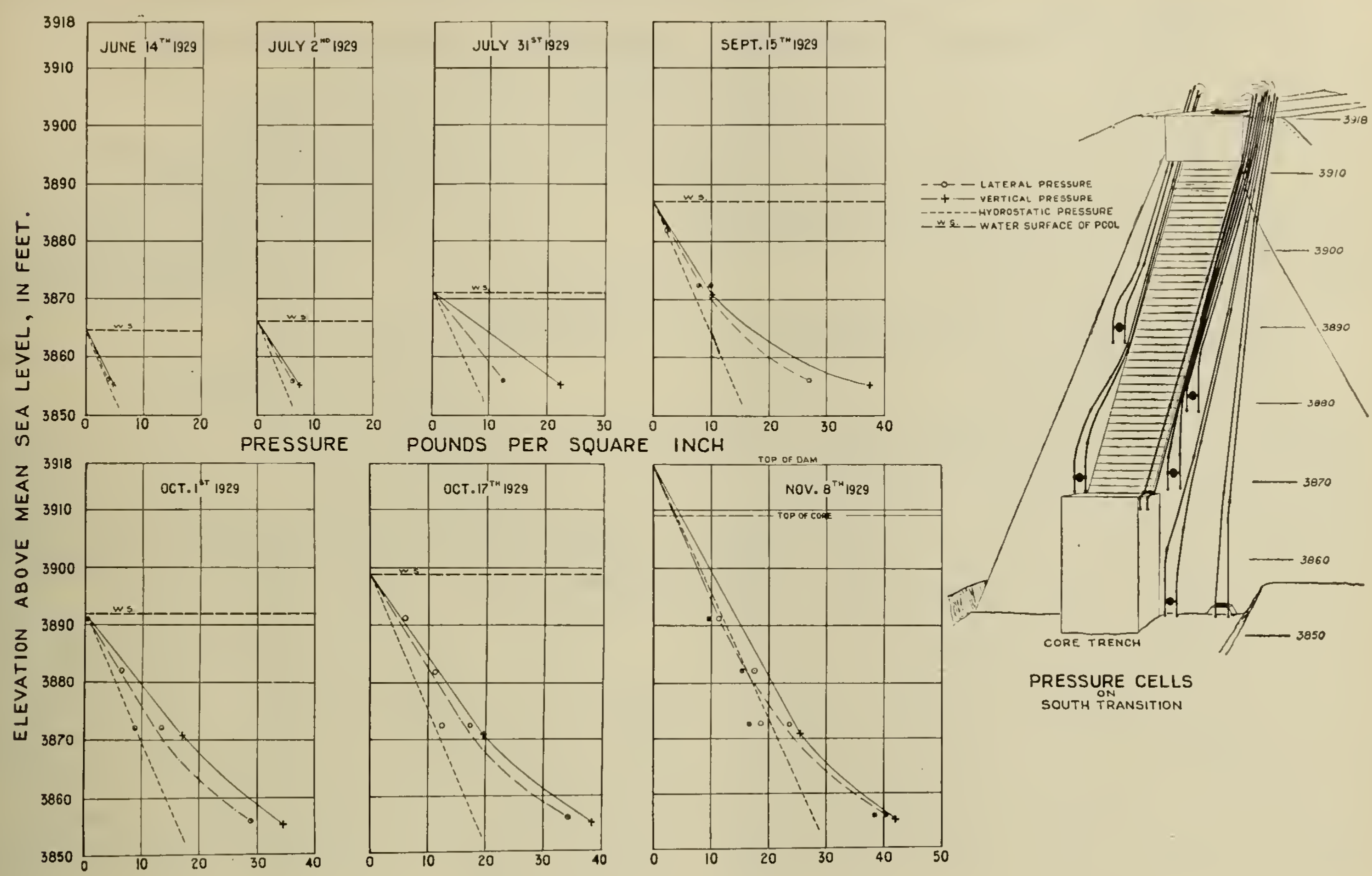

Figure No. 17.—Pressure Diagrams.

The testing apparatus used consisted of a small lamp connected in series with the button and the cover of the cell through the pipe line, and a pressure gauge. The current for the lamp was supplied by two dry batteries. The equipment was made up on the job.

The quantities in the north and south earth fills may be of interest:

North Earth Fill.

Excavation, hydraulic.......	79,000	
machine........	18,000	
Total.....................		97,000 c.y.
Fill, gravel by truck.........	144,000	
clay " "	53,000	
hydraulic..............	13,000	
Total..................		210,000 c.y.

South Earth Fill.

Stripping..................	18,000	
Core trench excavation......	25,000	
Total..................		43,000 c.y.
Fill, gravel by truck.........	624,000	
hydraulic..............	398,000	
Total..................		1,022,000 c.y.

The design of the concrete dam and the earth fill sections was made by the Montreal Engineering Company, with Dr. T. H. Hogg, M.E.I.C., of the Ontario Hydro-Electric Power Commission, as consulting engineer.

The design of the power house superstructure and all the construction work was done by the Foundation Company of Canada. The bridge piers and the excavation of the clay pits was done by sub-contract, Campbell Brothers doing the latter work.

The Water Problem in Oil and Gas Fields

W. P. Campbell,

Office of the Supervisory Mining Engineer, Department of the Interior. Calgary.

Paper read before Lethbridge Branch of The Engineering Institute of Canada, January 25th, 1930.

So important is the water problem in oil and gas fields that it must be reckoned with at every stage in the development of the field. It creates difficulties:—

(1) In the drilling of wells.
(2) In the maintenance of producing wells.
(3) In the proper abandoning of wells which have become unproductive.

When it is considered that only about 20 per cent of the oil underground is ever recovered, and that one of the chief factors which militates against more efficient recovery is water, which has been permitted to enter the oil sand from points above or below the same, in the drilling process, or is found in contact with the oil or gas in the producing zone. In view of this, any measures which can be employed to prevent the flooding of oil sands by water, and thereby prolong and maintain the productivity of oil and gas horizons, are certainly to be welcomed and encouraged. J. B. Case[1] puts it very ably when he says, "Efficiency in oil field development is the production of oil, free from water for the longest possible time in a manner to recover the greatest ultimate quantity from the underlying pool. Any conditions that prevent the accomplishment of this and which can be remedied are out of harmony with recognized principles of proper oil field practice and are detrimental to the best financial interests of the operators and landowners."

Oil "Sands"

Before discussing the problem further, it might be of interest to consider very briefly the nature of the formations in which *oil*, *gas* and *water* are found in oil fields. Sandstone beds, or "sands" as they are called in the industry, and limestone formations act as reservoirs for all three, singly and in combination. Of course, all sands do not necessarily contain any one of the three. The reason for their accumulation in the sand and lime zones is more or less evident, as the sandstone and porous and fractured limestone offer less resistance to their movement than do shales and clay, hence the tendency is to migrate to the areas of lower resistance to movement. Due to geophysical changes and forces, the entrapped material may become subject to great pressures, which condition manifests itself when the overlying impervious shales are penetrated by the drill. Water might rise, when a sand is reached, to a considerable height in the well, or may even overflow. In like manner, oil and gas may be under very great pressure and come from the well with great force, as in the case of the Turner valley wells which have reached the lime. The sands may not be uniform in texture but may contain lenses which are open grained and others which are tight. This lack of uniformity has an important bearing on the recovery of oil from horizons in which water has penetrated, as the tendency is for segregation of oil to take place in the tight lenses of the sands, and be held there while water replaces the oil in the looser areas. The result is, that wells will finally produce largely water, in spite of the fact that a large quantity of oil is still in the oil sand. Some interesting laboratory experiments have been carried out by the United States Bureau of Mines to prove this point.[2]

[1] Chief Deputy Supervisory, Dept. of Petroleum and Gas, State of California.

[2] Ambrose, A. W.—"Underground Conditions in Oil Fields," U. S. Bureau of Mines, page 70.

Classification of Oil Field Waters

In the industry, oil-field waters are divided into classes and are classified according to their relation to the oil producing zone, or zones.

The following classes are used:

(1) Top water.
(2) Middle or intermediate water.
(3) Lenticular water.
(4) Edge water.
(5) Bottom water.

The first class, "top" water, is water or waters which are met with above the oil producing zone; they may appear at relatively shallow or at considerable depth but so long as they are above the producing zone they are called "top" waters.

"Middle or intermediate" waters are those which occur between oil and gas sands. At early stages in the development of a field these might be regarded as bottom waters, until such time as a lower oil sand is discovered.

"Lenticular" water, is water carried by a water sand which pinches out in a field, and consequently may be met in one part of a field and not in another.

"Edge" water, is the water found in an oil sand in contact with the oil. It may not be apparent at first, but makes its appearance gradually as the oil is withdrawn from the sand.

Lastly, there is "bottom" water, which is the water that comes from beneath the lowest oil bearing zone in an area. It is not, in the initial stages at least, in contact with the oil, but may readily invade the oil sand if not taken care of.

The accompanying figure No. 3 will make clear the distinctions in the various classes of water enumerated above.

Water Troubles

All the classes of water just mentioned are capable of making trouble for the oil operator if proper precautions are not taken. With the exception of edge water, all can be satisfactorily dealt with, when correct measures have been taken in drilling the initial wells in an area. Edge water, however, is a very different matter from the others. In many fields, it may not appear for years, but when it does it marks the beginning of the end of that field. Methods have been employed, with more or less success, to hold back edge water encroachment but at best these merely delay the approach of the evil day when the field goes to water. In other fields edge water may make itself evident in the early stages of development, but not in such large quantity that it is considered detrimental; however, as the oil sand becomes depleted, the percentage of water increases until the oil practically disappears, or the quantity of oil recovered does not pay for the pumping of the oil and water mixture.

An example,[3] of what this means in actual practice, is shown in figure No. 4.

Sometimes bottom water is mistaken for edge water and cases are on record where wells, thought to be useless on account of edge water trouble, have been brought into good production by successful plugging off of bottom water. The productivity of oil sands containing water may be greatly improved by proper pumping methods. Wells

[3] Ambrose, A. W., *loc. cit.*, page 76.

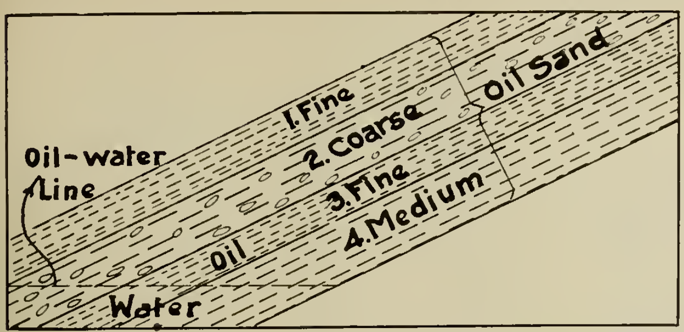

Figure No. 1.—Sketch showing Sand Texture and Original Relation of Oil and Water.

have been ruined by too great a rush to get the flush production; these might have produced a very much greater ultimate quantity of oil if the operators had been content with a lower daily production from the start. In view, therefore, of the inevitable end that awaits oil fields, it is surely to the interest of all operators that every reasonable precaution be taken to guard against the menace of all waters, particularly those waters the proper handling of which is largely a matter of care and suitable measures while the well is being drilled.

Water Sand Records

The drilling of an oil well means the outlay of a considerable amount of money. Of this sum, the actual amount required, in time and material for shutting off water, would represent a very small percentage of the total cost, and yet the whole success of the venture might hinge on the manner in which this was done. Even in the drilling of what is termed a "wild cat" well, where the primary object is information as to oil sands, it is just as important that every water sand be carefully recorded and proper measures taken to keep out the water as it is to record oil shows. The information obtained, by keeping such records, may be of the greatest value in event of the well proving to be a productive one. Since the first well drilled in any new field is more or less in the nature of a "wild cat" well, the recording of every item of information regarding water sands is highly important. It is evident then that the time to take the water problem in hand is when the field is first entered, and in order that the most accurate records of water sands be obtained it is essential that the initial wells be drilled with percussive tools, of which the familiar cable tools are a type. Only by their use can the lesser water sands and also oil and gas sands be detected and the exact depth at which they occur determined.

Having established the depths at which water, oil and gas sands were met with, information is now on hand as to the procedure to be followed if later wells are drilled by rotary. If these records are not first obtained small but useful oil and gas sands may be passed up, and water sands entirely overlooked which may later seriously endanger the productivity of the whole field. One unfortunate feature of the water problem is that not infrequently properly drilled wells are ruined through the carelessness of others in not shutting out water.

Sampling of Water in Sand

In dealing with the water problem, the petroleum engineer has called the chemist to his aid. Hence, in addition to logging carefully the exact depth at which water sands occur, he takes a representative sample of the water that comes from the particular sand. The sample should be truly representative, for upon this fact much might later depend. In taking a proper sample, certain precautions are necessary; the drilling water, in the case of cable tools and the mud fluid when the rotary is used, should be bailed from the well and the incoming water allowed to flush out the sand. Bailing should then be continued until all possible contamination by drilling water has been eliminated. The importance of this procedure cannot be over emphasized, for after all the analysis of a water merely tells what is in the sample received, consequently the greatest care should be exercised in obtaining a true sample of the water. If this procedure in sampling were followed with all waters encountered, and these waters carefully shut off before drilling be resumed, exceedingly reliable information would be obtained which could be of great use to the petroleum engineer. While government regulations in the province of Alberta make the sampling of all oil well waters obligatory, the operators, for their own interests, should see to it that their employees comply with not only the letter but the spirit of the regulation by taking true samples. For it is only along these lines that worthy and serviceable data can be collected which will materially assist in the development of commercial oil and gas fields.

Water Analysis[4]

For purposes of identification of oil-field water, use is made of the fact that every water carries certain mineral salts in solution. The amount may vary in different waters from a low to a high concentration. Well waters from Alberta oil fields, which have been examined by the department to date, lie between 0.02 and 23.0 per cent solutions of salts. As a general rule the dissolved salts appear to be more or less characteristic of the formations in which the waters are found. There are exceptions, however, the waters from the Milk river sand being a case in point; the waters from this sand vary quite considerably in different areas. On most fields the waters in different horizons vary to such a degree that identification is comparatively easy; in others they may be very similar, in which case dependence cannot be put entirely on the analysis of the water but must be considered along with whatever may be known of the drilling operations and the geology of the area.

Analysis of Water

The analysis of water, for oil-field purposes, consists in finding out what salts are in solution, or rather in determining what ions are present in the water. The constituents which predominate in oil-field waters, and the quantitative determination of which is sought, are: sodium, potassium, calcium, magnesium; and the acid radicles chloride, sulphate, bicarbonate, and carbonate. There are other constituents sometimes determined, but their amount is so small, generally, as to be negligible for ordinary purposes of description and identification.

Methods of Analysis

Time need not be taken here to describe the actual methods employed in analyzing the water. The methods outlined in any standard work on analytical chemistry are satisfactory for the purpose.

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[4] Campbell, W. P.—"Oil-Field Water." Can. Min. and Met. Bull. Dec. 1929, pp. 1400-1411.

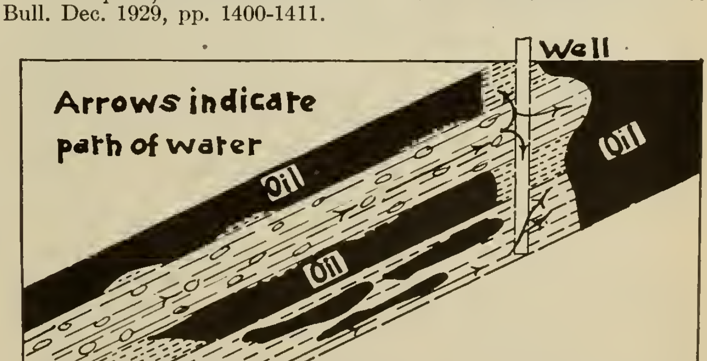

Figure No. 2.—Sketch showing how Fluid Advances Most Rapidly through the Coarse Sands and the Water thus Traps the Oil in the Fine Tight Sand. There is Incomplete Segregation of Oil and Water in the Medium Grained Sand.

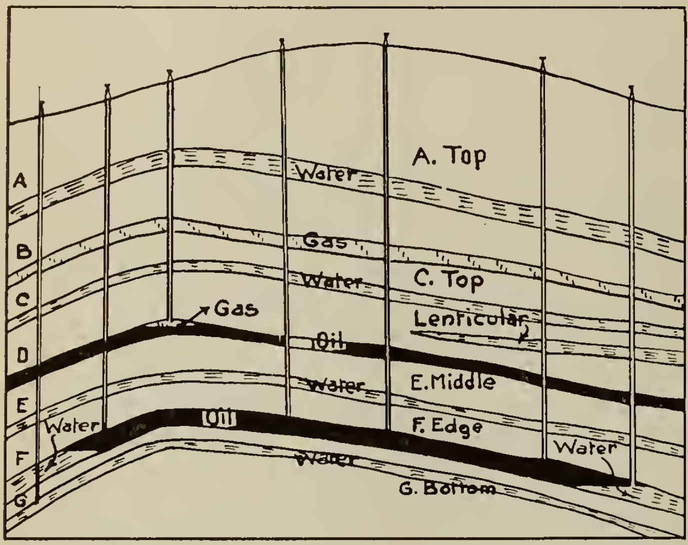

Figure No. 3.—Hypothetical Sketch showing Different Water Sands.

Methods of Reporting

In the past the results of oil-field water analyses have been reported to the petroleum engineer in a variety of ways; hypothetical combinations of several types, the Palmer system,[5] and the ionic system, were common. The Palmer system of interpreting water analyses has been in use for some time among oil men in the United States, and it has many excellent features. Though primarily used in classifying and comparing surface waters, it has also value in comparing oil-field waters. The Palmer method considers the reactive capacity of the various ions, rather than the relative concentration of the ions. The reactive capacity, or 'reactive value,' of each ion is calculated by dividing the concentration in milligrams per litre of each ion by the appropriate equivalent combining weight, oxygen 8, expressed in milligrams. Stabler[6] arrives at the same result by multiplying by the reciprocal of the corresponding equivalent combining weights. These reciprocals are called "reaction coefficients." From the sum of the reaction values of all the ions, the reaction value of each ion is calculated in percentage. The waters are compared on this basis. This is as far as the Palmer method is usually followed in reporting oil-field water analysis, although the complete system carries the analysis a step further; but that need not be discussed here.

The ionic form of reporting water is the simplest. It gives the chemical constituents of a water in the exact proportion in which they are present, and the plain statement of fact without any assumption being made. Reistle,[7] who has had a wide experience in dealing with the oil-field water problem in the United States, has this to say regarding the ionic statement: "For describing and identifying or differentiating any two waters, this system of reporting analyses is undoubtedly the most convenient and reliable; it cannot be misleading."

Table No. 1, illustrates the calculation of Palmer's reacting value from the ionic statement.

Graphic Classification of Water

Where a large number of waters are to be compared it is often found more convenient to represent them graphically than to compare them as groups of figures. Several graphic methods have been in use. No one of them is

Table No. 1

Radical	Parts per million (milligrams per litre)	Reaction co-efficient	Reacting value	Reacting value (Palmer) per cent	Per cent by Weight
Calcium *Ca*	1,500	.0499	74.87	4.6	3.2
Magnesium *Mg*	512	.0822	42.11	2.6	1.1
Sodium *Na*	15,878	.0435	690.39	42.8	33.3
Chloride $-Cl$	25,322	.0282	714.33	44.2	53.0
Sulphate $=SO^4$	4,262	.0208	88.74	5.5	8.9
Bicarbonate $-HCO^3$	262	.0164	4.29	0.3	0.5

perfect but the most recent one to the writer's knowledge, the Parker method,[8] appears to have fewer faults than any of the others. It was first used in comparing the oil-field waters of Trinidad. In the analyses which are given below, the Parker method is used, with a few changes to suit the special requirements of Alberta waters.

Characteristics of Waters

Just to what degree the character of a water is influenced by the structure in which it is entrapped, or moves, and how much of the original character is still retained, is a question about which there can be justifiable differences of opinion. That changes do take place, the example of the different waters from the Milk river sand is evidence. There are without doubt, in Alberta, oil-field waters which are "connate" waters. These waters have retained many of the marks of their original character and appear to have been influenced but little by their surroundings. Iodine is present in most brines met with, which is suggestive as to their origin.

Deep waters encountered in Alberta fields are almost wholly chlorides of sodium, calcium and magnesium. Sodium chloride is most prevalent, and magnesium chloride least. So far, only one exception to this rule has been noted, in which case the calcium chloride content exceeded the sodium chloride. A certain amount of bicarbonate is carried in the very heavy brines but it never exceeds 1,000 p.p.m. An interesting fact, worthy of more than passing notice, is the entire absence of sulphates in many of these brines. Sea water contains sulphates; consequently one would expect to find them in the oil-field brines. Rarely in Alberta are sulphates found in a brine at all near an oil-sand. This may perhaps be simply a coincidence, but it is certainly an interesting fact nevertheless. There is one well being drilled at present where the sulphate content of the deep waters is just the reverse of what is usually found in brines. Up to the present this well has shown little or no evidence

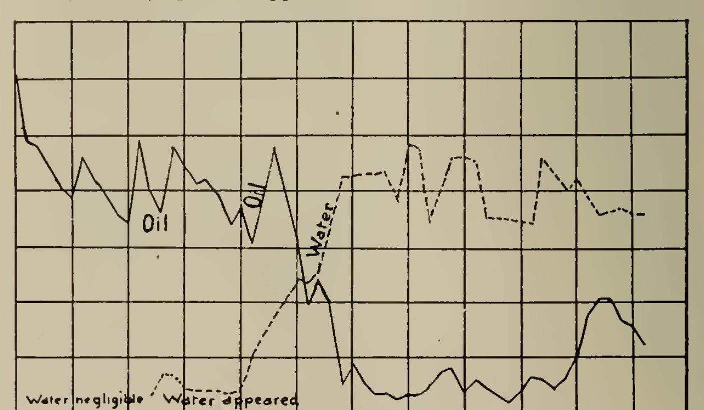

Figure No. 4.—Plot showing Effect of Water and Oil Production of a Well.

[5] Palmer, Chase—"The Geochemical Interpretation of Water Analyses." Bull. No. D. 79, U.S. Geol. Survey, 1911.

[6] Stabler, Herman, U. S. Geol. Survey Water Supply Paper No. 27A, 1911, p. 188.

[7] Reistle Jr. C. E., "Identification of Oil-field Waters by Chemical Analysis," U.S. Bureau of Mines, technical paper No. 404.

[8] Parker, W. S. and Southwell, C. A. P. Journ. Inst. Pet. Tech., Vol. 15, No. 73, April 1929 pp. 138-182.

Table No. 2—Ionic Statement of Analyses of Waters.

Area	Depth. (approx)	Parts per million (milligrams per litre)							
		Total solids	*Na+K*	*Ca*	*Mg*	—*Cl*	$=SO^4$	$—HCO^3$	$=CO^3$
(Figure No. 5) Wainwright	2,072	79,419	27,136	2,503	1,045	48,379	0	356	0
	2,069	78,875	26,370	2,646	1,109	48,475	0	275	0
(Figure No. 6) Milk River Sand	215	2,405	728	13	7.2	186	595	792	84
	1,890	1,980	655	14	5.3	516	71	695	24
	1,595	7,909	2,986	47	13	4,538	5.2	320	0
(Figure No. 7) Medicine Hat	1,890	1,980	655	14	5.3	516	71	695	24
	3,340	5,817	2,075	25	6.7	2,643	0	1,067	0
	3,680	8,899	3,295	33	17	4,666	34	854	0
	3,990	8,803	3,034	13	18	3,175	118	2,330	115
(Figure No. 8) Ribstone	202	1,316	411	10	4.1	271	103	499	18
	1,670	85,464	28,836	2,542	1,113	52,518	0	455	0
	1,820	144,546	48,843	4,164	2,070	89,027	0	442	0
	1,820	88,238	29,641	2,512	1,485	54,250	0	350	0

of oil. It is not being suggested that there is any relation between the sulphate content of waters and the presence of oil, although the query might be raised.

The absence of sulphates in oil-field brines has been known a long time, and two theories have been brought forward to explain this phenomenon. The older theory suggests that sulphate removal is brought about by reduction to hydrogen sulphide, the reducing agent being 'dead' organic matter present in, or contiguous to, the water-sand. This reaction can be brought about in the laboratory, but it only takes place at very high temperatures. Time as well as temperature is a factor in chemical reactions; consequently, given time enough, the reaction might be possible at relatively low temperatures. A recent theory, brought forward by Bastin,[9] explains the reduction of sulphates by the action of bacteria. Oxygen is removed by the bacteria and the sulphates are reduced to hydrogen sulphide. Bastin has gathered some very fine experimental evidence in favour of his theory. He does not, however, exclude the possibility of the older theory.

Shallow waters differ from deep, in that there is more likelihood of their dissolved solids reflecting the nature of the overlying strata. It has been pointed out above that the amount of dissolved solids in surface waters is very much lower than in the deeper waters. This is due largely to the nature of the dissolved salts, for with but few exceptions sulphates and bicarbonates predominate in surface and shallow waters. Since the calcium salts of these acids are not very soluble, there is a limit to the quantity of these salts which can be held in solution. Sodium is the chief alkali, metal or earth, present in surface waters; occasionally, the calcium and magnesium content exceeds it, but this only occurs in waters of low concentration. The chloride content of surface waters is almost negligible, unless the waters are found in the neighbourhood of salt deposits, e.g., the waters from the McMurray area. Here the character of the water is reflected by the formation.

In most oil fields, methods of correlation have depended on the facts that:

(1) Concentration increases with depth.
(2) The sulphate content decreases with depth.
(3) The carbonate-plus-bicarbonate content decreases with depth.

For some areas in Alberta, all three conditions hold good, but only the first has anything like a general application to all fields. The bicarbonate and sulphate content of Alberta oil-well waters appears to vary quite a bit in different fields. In most cases the deep waters have less than the shallow waters, but in some wells the deep waters may contain more than the waters higher up.

Use Made of Water Analysis by Petroleum Engineers

With reliable records on hand, as to the depths at which water sands were struck and the analyses of these waters, the petroleum engineer has information which is of great value to him in laying plans for the drilling of other wells in the area. For example: he knows the depths at which water shut-off jobs would have to be done, he can estimate closely the amount and dimensions of casing required for the new wells and can decide beforehand the most economical use he can make of it, commensurate with safety. In addition to this, unsuccessful water shut-offs can be checked and the source of water, which might later make its appearance in a completed well, can be identified; for having on record the analysis of all waters encountered in drilling the well, and the depths at which they occurred, the trouble can be overcome with less difficulty than if no

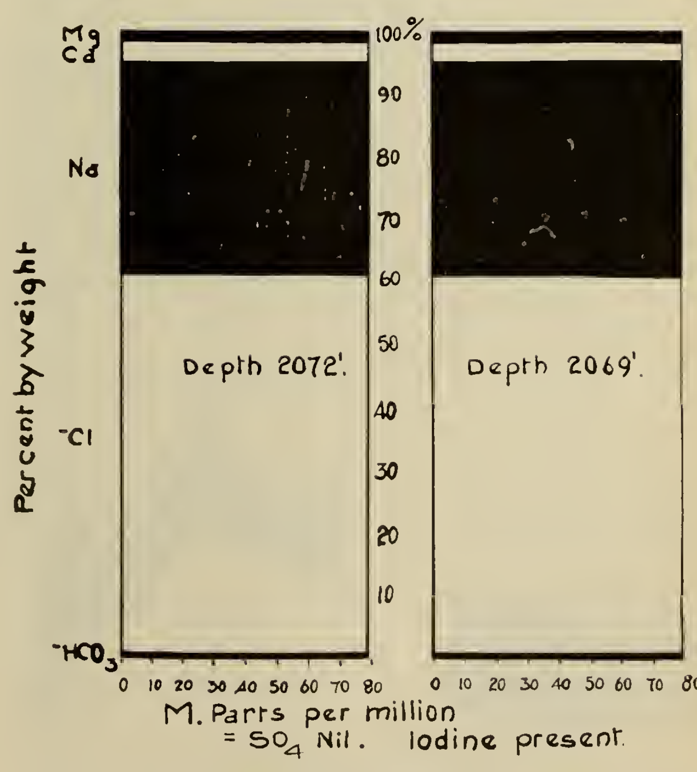

Figure No. 5.—Wainwright Area — Water from Same Horizon in Different Wells.

(9) Bastin, Edson S., "The Problem of the Natural Reduction of Sulphates," Bulletin Amer. Assoc. Pet. Geol., Vol. 10, Dec., 1926, pp. 1270-1299.

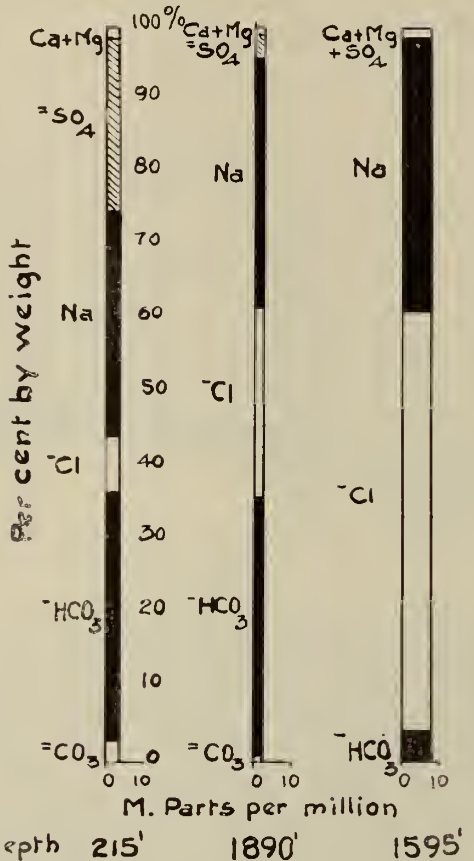

Figure No. 6.—Milk River Sand — Water from Same Sand — Different Fields.

such record had been kept. With the use of just such information as has been enumerated, progressive engineers have saved their companies hundreds of thousands of dollars in the oil fields of the United States. Figure No. 9 shows improved production after water has been shut-off.[10]

Cementation

The next step in a properly drilled well is to shut off the water, but this should not be proceeded with before careful tests have been made to ascertain the exact depth of the water sand. This is important, as setting the casing too high is just as bad as a poor job although everything may have been perfectly done. The water shut-off should be done so effectively that the water will give no further trouble during the life of the particular field. It is generally useless to attempt to pump a water sand dry. Formation shut-off jobs may sometimes prove effective where cavings become packed around the casing but there is an element of uncertainty in this. The most reliable if not the only means employed in shutting out water effectively is cementation. The work of cementation stated simply consists of surrounding the casing or water string set at a convenient point below the water sand with cement, from the bottom of the casing, to a point well above the water sand. The actual carrying out of this operation and the realization of the desired result is, however, a somewhat hazardous affair that calls for careful consideration before being attempted, and thorough work in the undertaking. There is a feeling in certain quarters that anyone can cement a well, but judging by the member of failures to do this it does not appear to be quite so simple as is popularly thought. Even those who make it their sole business cannot report 100 per cent results. So much depends on the effectiveness of a water shut-off, that no reasonable expense and effort should be spared in securing it. Failure means a great deal of added expense. Recementing may have to be attempted, provided circulation can be established; failing this, drilling may be proceeded with, but on account of the water in the hole progress will be very much slower. An additional string of casing will now be necessary to shut the water out; this is an added expense besides decreasing the size of the hole. Quite often small but useful gas horizons, with volume sufficient to run the boilers and supply the camp, have been drowned out by water standing in the hole from unsuccessful water shut-off jobs. For these reasons, therefore, the actual operation of cementation should be entrusted to competent men only, and even in their hands it may prove difficult and not always successful. It should be borne in mind that no two wells are exactly alike; different methods will be necessary in different wells. Conditions, too, vary in the different fields, making the cementation difficult or comparatively easy. There are fields in Alberta which present peculiar difficulties in making successful water shut-offs on account of the nature of the formation. This is especially true of those areas where the structure is more or less unconsolidated or where local fractures and fissures occur. At the present time there is a company operating in Alberta which makes a business of cementing wells. They guarantee to place the cement where it is supposed to go, which at least suggests that they have some confidence in their work. Even if it does cost more to have cementation jobs done by such a company, it may prove to be more economical in the long run. When cementation has been done, ample time should be allowed for thorough setting of the cement before drilling is proceeded with. It is poor economy to recommence drilling before the cement has had time to set properly and incur all the inconveniences of an unsuccessful shut-off. It is also essential that agitation of the cement from gas or movement from other causes be entirely avoided during the setting period, otherwise what would be a successful job may prove to be a failure.

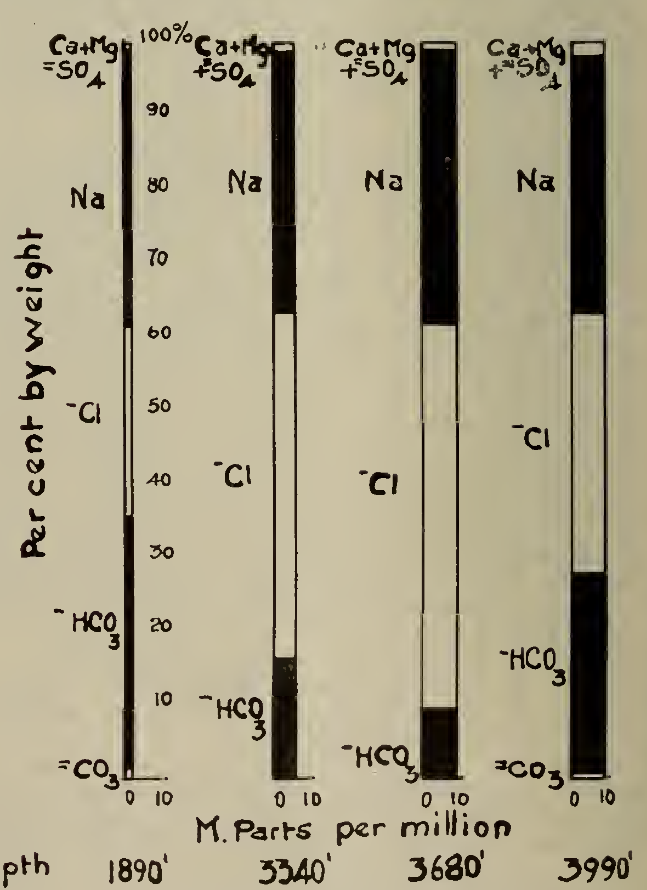

Figure No. 7.—Medicine Hat—Different Waters from Same Well.

(10) Ambrose, A. W., *loc. cit.* p. 99.

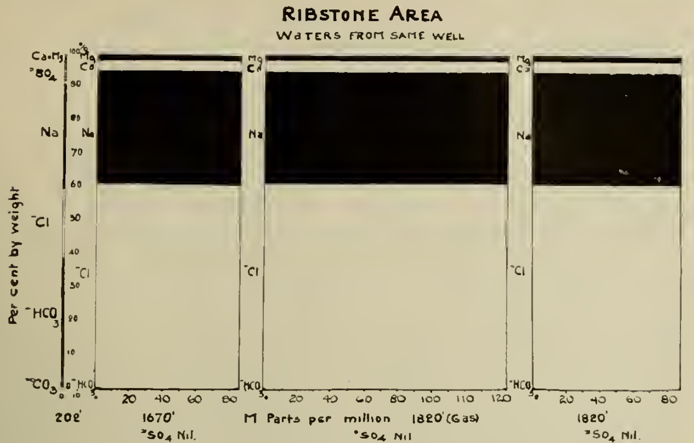

Figure No. 8.—Note Similarity of Waters Encountered at 1670′ and 1820′. A Clear Case of Incomplete Shut-off at 1670′. The Water Marked 1820′ (Gas) was blown from the Well when Gas was struck.

Taking the simplest case of cementation as an example, the procedure is as follows:—

(1) Circulation is established, i.e. it is made certain that there is a free passage from the inside of the casing up between the outside of the casing and the formation.

(2) Neat cement of suitable quantity and consistency is introduced into the bottom of the hole or inside the casing—there are a variety of ways in which this can be done.

(3) Pressure is applied on the column of cement so that it is forced from the bottom or out of the casing into the space between the outside of the casing and the formation. The pressure should be maintained undiminished until the cement has thoroughly hardened.

Many modifications in procedure will be necessary to fit the particular circumstances. In the case of very deep wells, cementation is more intricate and much ingenuity and very elaborate equipment is necessary for its successful accomplishment but the final result is just as has been described.

There are many cementation methods in use at present, some of which are protected by patents. The Perkins and Haliburton processes are well known; the latter is being used quite extensively in this province. The tubing and dump bailer methods are in common use, the latter being of great service in cable tool drilling where pumps for circulating are not available.

The methods of cementation which have just been mentioned have to do more particularly with water encountered in the drilling of new wells, i.e. with "top" and perhaps "intermediate" waters. If the water problem were confined to these alone, its solution would be comparatively easy but the real problem has to do with water troubles which arise in producing wells. These water troubles require somewhat different treatment and are much more difficult to deal with. Water may get into a producing well from various sources. Casing joints may be defective, or the casing itself may have been damaged, permitting surface water to seep in. Water may break through from water shut-off jobs which were improperly done. The producing zone itself may contain water in the form of edge water, and bottom water may have been permitted to invade the producing zone when the drill has penetrated the underlying water sand, lastly water may find its way into a properly drilled well from other wells, in the same area, in which the necessary precautions have not been taken to protect the oil zone by shutting off water sands. When water appears in a producing well, the first step is to determine if possible the source of the water. If the operator has been careful in taking samples of water encountered in drilling the well, and has had analysis made of these, he has a ready means whereby he can check up whether these waters are responsible for the trouble. If care has not been exercised and mixing has been permitted in taking these original samples, the identification of the water is made very difficult. Should the analysis of the intruding water prove to be one of those which was sampled, the depth at which the trouble is seated is known.

The next step is to find out just how the water is getting into the well. If the water is of surface origin, sometimes the water string joints may be responsible and these may be tightened up. Cases are on record where water strings in producing wells have been screwed up as much as 26 inches, with successful exclusion of water. It may prove to be that water is leaking past the casing shoe, which has been set a little above the bottom of the water sand; in this event driving the casing may be effective in keeping out the water. It may be found that the casing has collapsed in which case it would have to be swaged out and a bridge set at some point below the damaged length, then cement forced through the opening into the space between the two strings of casing. The use of tubing with packers set at some point below the place of entry of the water has proved useful, where other means have failed. Only a few of the possibilities have been suggested but perhaps sufficient has been said on this point to indicate the real difficulties that the petroleum engineer is faced with, first in locating the seat of the trouble, and second in successfully correcting it after the cause has been discovered.

If the water proves to be different from any of those of which records are on file, the new water may be edge or bottom water. Examination of other wells further down the dip may decide whether it is edge water or not. There appears to be a general feeling among those whose business it is to see that the maximum amount of oil is produced from an oil sand, that operators are too easily discouraged when water appears which is suspected of being edge water. An honest attempt to shut off such water has often been rewarded with success. Even after several failures success has come, for what was thought to be edge water proved to be simply bottom water. When the bottom water is under considerable head the shutting off presents many difficulties. Lead and lead wool plugs have been employed with fair success, but as a general rule cementation, where at all possible, is much more satisfactory. For edge water little can be done. Compressed air methods have been tried but these have proved merely palliatives.

Examples of methods of dealing with water troubles might be multiplied but it must be evident that all the aspects of so wide a subject cannot be fully dealt with in the course of so short a paper.

Figures Nos. 10 and 11 demonstrate the reality of the water problem in some of the oil and gas areas in Alberta.

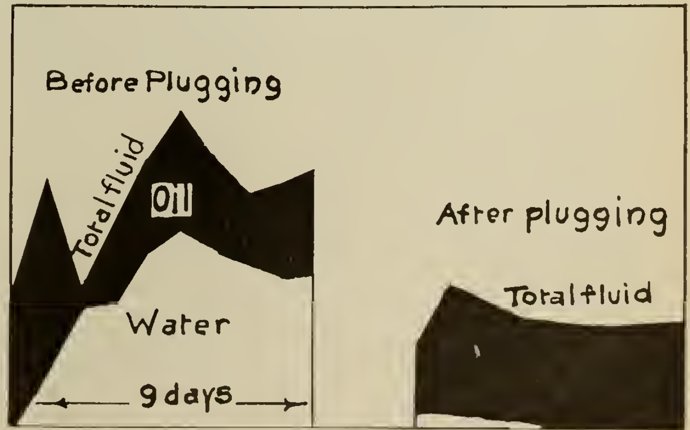

Figure No. 9.—Sketch showing Production of Oil Well before and after Plugging off Bottom Water. The Source of the Water was determined by Chemical Analysis.

A Short Monograph on Nomography (Part I)*

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Nomography may be defined as the science of representing the relations between variables in a graphical form, and by its aid solutions of formulae may be obtained in a graphical manner. It has as its foundation analytic or co-ordinate geometry, and may be considered as one of the youngest of the mathematical sciences, since it was not developed to any extent until the last decade of the nineteenth century, when D'Ocagne and his successors demonstrated its utility and, incidentally, gave it a name.

It is unfortunate for those of us who claim English as our mother tongue that most of the work on the subject has been done by the French. It seems to the writer to be an added misfortune that nearly all of these writers have employed cumbersome analytical methods, which tend to discourage the engineer at the outset. D'Ocagne for instance devotes little time to the use of the determinant notation, which the author thinks is of the greatest help not only in the study of the theory but also in the practical solution of particular problems. One of the best books on the subject written in recent years in the English language is that by Hewes and Seward. This, however, is in the nature of a text book, and several types of chart are discussed which are interesting for academic reasons but are not suitable for practical application.

This paper has been written with three main objectives:

(1) To simplify the study of the theory for the practising engineer.
(2) To codify if possible, the various types of formulae and their corresponding charts.
(3) To point out the desiderata of a good chart and show how these may be obtained.

With regard to the methods employed in obtaining the chart, they should be simple, clear, and flexible, in order to permit ready adjustment to the peculiar properties of the particular problem in hand. The chart itself, when complete, should be not only clear and simple to read, but also accurate and adequate over the range of values of the variables to be encountered.

Types of Nomograms

We may divide nomograms into two main classes:

(1) Those whose solution is given by the intersection of lines.
(2) Those whose solution is obtained by the collinearity of points.

The first class has been called "charts of intersection" (d'entrecroisement) by D'Ocagne. Another name that suggests itself is "charts of concurrence."

The second class are now generally known as "alignment" charts. They may also be called "charts of collinearity." There is a close mathematical connection between these two types which will be pointed out later in an appendix. Their relationship is analogous to that between poles and polars in geometry.

Both types of chart are popular and both have their good and bad points. Let us take an example of each to illustrate this. In the chart of intersection for Scobey's formula $Q=1.272\,D^{2.65}H^{0.555}$ (figure No. 5), there is a set of horizontal lines for values of H, a set of vertical lines for values of Q, and a third set of inclined lines for value of D. Any point on the chart denotes a particular value of each of the variables H, Q, and D, since it has a definite position with respect to each of the three sets of lines, and we may consider that each point on the chart is a point of intersection of an H line, a V line, and a D line. The chart is constructed in such a way that three such values for H, V, and D will satisfy the given equation.

*Part II, with appendices, will follow in a later issue of The Journal.

Turning now to the alignment chart for the same equation, (figures Nos. 10 or 11), we notice that any straight line drawn across the chart will cut the three scales H, Q, and D at particular values of the variables H, Q, and D. These scales are so constructed that any three such values of H, Q, and D will satisfy the given equation.

In comparing the two types of chart, it may be said that the charts of intersection are more easily made, mainly because the theory on which they are based is not very difficult to master. However, they are confined to problems and equations involving at most three independent variables. In some respects these charts furnish a better picture of the relationship between the variables than the alignment charts do. They have also the advantage that solutions may be obtained without the use of a straight edge. Against these, we may say that their chief disadvantages are (1) their heavy appearance which renders them somewhat confusing to the reader, and (2) the fact that the method used in solution does not permit of the accuracy obtainable with the alignment chart. It is generally found much easier to interpolate between two points on a line than between two parallel lines, especially when two such interpolations must be made simultaneously, as in the case of the chart of intersection.

Intersection Charts for Two Variables

These charts are based on the elementary theory of co-ordinate geometry. They may be constructed in either of the two systems of co-ordinates (a) rectangular or (b) polar. The polar system is useful in cases where one of the variables is an angle. In either system, one of the variables is allotted to one of the co-ordinates, and the second variable to the other. Points are located whose co-ordinates satisfy the relationship between the variables, and the locus of these points furnishes the general solution. Examples are given of the solution of $V^2=2gH$ (figures Nos. 1 to 4). In these charts it is seen that the variable H has been allotted to the X axis, and the variable V to the Y axis.

Scales

At this point it seems advisable to discuss the proper selection of scales for the co-ordinates. There is a choice as regards (1) type, and (2) size. The types of scale may be classified as follows:

(a) Ordinary linear scale, in which points representing uniformly increasing values are equidistant. (Figure No. 1.)

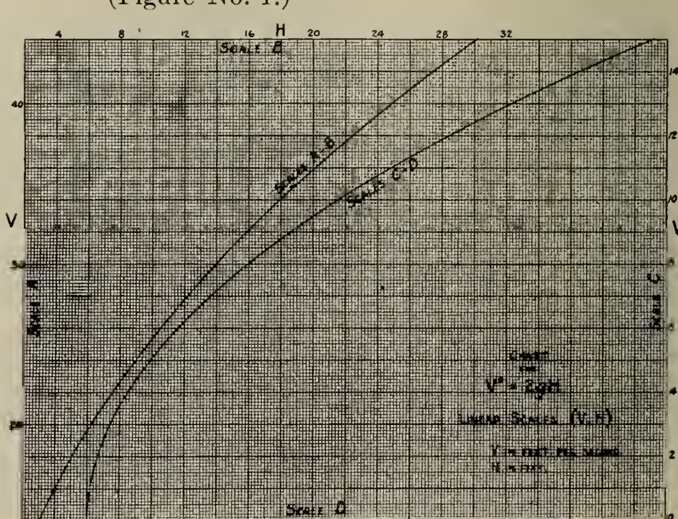


Figure No. 1.

(b) Logarithmic scale, in which the distances between the points are proportional to the differences between the logarithms of the values they represent. (Figure No. 2.)

(c) Power, or functional scale, in which the graduations are spaced in accordance with the values of some power or function of the variable. (Figures Nos. 3 and 4.)

The logarithmic scale is virtually a functional scale, but deserves particular mention because of its extensive use.

By "size of scale" is meant the actual distance on the chart corresponding to a definite change in value of the variable.

The selection of the size of the scale is governed by the range in value of the variable. Consideration should also be given to the angles of intersection between the various sets of lines. The most suitable angles for accurate reading are between 30° and 90°. In some cases it may be necessary to make two charts, each covering part of the range of values, in order that the required accuracy may be obtained. As an illustration, in figure No. 4, it was decided to break up the range of values of V and H into two scales each. The total range for V is 2 to 50, one scale covering the values 2 to 15, and the other the values 15 to 50. Taking the lower scale, $\frac{1}{V^2}$ varies between $\frac{1}{4}$ and $\frac{1}{225}$, and the range covered is $.25 - .00445 = .24555$ units, say .25 units. Since there are 15 main divisions, we make 15 divisions $= .25$ units or one unit $= 60$ divisions. The lower end of the scale is marked $V = 2.0$ and represents $\frac{1}{4} \times 60$ or 15 divisions, so that the divisions decrease as we go up the scale. The value $V = 3$ corresponds to $\frac{1}{9} \times 60 = 6.667$ divisions, and the value $V = 3$ is marked at the point $15 - 6.667$ or 8.333 divisions from the bottom. It is readily seen how a suitable adjustment of the size of scale may be made in each particular case.

The selection of the type of scale depends on the type of equation involved. If the equation is made up of the sum or difference of functions of the variables, the linear scale or the functional scale may be most suitable. If the equation involves the product of powers of the variables, especially when the powers are fractional, the logarithmic scale may prove most effective. A study of the four charts of the relation $V^2 = 2gH$ will illustrate these points. The linear chart gives a curve for the locus, whereas the V^2 chart gives a straight line. It is a debatable point which chart is the easier to construct, and which the more accurate in solution. In the case of the V^2 chart we can avoid the trouble of making a V^2 set of lines by plotting a V^2 scale on ordinary graph paper, as in our figure. This, however, is liable to cause confusion. The straight line locus is preferable to the curved in that all intersections are at a suitable angle. This advantage is more apparent than real because the answer must in the end be read on an irregular scale. In order to straighten out the curved locus of the linear scale we have been forced to warp this linear scale

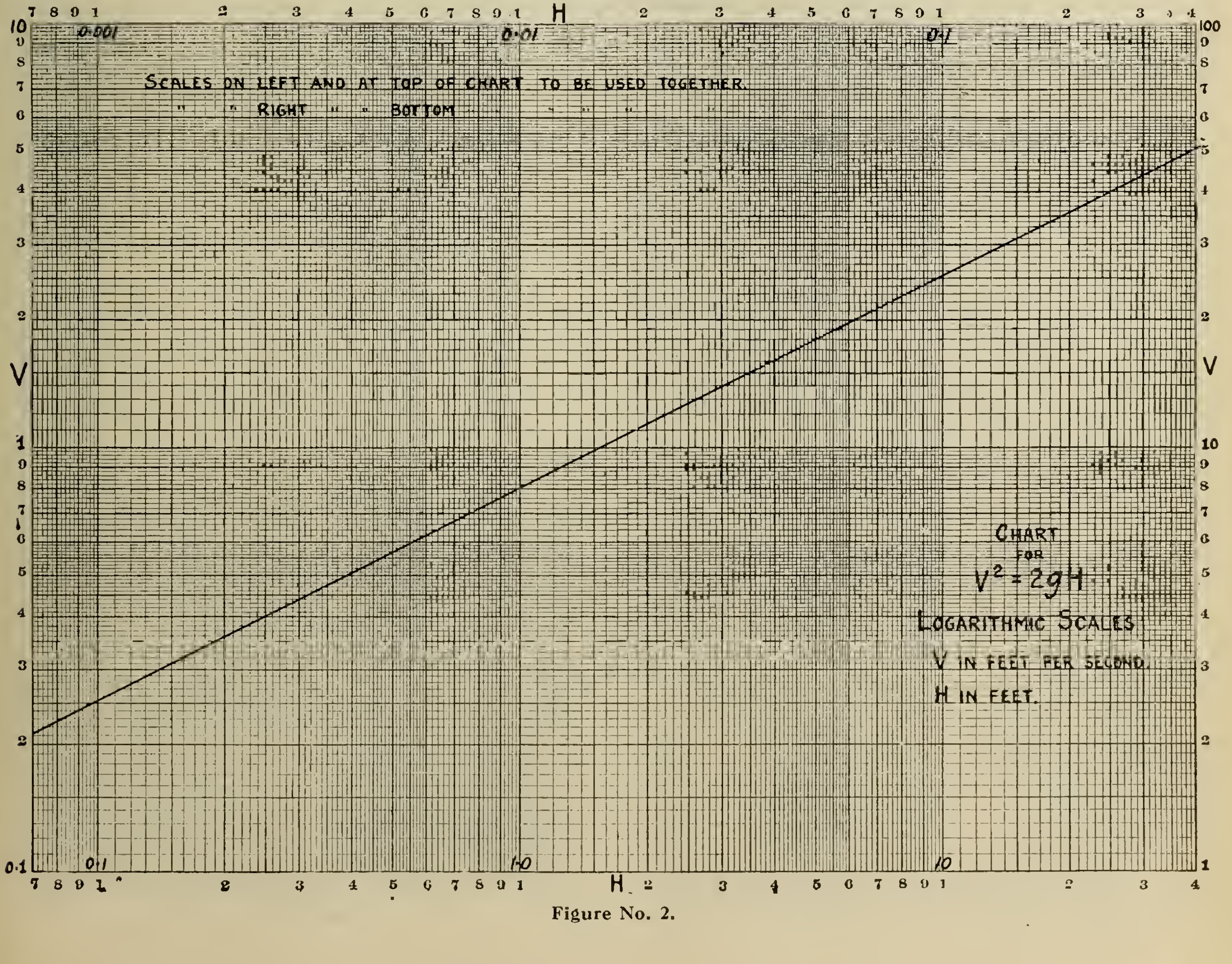


Figure No. 2.

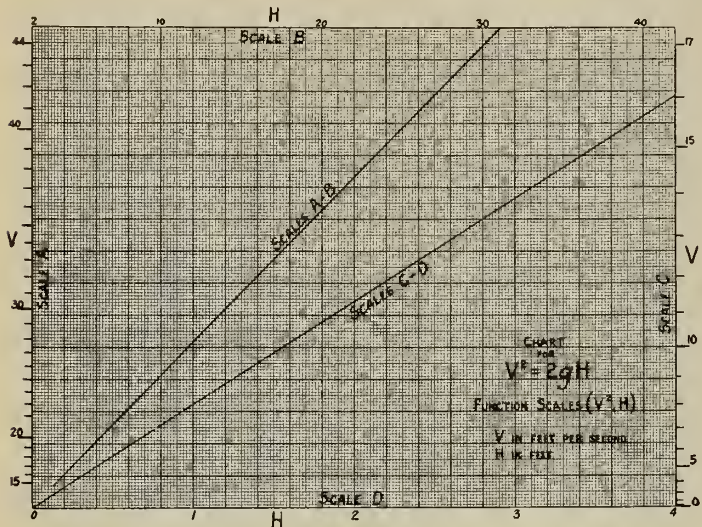


Figure No. 3.

into a V^2 scale. It is seen that in contrast with the uniform accuracy in reading the H scale the accuracy in solving for V is greater for higher values of V for both types of chart. This is why a second chart is necessary, covering the lower values of the variables.

Turning now to the inverse function scales (figure No. 4) the accuracy here is greater for the lower values of the variables. This is generally true for inverse scales and they should be chosen whenever greater accuracy is required over the lower range of values. The three charts of figures Nos. 1, 3, and 4 have been plotted for similar ranges in value of the variables to facilitate comparison.

Figure No. 2, based on logarithmic scales, has been plotted on commercially available paper. This has a great disadvantage in that it limits the range of values of the variable, and also fixes the size of the scale. Two sets of scales have been allotted to the one locus in order to minimize this defect and our H scales range from 0.07 to 40 and from 0.0007 to 0.4. Nevertheless, the logarithmic scales have the advantage of providing a much more extensive range of values than the other types, and in this case the ratio of highest to lowest value of H is 40/.07 or approximately 600. Another advantage is that the accuracy of solution is independent of the numerical value of the variable, being determined by the number of significant figures, and not by the position of the decimal point. Of course the accuracy is greater between the values 1 and 2 than higher up along the scale.

Some problems may require the use of more than one type of scale. In this case the logarithmic scale was convenient for higher values of S, but the linear scale was more suitable for lower values, which extended down to zero. Other examples may require different types of scale for the different variables, as may be noted in the example of figure No. 6, where the formula has two linear variables and one of the other variables is an exponent. Semi-logarithmic paper is very convenient for use with formulae of the type $10^V = H$, which should be transformed to the form $V = \log H$.

Intersection Charts for Three Variables

An example of this type of chart is given in figure No. 5, for solution of Scobey's formula. These charts are an extension of the charts for two variables, and since polar co-ordinates are seldom used in cases of three variables, and as the principle is the same for both types of co-ordinates, we will confine our discussion to the rectangular type of co-ordinates.

It is customary to allot one variable to one axis and a second variable to the other axis. In this way each point in the plane represents by its co-ordinates a particular value of each of the two variables. Two sets of lines, one vertical and the other horizontal, may be marked off with values of their respective variables. With linear scales, these lines will be equally spaced but with functional scales along the axes, they will not be spaced uniformly. A third set of lines must now be constructed, each line denoting a particular value of the third variable. This set of lines must be placed so that any point in the plane will determine a particular value for each of the three variables, and these values will satisfy the given equation. This result may be realized by taking each value of the third variable in turn, and finding a set of simultaneous values of the other two variables which go with it. These points are all joined up to give the locus for this particular value of the third variable.

Let us make this clear by means of the example in figure No. 5. We will assume that the logarithmic form of the equation has been chosen,

$$\log Q = \log 1.272 + 2.65 \log D + 0.555 \log H.$$

The logarithmic scales $\log Q$ and $\log H$ have been selected, the Q scale being placed horizontally because a greater range of values is required for Q than for H. In order to obtain the D set of lines, we transform the equation to read:

$$\log Q - 0.555 \log H = \log 1.272 + 2.65 \log D.$$

If now we represent $\log Q$ by x and $\log H$ by y this becomes

$$x - 0.555\, y = \log 1.272 + 2.65 \log D,$$

a set of straight lines for different values of D. It is therefore sufficient to find only two simultaneous sets of values for Q and H corresponding to each value of D. If this D set of lines were curved it would be necessary to find a series of simultaneous values of x and y (i.e. of Q and H) for each particular value of D, and join these points (x, y) in a locus.

In this case we may fix the value of $H = 0.1$ for one set of points, and it will be necessary to solve the equation

$$\log Q - 0.555 \log 0.1 = \log 1.272 + 2.65 \log D.$$

Each particular value of D will determine the correct value of Q which will determine the corresponding point on the line $H = 0.1$. Thus for $D = 10$, we find

$$\log Q = \log 1.272 + 2.65 \log 10 + 0.555 \log 0.1,$$

or $Q = 158$. Hence one point on the $D = 10$ line is given by $H = 0.1$ and $Q = 158$. In a similar manner a set of points may be marked off along the upper line $H = 10$, and also along the centre line $H = 1.0$, covering a range in values of the variable D. The centre set of points are used mainly as a check, but they are necessary for the upper and lower values of the variable, where the D lines do not extend

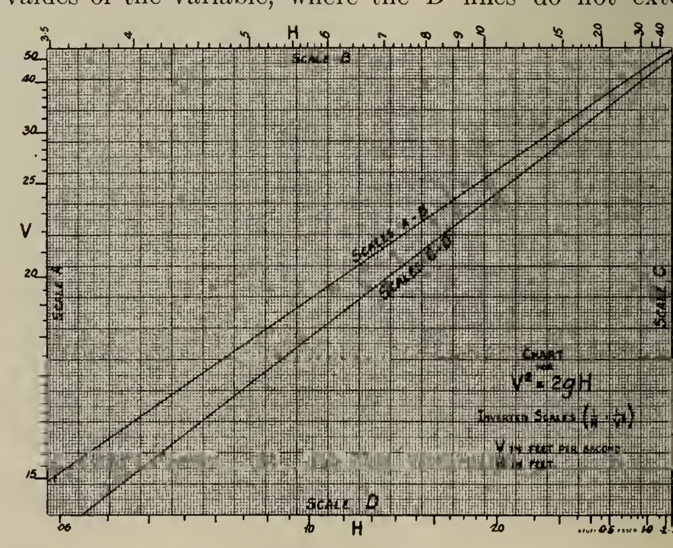


Figure No. 4.

across the paper. We can check up on the draughting work by verifying that the D lines are parallel, and inclined at an angle of $\cot^{-1} 0.555$ to the horizontal.

In making these intersection charts for three variables on prepared graph paper, it is evident that at least one set of lines must be drawn diagonally, while the other two variables may be allotted to the two perpendicular sets of lines (linear or logarithmic) already printed on the paper. It is necessary therefore in each formula to decide which of the variables will have the simplest values in practice, and pick this variable for the diagonal set of lines. Thus in Scobey's formula, the variable D or the diameter of the pipe is most suitable for this set of lines, since almost all diameters are chosen in integral, half or quarter feet. Regarding the range of values to be covered by the chart, this is known in most practical cases for two of the variables at least, and the third variable must be made to conform to these.

It is seen that a set of V lines has also been drawn on Scobey's chart. These were obtained in a similar way to the D lines, from the relation $V^{2.65} = KQ^{.65}H^{.916}$ which can be obtained readily from the given equation between Q, H, and D. We have thus two charts drawn on one piece of paper and any two simultaneous values of two of the variables Q, H, D, and V will give directly a solution for the other two variables.

It is evident that any intersection chart for three variables may be constructed by the method illustrated above, but it is advisable to choose the scales along the principal axes in such a way as to give a set of straight lines for the third variable. If the third set of lines is curved there is a great amount of labour involved in constructing them. Suppose for instance we had kept Scobey's formula in its original form $Q = 1.272\ D^{2.65} H^{0.555}$. With simple linear scales for Q and H along the axes, the D set of lines would have been given by the relation

$$QH^{-0.555} = 1.272\,D^{2.65}$$

which results in a set of curves $xy^{-0.555} = \text{Constant}$.

Summarizing analytically our discussion of intersection charts for three variables:

The general equation for this type of chart may be expressed $f(\alpha\beta\gamma) = 0$ where α, β, and γ are the three variables. By assigning particular values K to the variable γ, our equation becomes $f(\alpha, \beta, K) = 0$.

If we represent values of α by some functional scale along the x axis, and values of β by some other functional scale along the y axis, the equation will take the form $F(x, y, K) = 0$. The functional scales for α and β should be chosen in such a manner as to make this last equation in x and y as simple as possible. Each value $\gamma = K$ gives us a curve $F_1(x, y) = 0$ and this curve when plotted may be marked $\gamma = K$.

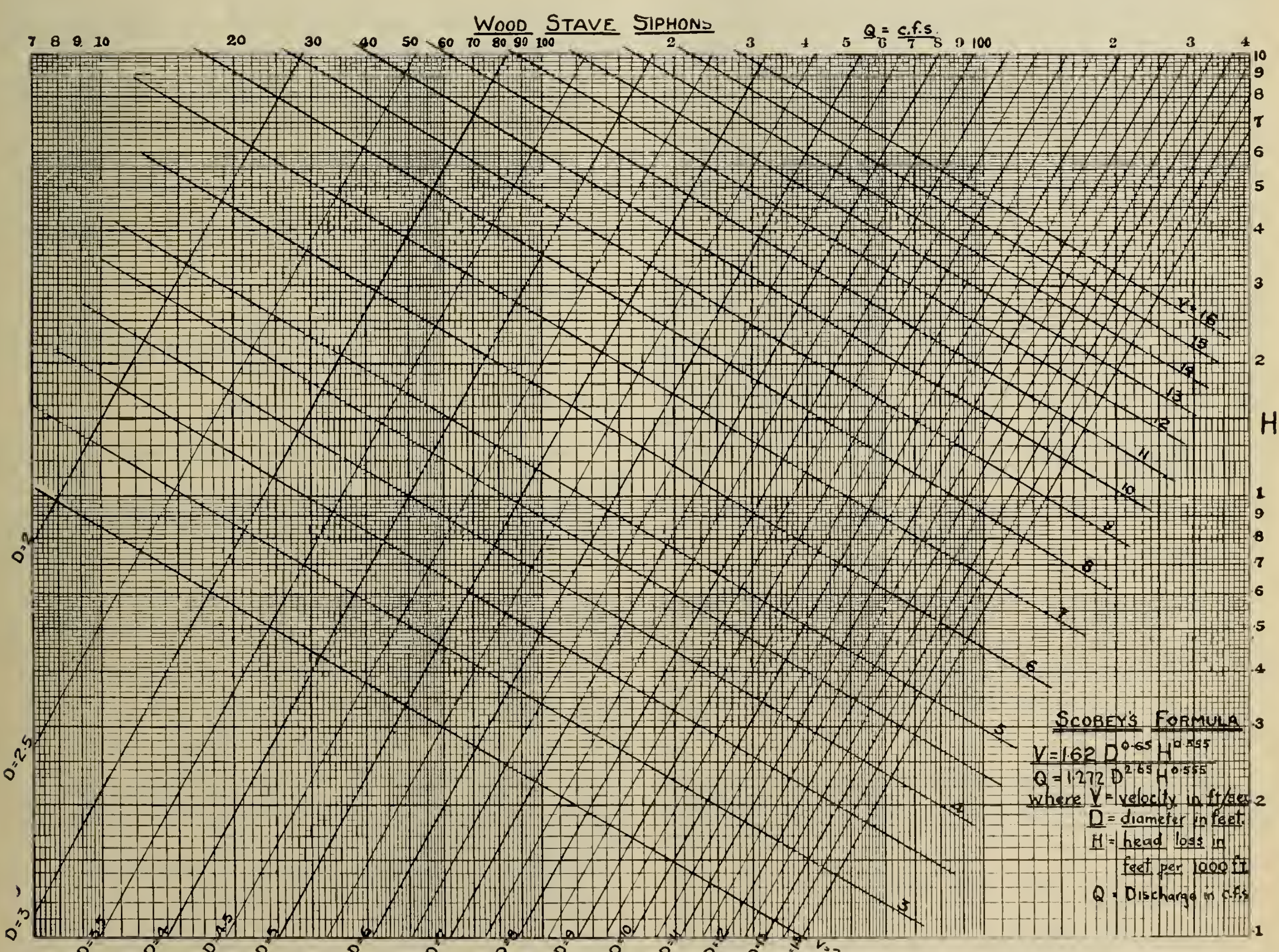


Figure No. 5.

The scales for α and β need not necessarily be functional. When for instance the chart is the outcome of certain test data, it may be found advisable to pick the α and β scales arbitrarily, although the usual practice in such cases is to choose a simple scale.

Example for our summary:

$$F(a, T, G) = (a^2-1) - T^3 - 6G = 0.$$

Assuming that variable "a" is placed along the x axis, and the T variable along the y axis, it would be convenient to have functional scales $x = a^2-1$, and $y = T^3$.

Then the G lines will be given by the equation

$$x - y = 6G.$$

Alignment Charts

In this type of chart graphical solutions may be obtained for equations involving three or more variables. The simplest case is that with three variables. The solution of this chart is given by the collinearity of three points, each of which is situated on a scale representing one of the variables. The more complicated formulae which involve more than three variables are solved either by a repeated use of the collinearity idea, or else by a combination of the collinearity principle with charts of intersection.

As has been indicated in the introductory paragraphs, the determinant notation is a great help in the study of the theory of the alignment chart, and it is also useful as an instrument in the construction of particular nomograms. A considerable amount of work must be done in transforming the appearance of every nomogram after its general outline has been decided on. Each problem calls for its own special treatment, the final form of the chart depending on the ranges of value of the variables and the degree of accuracy required in solution, as well as on the limitations caused by the appearance of the given equation. Whatever the method of attack, this work of transformation cannot be carried out efficiently unless the underlying principles are understood.

The problems in both theory and practice are solved in such a neat and logical way, with the aid of determinants, that it seems well worth while to spend a little time in reviewing the rules of this mathematical symbolism.

As we deal with determinants of the third order, which are always equated to zero, the rules themselves are simple and the novice will not find their application difficult. It will be found advisable to devote some time to practice in the use of the rules, and in checking up their validity, before proceeding with their application.

Determinants—Summary of Rules for Transformation, Etc.

Definition:—

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} \equiv a_1(b_2c_3 - b_3c_2) - a_2(b_1c_3 - b_3c_1) + a_3(b_1c_2 - b_2c_1)$$

A particular case of this determinant of the third order is

$$\begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix} \equiv a_1(b_2 - b_3) - a_2(b_1 - b_3) + a_3(b_1 - b_2)$$

Rule 1. Multiplying all the members of a column or of a row in a determinant by some multiple m, is equivalent to multiplying the whole expression (or determinant) by m.

$$\begin{vmatrix} ma_1 & b_1 & c_1 \\ ma_2 & b_2 & c_2 \\ ma_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & b_1 & c_1 \\ ma_2 & mb_2 & mc_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = m\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Rule 2. The value of the determinant remains unchanged when the members of any column (or row) are

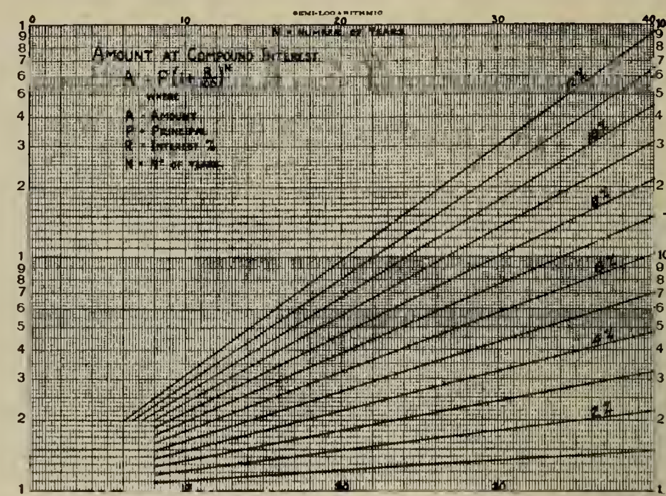


Figure No. 6.

increased or reduced by some fixed multiple of the corresponding members of another column (or row).

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 - nc_1 & b_1 & c_1 \\ a_2 - nc_2 & b_2 & c_2 \\ a_3 - nc_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 + na_1 & b_2 + nb_1 & c_2 + nc_1 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Rule 3. The interchanging of two adjacent rows (or columns) changes the sign of the determinant.

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = -\begin{vmatrix} a_1 & c_1 & b_1 \\ a_2 & c_2 & b_2 \\ a_3 & c_3 & b_3 \end{vmatrix} = -\begin{vmatrix} a_2 & b_2 & c_2 \\ a_1 & b_1 & c_1 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Rule 4. Changing rows to columns does not change the determinant.

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

Rule 5. Three equations

$$\left.\begin{matrix} a_1x + b_1y + c_1 = 0 \\ a_2x + b_2y + c_2 = 0 \\ a_3x + b_3y + c_3 = 0 \end{matrix}\right\} \text{ will be true}$$

simultaneously if

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0.$$

The converse of this also holds true.

Rule 6. Three points in the co-ordinate plane $(a_1\ b_1)$, $(a_2\ b_2)$, and $(a_3\ b_3)$ will be collinear if

$$\begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix} = 0.$$

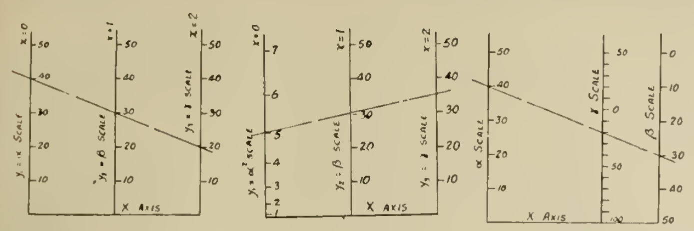
The converse of this also holds true.

It should be noted that whenever the determinant is equal to zero, our rules one and three have an added significance. For instance, multiplying the determinant by m will not alter the truth of the equation; neither will the interchange of two adjacent rows or columns. In other words, we may apply any of the four transformations described by these rules without affecting the value of the determinant when it is equated to zero.

Rule 5 is the basis of the charts of intersection.

Rule 6 is the basis of alignment charts.

Rule 5 is to be dealt with in the appendix, but has not been used in the discussion of intersection charts just concluded.



$\alpha + \gamma - 2\beta = 0$ $\alpha^2 + \gamma - 2\beta = 0$ $\alpha + \gamma - 2\beta = 0$

Figures Nos. 7, 8 and 9.

Alignment Charts

According to rule 6, three points $(x_1 y_1)$, $(x_2 y_2)$ and $(x_3 y_3)$ are collinear if

$$\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0.$$

Expanded, this gives us the equation

$$x_1 (y_2 - y_3) - x_2 (y_1 - y_3) + x_3 (y_1 - y_2) = 0.$$

Alignment Charts of Three Parallel Straight Lines

This is the simplest case, in which the scales for the three variables lie along parallel straight lines. Let these lines be $x = 0$, $x = 1$, and $x = 2$. The co-ordinates of any three points on these lines are $(0, y_1)$, $(1, y_2)$, and $(2, y_3)$. If we mark off a simple linear scale on each of these lines starting with zero at the X axis in each case, then the ordinates y_1, y_2, y_3 will be identical with the scale readings. If we place the α scale along $x = 0$, the β scale along $x = 1$, and the γ scale along $x = 2$, where α, β and γ signify three variables then there are three relations $y_1 = \alpha$; $y_2 = \beta$; $y_3 = \gamma$.

The three points $(0, y_1)$, $(1, y_2)$ and $(2, y_3)$ are collinear if

$$\begin{vmatrix} 0 & y_1 & 1 \\ 1 & y_2 & 1 \\ 2 & y_3 & 1 \end{vmatrix} = 0.$$

Replacing y_1, y_2 and y_3 by the variables, this gives

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0.$$

Conversely we may say that if

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0$$

then the three points $(0, \alpha)$, $(1, \beta)$, and $(2, \gamma)$ will be collinear.

Our determinant form expands to $-1(\alpha-\gamma) + 2(\alpha-\beta) = 0$ or $\alpha - 2\beta + \gamma = 0$ so that the three scales α, β, and γ, parallel and equally spaced, furnish a nomogram for this equation.

Suppose now we alter one of the scales, and in place of the α scale mark down an α^2 scale. That is to say, points at distances of 1, 4, 9, 16 etc. from the X axis will be marked $\alpha = 1, 2, 3, 4$, etc. Then the relation holds $y_1 = \alpha^2$.

Our condition of collinearity becomes

$$\begin{vmatrix} 0 & \alpha^2 & 1 \\ 1 & \beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0$$

or expanded $\alpha^2 - 2\beta + \gamma = 0$, a new equation in α, β, and γ. This equation will be satisfied for values of α, β and γ corresponding to points on the three scales which are collinear. Given a value of α and β, the satisfying value of γ may be obtained by drawing a straight line through the points marked with these values on the α^2 and β scales and finding where this line cuts the γ scale. A similar operation may be performed given any two of the variables, to find the third, (figures Nos. 7 and 8).

In general the scales may be marked off as functions of the three variables, so that the nomogram for the general equation $f(\alpha) - 2\phi(\beta) + \psi(\gamma) = 0$ is

$$\begin{vmatrix} 0 & f(\alpha) & 1 \\ 1 & \phi(\beta) & 1 \\ 2 & \psi(\gamma) & 1 \end{vmatrix} = 0$$

three parallel equidistant scales

$$x = 0;\quad y = f(\alpha);$$
$$x = 1;\quad y = \phi(\beta);$$
$$x = 2;\quad y = \psi(\gamma);$$

In future it will be assumed that the symbol α does not denote the simple variable, but designates a function of some variable. When we speak of an α scale or a β or a γ scale, we will mean functional scales of three variables. This is done to simplify the notation.

We have seen that the chart with three parallel scales solves an equation made up of the sum of three functions of independent variables. It is almost always necessary to transform this elementary form of the determinant because in every example it will be found that the size of the scales is unsuitable on account of the range of values taken by the variables. It will also be found that the scales are not opposite each other, and should be modified in some way so that a compact chart is obtained.

A good illustration of this is given in the chart of figure No. 10, which is drawn according to the elementary form of the determinant for the equation $Q = 1.272\, D^{2.65} H^{0.555}$ This equation was transformed into the sum of three variables by taking logarithms, giving

$$\log Q = \log 1.272 + 2.65 \log D + 0.555 \operatorname{Log} H,$$

or $(2.65 \log D + \log 1.272) + (0.555 \log H) - \log Q = 0.$

Comparing this with the equation $\alpha + \gamma - 2\beta = 0$ we see that the determinant form is

$$\begin{vmatrix} 0 & (2.65 \log D + \log 1.272) & 1 \\ 1 & \frac{1}{2} \log Q & 1 \\ 2 & 0.555 \log H & 1 \end{vmatrix} = 0.$$

It should be noted that we have arranged the variables in such a way as to obtain positive terms in the determinant form.

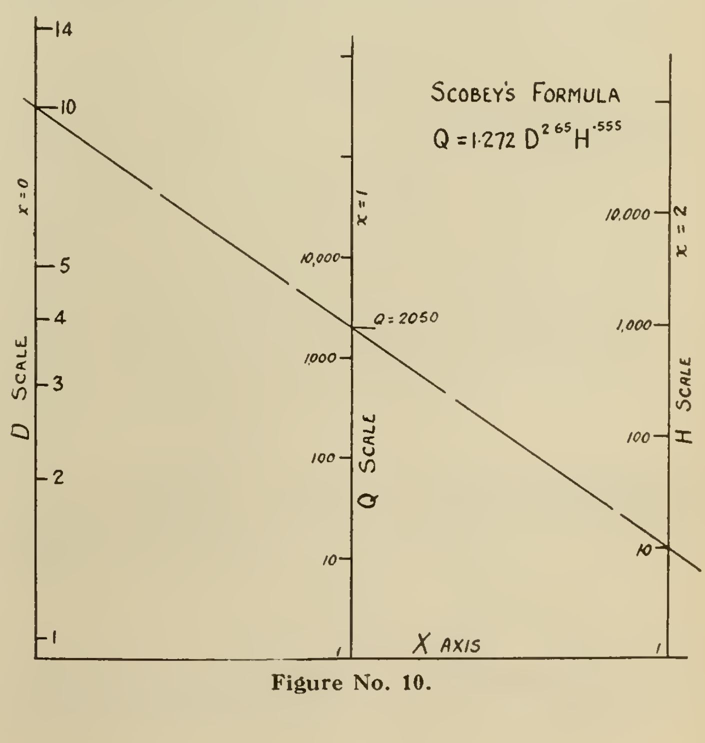


Figure No. 10.

Figure No. 10* has been drawn accordingly, with three scales

$x = 0;\ y = 2.65 \log D + \log 1.272;$
$x = 1;\ y = \frac{1}{2} \log Q;$
$x = 2;\ y = 0.555 \log H;$

This chart is not suitable for practical solutions because the scales do not suit the ranges of values of the variable met with in practice. Although D varies from 1 to 14, it is seen that Q varies from 1 to 1,000,000, and H from 1 to 100,000.

In studying the length and range for the D scale, suppose that 2.65 log 14 equals 6 inches approximately. Thus 3.04 scale units = 6 inches, or one scale unit (i.e. the distance between $D = 10$ and $D = 1$), is approximately 2 inches. If the Q scale were plotted to this size, since it is a scale of $\frac{1}{2} \log Q$, the distance between $Q = 1$ and $Q = 10$ would be about one inch. Similarly for the H scale.

Suppose we wish the chart to show a range of values of Q from 10 to 4,000 c.f.s. On the above scale the distance between these values of Q is $2 \times \frac{1}{2} \log \frac{4000}{10}$ or 2.6 inches. Therefore we must enlarge the Q scale 6 : 2.6 or 2.3 times.

The values of D met with in practice vary between 2 and 14 so we must alter the D scale and enlarge it in the ratio

$$\frac{\log 14}{\log 14 - \log 2} = 1.356.$$

The relative enlargement of the Q scale with respect to the D scale is therefore $\frac{2.3}{1.356}$.

The log H scale will then look after itself, i.e. it must conform to the sizes of the other two scales, but it is still necessary to arrange that the D and Q scales commence and end on the same level.

In other words the values $D = 2$ and $Q = 10$ must lie approximately on a horizontal line.

We will now show how the scales may be enlarged by any multiple number of times, and then translated vertically with respect to each other. After obtaining general formulae for these transformations, we will return to the particular solution of Scobey's formula.

The determinant in the elementary form is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0.$$

This must first be altered to the form

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta & 1 \\ ? & ?\gamma & 1 \end{vmatrix} = 0.$$

First Method (analytical)

Assume the new form to be

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta & 1 \\ k & n\gamma & 1 \end{vmatrix} = 0.$$

Then

$$\left.\begin{array}{l} \alpha - 2\beta + \gamma = 0 \\ (1-k)\ \alpha + mk\beta - n\gamma = 0 \end{array}\right\} \text{ are identical.}$$

Therefore $\frac{1-k}{1} = \frac{mk}{-2} = \frac{-n}{1}$, whence $(1-k)\ 2 = -mk$

$$\text{or } k = \frac{2}{2-m}$$

On substitution it follows that $n = k - 1 = \frac{m}{2-m}$.

Therefore the new form is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta & 1 \\ \frac{2}{2-m} & \frac{m\gamma}{2-m} & 1 \end{vmatrix} = 0.$$

*As printed, figure No. 10 is approximately one half the size named.

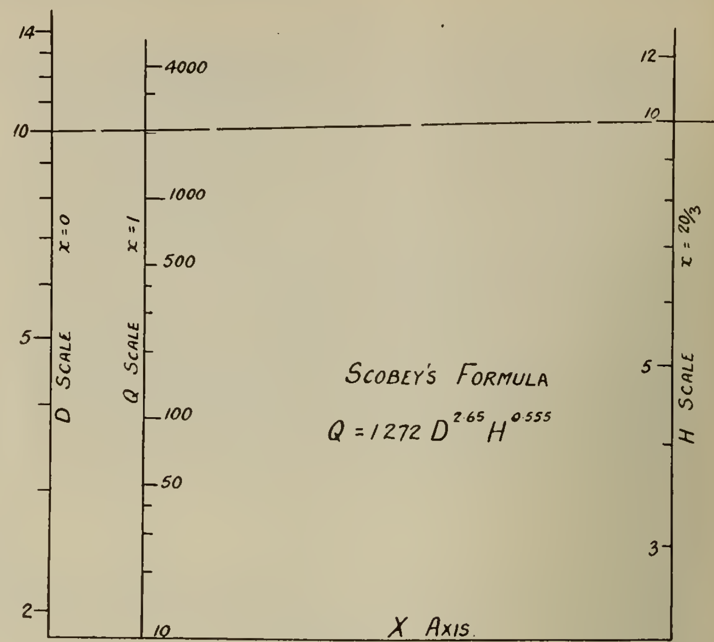


Figure No. 11.

Second Method:

This employs successive transformations of the original determinant form, and a little practice with the rules renders these operations comparatively easy. The analytical method has one disadvantage in that it is necessary to assume the final determinant form. The second method is more straightforward. Thus, we proceed:—

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha & 1 \\ m & m\beta & m \\ 2 & \gamma & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha & 1-0 \\ m & m\beta & m-m \\ 2 & \gamma & 1-2 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha & 1 \\ m & m\beta & 0 \\ 2 & \gamma & -1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 0+m\,.\,1 & \alpha & 1 \\ m+m\,.\,0 & m\beta & 0 \\ 2+m\,.-1 & \gamma & -1 \end{vmatrix} \rightarrow \begin{vmatrix} m & \alpha & 1 \\ m & m\beta & 0 \\ 2-m & \gamma & -1 \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \alpha & 1 \\ 1 & m\beta & 0 \\ \frac{2-m}{m} & \gamma & -1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 1 & \alpha & 1 \\ 1 & m\beta & 0 \\ 1 & \frac{m\gamma}{2-m} & \frac{-m}{2-m} \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \alpha & 1-1 \\ 1 & m\beta & 1-0 \\ 1 & \frac{m\gamma}{2-m} & 1+\frac{m}{2-m} \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta & 1 \\ \frac{2}{2-m} & \frac{m\gamma}{2-m} & 1 \end{vmatrix} = 0$$

To a beginner, the above sequence may seem difficult to plan, and execute. Experience is essential for proficiency in this work. However, the above has been given mainly to show what a neat tool this notation affords us. The checking up of the steps will be left as an exercise for the reader.

The second transformation necessary is to translate one scale vertically with respect to the other. This may be done as follows:

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta & 1 \\ \frac{2}{2-m} & \frac{m\gamma}{2-m} & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha+n\,.\,0 & 1 \\ 1 & m\beta+n\,.\,1 & 1 \\ \frac{2}{2-m} & \frac{m\gamma}{2-m}+n\,.\,\frac{2}{2-m} & 1 \end{vmatrix}$$

or

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m\beta+n & 1 \\ \frac{2}{2-m} & \frac{m\gamma+2n}{2-m} & 1 \end{vmatrix} = 0$$

where the $m\beta$ scale has been moved vertically upwards n units with respect to the α scale.

Returning to the particular case of Scobey's formula, we must first transform the determinant using

$$m = \frac{2.3}{1.356}, \text{ say } 1.7$$

This gives

$$\begin{vmatrix} 0 & (2.65 \log D + \log 1.272) & 1 \\ 1 & 0.85 \log Q & 1 \\ \frac{20}{3} & \frac{1.7 \times 0.555}{0.3} \log H & 1 \end{vmatrix} = 0.$$

The lowest point on the D scale is now

$$2.65 \log 2 + \log 1.272 = 0.80$$

The lowest point on the Q scale is

$$0.85 \log 10 = 0.85$$

These units are almost equal, so that it is not necessary to translate any of the scales vertically with respect to any other. However, if we had wished to lower the Q scale 0.05 with respect to the D scale, this could have been effected by the transformation:

$$\rightarrow \begin{vmatrix} 0 & 2.65 \log D + \log 1.272 & 1 \\ 1 & 0.85 \log Q - (.05 \times 1) & 1 \\ \frac{20}{3} & \frac{1.7 \times 0.555}{0.3} \log H - \left(.05 \times \frac{20}{3}\right) & 1 \end{vmatrix} = 0$$

All that remains to be done now is to choose the size of the scales.

The D scale starts at 0.80 unit for $D = 2$ feet and finishes at

$$2.65 \log 14 + \log 1.272 = 3.14 \text{ units for } D = 14 \text{ feet,}$$

a range of 2.34 units.

We must for convenience choose the log scales making 2.34 units = about 6 inches or 1 unit = 2.564 inches. We will make log 10 scale $2\frac{1}{2}$ inches; i.e. $2\frac{1}{2}$ inches represents unity.

In order to make all the scales start from the X axis we will make the last transformation

$$\begin{vmatrix} 0 & 2.65 \log D + 1.272 - 0.80 & 1 \\ 1 & 0.85 \log Q - .05 - 0.80 & 1 \\ \frac{20}{3} & \frac{1.7 \times 0.555}{0.3} \log H - \frac{1}{3} - 0.80 & 1 \end{vmatrix} = 0$$

Figure No. 11 has been drawn accordingly.*

In our discussion so far we have taken a certain determinant form of the equation $\alpha - 2\beta + \gamma = 0$ and shown how this form may be altered to give a suitable location and size of scales in the resulting nomogram. Let us now tackle the problem from another angle and see how we can obtain the determinant equation from the given algebraic form.

By comparing with our previous work, we see that the equation $\alpha + \beta + \gamma = 0$ may be expressed

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0$$

There is another way of doing this, by building up the determinant as follows:

We will start off with the skeleton form

$$\begin{vmatrix} ? & 0 & 1 \\ ? & 1 & 1 \\ ? & 2 & 1 \end{vmatrix} = 0$$

Here we have left the first column to be filled in by the variables, instead of the second column. This will simplify the building-up process, and after that has been done we can interchange the first and second columns, giving the final form.

We first try α in the top blank space. Then its coefficient is $(1-2)$ or -1. The coefficient of the second blank space is $-(0-2)$ or 2. Therefore if we try the β variable there, our given equation $\alpha + \beta + \gamma = 0$ will require an insertion of $-\frac{1}{2}\beta$ giving

$$\begin{vmatrix} \alpha & 0 & 1 \\ -\frac{1}{2}\beta & 1 & 1 \\ ? & 2 & 1 \end{vmatrix} = 0$$

The last blank space has a coefficient $(0 - 1) = -1$ so that we may place γ there, giving

$$\begin{vmatrix} \alpha & 0 & 1 \\ -\frac{1}{2}\beta & 1 & 1 \\ \gamma & 2 & 1 \end{vmatrix} = 0,$$

or expanded $\quad -\alpha - \beta - \gamma = 0.$

The correct form of this for plotting is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0$$

If in our building-up process, we had put α at the top and tried the γ variable next, we would have obtained the final form

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & \beta & 1 \end{vmatrix} = 0$$

It is evident by comparing the last two determinants that an interchange of the β and γ scales causes a change in sense for each; also that the scale in the centre is reduced in size (in this case of equidistant scales by a half). We can formulate rules in accordance with this knowledge. Thus, in equations of the form $\alpha + \beta + \gamma = 0$ when two of the variables increase or decrease together, these variables should be placed on the outside scales. In this way the lines of intersection will always be near the horizontal, giving good intersections on the scales.

To illustrate the above, figure No. 9 has been constructed, which differs from figure No. 7 in that the β and γ scales have been interchanged. The elementary form for this nomogram is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & -2\beta & 1 \end{vmatrix} = 0,$$

obtained from the preceding determinant by substituting -2β for β. First we must reduce the β scale by half if we wish it to be the same size as in figure No. 7.

This operation gives

$$\begin{vmatrix} 0 & \alpha & 1 \\ 2 & -\frac{1}{3}\gamma & 1 \\ 3 & -\beta & 1 \end{vmatrix} = 0$$

The steps here are

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & -2\beta & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 1 & -\beta & \frac{1}{2} \end{vmatrix} \rightarrow \begin{vmatrix} 0 + 2 \times 1 & \alpha & 1 \\ 1 + 2 \times 1 & -\frac{1}{2}\gamma & 1 \\ 1 + 2 \times \frac{1}{2} & -\beta & \frac{1}{2} \end{vmatrix}$$

$$\text{or} \begin{vmatrix} 2 & \alpha & 1 \\ 3 & -\frac{1}{2}\gamma & 1 \\ 2 & -\beta & \frac{1}{2} \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \alpha & 1 \\ \frac{3}{2} & -\frac{1}{2}\gamma & 1 \\ 1 & -\beta & \frac{1}{2} \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \alpha & 1 \\ 1 & -\frac{1}{3}\gamma & \frac{2}{3} \\ 1 & -\beta & \frac{1}{2} \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 1 & \alpha & 1 \\ \frac{2}{3} & -\frac{1}{3}\gamma & 1 \\ \frac{1}{2} & -\beta & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 6 & \alpha & 1 \\ 4 & -\frac{1}{3}\gamma & 1 \\ 3 & -\beta & 1 \end{vmatrix} \rightarrow \begin{vmatrix} -6+6 & \alpha & 1 \\ -4+6 & -\frac{1}{3}\gamma & 1 \\ -3+6 & -\beta & 1 \end{vmatrix}$$

$$\text{or} \quad \begin{vmatrix} 0 & \alpha & 1 \\ 2 & -\frac{1}{3}\gamma & 1 \\ 3 & -\beta & 1 \end{vmatrix} = 0$$

In its present form the α scale runs from 0 to 50, and the β scale from 0 to $-$ 50. Therefore we must raise the β scale 50 units, giving the final form.

$$\rightarrow \begin{vmatrix} 0 & \alpha + 0 . \frac{50}{3} & 1 \\ 2 & -\frac{1}{3}\gamma + 2 . \frac{50}{3} & 1 \\ 3 & -\beta + 3 . \frac{50}{3} & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \alpha & 1 \\ 2 & -\frac{1}{3}\gamma + \frac{100}{3} & 1 \\ 3 & -\beta + 50 & 1 \end{vmatrix} = 0$$

If possible it is advisable to place the variables which are the most independent of each other, or which are given in any particular problem, on the outside scales.

*As printed, figure No. 11 is approximately one half the size named.

Then if these scales cover the full range of values of these variables, we need not worry about the third variable in the middle of the chart since all possible lines of intersection will cut the middle scale within the bounds of the chart. In this connection if we turn to figure No. 11 we notice that the range of values for H is from 3 to 12. We would be sure to get a suitable range for H if we placed its scale in the centre. Another procedure would be to reduce the Q scale slightly. A summary of determinant forms for the "three parallel line" type of nomogram follows:

Equation $\alpha + \beta + \gamma = 0$

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\beta) & 1 \\ \dfrac{2}{2-m} & \dfrac{m\gamma}{2-m} & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\beta) + n & 1 \\ \dfrac{2}{2-m} & \dfrac{m\gamma + 2n}{2-m} & 1 \end{vmatrix} = 0$$

(Cannot be used for $m = 2$)

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 0 & \alpha & 1 \\ \dfrac{2}{m+1} & \dfrac{-m\beta}{m+1} & 1 \\ 2 & m\gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 0 & \alpha & 1 \\ \dfrac{2}{m+1} & \dfrac{-m\beta + n}{m+1} & 1 \\ 2 & m\gamma + n & 1 \end{vmatrix} = 0$$

(Cannot be used for $m = -1$)

To reverse the β and γ scales with respect to the α scale we interchange the variables β and γ, obtaining

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & \beta & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\gamma) & 1 \\ \dfrac{2}{2-m} & \dfrac{m\beta}{2-m} & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\gamma) + n & 1 \\ \dfrac{2}{2-m} & \dfrac{m\beta + 2n}{2-m} & 1 \end{vmatrix} = 0$$

and

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & \beta & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 0 & \alpha & 1 \\ \dfrac{2}{m+1} & \dfrac{-m\gamma}{m+1} & 1 \\ 2 & m\beta & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 0 & \alpha & 1 \\ \dfrac{2}{m+1} & \dfrac{-m\gamma + n}{m+1} & 1 \\ 2 & m\beta + n & 1 \end{vmatrix} = 0$$

Any other reversal of scales may be obtained by rearranging the given equation. This could have been done for the second set of forms given above by writing the equation $\alpha + \gamma + \beta = 0$.

Illustration. Solution of the quadratic equation (figure No. 12). The form $x^2 - 2bx + c = 0$ is used. The solution for this is $x = b \pm \sqrt{b^2 - c} = b \pm p$ and the chart is constructed to solve the equation $p^2 = b^2 - c$. If this is written $p^2 + c - b^2 = 0$ and compared with $\alpha + \beta + \gamma = 0$ the determinant form is found to be

$$\begin{vmatrix} 0 & p^2 & 1 \\ 1 & -\dfrac{c}{2} & 1 \\ 2 & -b^2 & 1 \end{vmatrix} = 0$$

Since solutions are obtained by intersections on the p scale it is advisable to have the c scale as close as possible to the p scale, maintaining suitable sizes of the scales.

A multiple $m = \frac{4}{3}$ is chosen for the c scale and the scale lines are at

$$x = 0, \quad x = 1, \quad \text{and} \quad x = \frac{2}{2-m} = 3.$$

Of course we could get around this difficulty by placing the p scale in the centre, but the result of this operation would be a reversal of the c scale with respect to the b scale, which is not desirable.

The revised determinant is

$$\begin{vmatrix} 0 & p^2 & 1 \\ 1 & -\frac{2}{3}c & 1 \\ 3 & -2b^2 & 1 \end{vmatrix} = 0$$

Four different nomograms have been constructed on the chart. In nomogram (1) the transformation has been made

$$\rightarrow \begin{vmatrix} 0 & p^2 & 1 \\ 1 & -\frac{2}{3}c + 30 & 1 \\ 3 & -2b^2 + 30 \times 3 & 1 \end{vmatrix} \text{ or } \begin{vmatrix} 0 & p^2 & 1 \\ 1 & -\frac{2}{3}c + 30 & 1 \\ 3 & -2b^2 + 90 & 1 \end{vmatrix} = 0.$$

The X axis cuts the scales at

$p = 0$; $\frac{2}{3}c = 30$; $2b^2 = 90$; or $p = 0$; $c = 45$; $b = 3\sqrt{5} = 6.71$. The X axis has been placed in the centre of the chart.

Nomogram (2) is based on the transformation.

$$\rightarrow \begin{vmatrix} 0 & p^2 & 1 \\ 1 & -\frac{2}{3}c + \frac{260}{3} & 1 \\ 3 & -2b^2 + 260 & 1 \end{vmatrix} = 0,$$

and the X axis cuts the scales at values

$$p = 0; \quad c = 130; \quad b = \sqrt{130} = 11.4.$$

Nomogram (3) has the X axis shifted down to the value $p = 10$, near the bottom of the chart. The c scale has been translated to give a corresponding value of $c = -15$. In nomogram (4) the X axis remains at $p = 10$ but the corresponding value of c has been changed to 85.

It is seen that the alignment chart lends itself to the superimposing of different ranges of value of the variables. Such a treatment would lead to confusion in an intersection chart.

The scales in the X direction are not affected in the least by the size of the scales in the Y direction. Our first column in the determinant for the quadratic tells us that the distance between the p and c scales is half that between the c and b scales. We do not alter the validity of the equation by multiplying all the terms of the first column by some constant K.

Two Parallel and One Diagonal Scale

All charts of this type may be developed from the simple case where the scales are placed on the lines $x = 0$, $x = 1$, and $y = 0$. The determinant form is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ \gamma & 0 & 1 \end{vmatrix} = 0,$$

which expands to

$$\alpha(1 - \gamma) + \beta\gamma = 0$$

or

$$\alpha + \beta\left(\frac{\gamma}{1-\gamma}\right) = 0,$$

a product of two functions equal to a third function, e.g.

$$P = QR.$$

Such an equation could of course be put in the logarithmic form $\log P = \log Q + \log R$ which gives a chart with three parallel scales.

Suppose we start afresh with the equation $\alpha + \beta\gamma = 0$. Comparing this with the equation $\alpha + \beta\left(\dfrac{\gamma}{1-\gamma}\right) = 0$ above, we see that α and β are unchanged but $\dfrac{\gamma}{1-\gamma}$ has become a new γ. Writing this $\gamma_2 = \dfrac{\gamma_1}{1-\gamma_1}$ we find $\gamma_1 = \dfrac{\gamma_2}{1+\gamma_2}$,

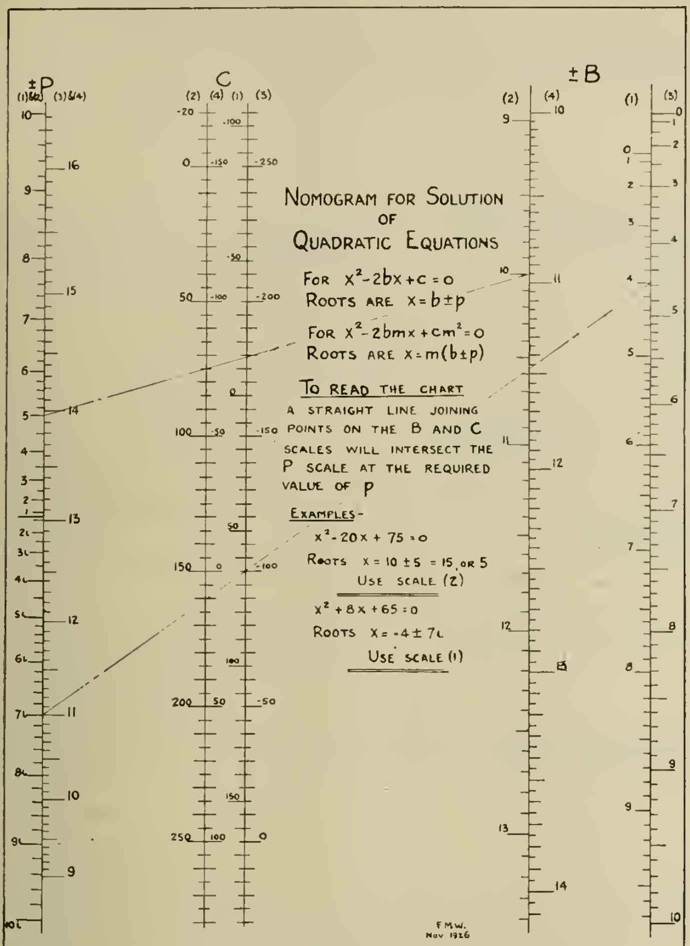


Figure No. 12

so that the determinant form for $\alpha + \beta\gamma = 0$ is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ \frac{\gamma}{1+\gamma} & 0 & 1 \end{vmatrix} = 0.$$

This could have been done as follows:

A first trial determinant is found

$$\begin{vmatrix} \beta & -1 & 1 \\ \alpha & \gamma & 1 \\ 0 & 0 & 1 \end{vmatrix} = 0$$

Here we must try and separate the α and γ terms. Hence

$$\rightarrow \begin{vmatrix} \beta & -1-\gamma.1 & 1 \\ \alpha & \gamma-\gamma.1 & 1 \\ 0 & 0-\gamma.1 & 1 \end{vmatrix} \text{ or } \begin{vmatrix} \beta & -1-\gamma & 1 \\ \alpha & 0 & 1 \\ 0 & -\gamma & 1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} \beta & 1 & 1 \\ \alpha & 0 & 1 \\ 0 & \frac{-\gamma}{-1-\gamma} & 1 \end{vmatrix}$$

or

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & \alpha & 1 \\ \frac{\gamma}{1+\gamma} & 0 & 1 \end{vmatrix} = 0,$$

as before.

If plotted according to this form, the chart will be U-shaped (see figure No. 13). If α and β are both positive or both negative the intersection lines will cut the γ scale on the outside of the U. The α and β scales should therefore be arranged to lie on opposite sides of the X axis, and the chart will then appear as in figure No. 13a.

The chart is still unsuitable for plotting and it must be transformed so that the α and β scales are on the same level. The γ scale will then run diagonally across the chart (see figure No. 13b).

When the variables α and β are of the same sign the first trial determinant is

$$\begin{vmatrix} \beta & 1 & 1 \\ -\alpha & \gamma & 1 \\ 0 & 0 & 1 \end{vmatrix} = 0,$$

and this transforms to

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & -\alpha & 1 \\ \frac{\gamma}{\gamma-1} & 0 & 1 \end{vmatrix} = 0,$$

corresponding to figure No. 13a.

To secure the form of figure No. 13b the following simple transformation is made:

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \beta + n.1 & 1 \\ 0 & \alpha + n.0 & 1 \\ \frac{\gamma}{\gamma+1} & 0 + n.\frac{\gamma}{\gamma+1} & 1 \end{vmatrix}$$

or

$$\begin{vmatrix} 1 & \beta + n & 1 \\ 0 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} & \frac{n\gamma}{\gamma+1} & 1 \end{vmatrix} = 0$$

for the case when α and β happen to have opposite signs, and

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & -\alpha & 1 \\ \frac{\gamma}{\gamma-1} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \beta + n & 1 \\ 0 & -\alpha & 1 \\ \frac{\gamma}{\gamma-1} & \frac{n\gamma}{\gamma-1} & 1 \end{vmatrix} = 0$$

for the case when α and β are of the same sign. In both cases the β scale has been translated upwards n units. n may be any constant, positive or negative, (in figure No. 13b, $n = -50$).

There is another transformation which must be studied in connection with this type of chart, the transformation by means of which one scale is enlarged with respect to another scale. Since the γ scale is the only one running in the horizontal direction, we need not consider its enlargement. This may be obtained by simply multiplying all terms of the first column by a constant K.

It is best to enlarge the scales first before translating them. The steps for this enlargement are:

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} m & m\beta & m \\ 0 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} & 0 & 1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} m & m\beta & m - m \\ 0 & \alpha & 1 - 0 \\ \frac{\gamma}{\gamma+1} & 0 & 1 - \frac{\gamma}{\gamma+1} \end{vmatrix}$$

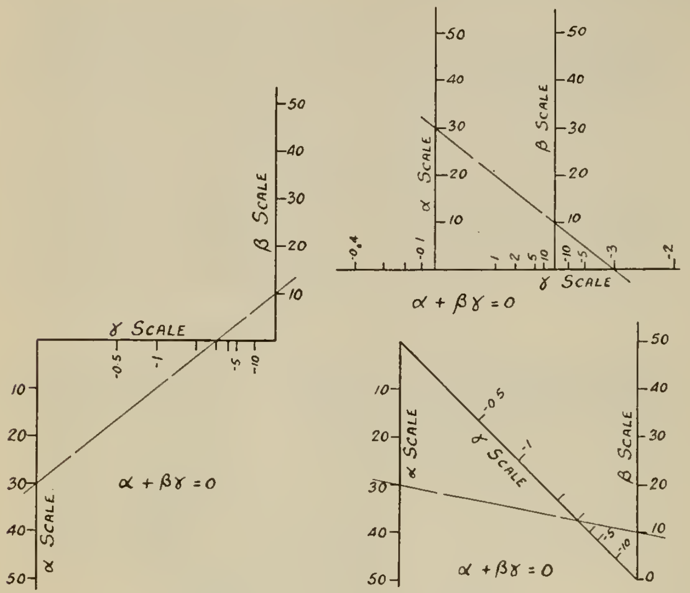
or

$$\begin{vmatrix} m & m\beta & 0 \\ 0 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} & 0 & \frac{1}{\gamma+1} \end{vmatrix} \rightarrow \begin{vmatrix} m + m.0 & m\beta & 0 \\ 0 + m.1 & \alpha & 1 \\ \frac{\gamma}{\gamma+1} + m.\frac{1}{\gamma+1} & 0 & \frac{1}{\gamma+1} \end{vmatrix}$$

or

$$\begin{vmatrix} m & m\beta & 0 \\ m & \alpha & 1 \\ \frac{m+\gamma}{\gamma+1} & 0 & \frac{1}{\gamma+1} \end{vmatrix} \rightarrow \begin{vmatrix} 1 & m\beta & 0 \\ 1 & \alpha & 1 \\ \frac{m+\gamma}{m(\gamma+1)} & 0 & \frac{1}{\gamma+1} \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 1 & m\beta & 0 \\ 1 & \alpha & 1 \\ 1 & 0 & \frac{m}{m+\gamma} \end{vmatrix} \rightarrow \begin{vmatrix} 0 & m\beta & 1 \\ 1 & \alpha & 1 \\ \frac{m}{m+\gamma} & 0 & 1 \end{vmatrix} = 0.$$



Figures Nos. 13, 13a and 13b.

The β scale has been multiplied by m, but it is on the wrong side of the chart, so we transform again

$$\rightarrow \begin{vmatrix} 0 & m\beta & 1 \\ -1 & \alpha & 1 \\ \dfrac{-m}{m+\gamma} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0+1 & m\beta & 1 \\ -1+1 & \alpha & 1 \\ -\dfrac{m}{m+\gamma}+1 & 0 & 1 \end{vmatrix}$$

or

$$\begin{vmatrix} 1 & m\beta & 1 \\ 0 & \alpha & 1 \\ \dfrac{\gamma}{m+\gamma} & 0 & 1 \end{vmatrix} = 0$$

Translating the β scale with respect to the α scale gives

$$\begin{vmatrix} 1 & m\beta + n & 1 \\ 0 & \alpha & 1 \\ \dfrac{\gamma}{m+\gamma} & \dfrac{n\gamma}{m+\gamma} & 1 \end{vmatrix} = 0.$$

A summary of transformations for this case follows.

Equation $\alpha + \beta\gamma = 0$, or $\dfrac{1}{\alpha} + \dfrac{1}{\beta} \cdot \dfrac{1}{\gamma} = 0.$

(a) For α and β like in sign

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & -\alpha & 1 \\ \dfrac{\gamma}{\gamma-1} & 0 & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 1 & m\beta & 1 \\ 0 & -\alpha & 1 \\ \dfrac{\gamma}{\gamma-m} & 0 & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 1 & m\beta + n & 1 \\ 0 & -\alpha & 1 \\ \dfrac{\gamma}{\gamma-m} & \dfrac{n\gamma}{\gamma-m} & 1 \end{vmatrix} = 0$$

(b) For α and β opposite in sign

$$\begin{vmatrix} 1 & \beta & 1 \\ 0 & \alpha & 1 \\ \dfrac{\gamma}{1+\gamma} & 0 & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} 1 & m\beta & 1 \\ 0 & \alpha & 1 \\ \dfrac{\gamma}{m+\gamma} & 0 & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} 1 & m\beta + n & 1 \\ 0 & \alpha & 1 \\ \dfrac{\gamma}{m+\gamma} & \dfrac{n\gamma}{m+\gamma} & 1 \end{vmatrix} = 0$$

Of course these transformations in case (b) might be dispensed with if we expressed the given equation

$$\alpha + (-\beta) \quad (-\gamma) = 0$$

Illustration. Stadia equation

$$V - (100\,I + 1)\,\tfrac{1}{2}\sin 2\,\alpha = 0.$$

The functions V, I, and α may be assumed positive, so we take the initial determinant form

$$\begin{vmatrix} 1 & (100\,I + 1) & 1 \\ 0 & -V & 1 \\ \dfrac{\frac{1}{2}\sin 2\alpha}{1+\frac{1}{2}\sin 2\alpha} & 0 & 1 \end{vmatrix} = 0.$$

Suppose we wish to show a range of values of I from 0 to 5.0, of V from 0 to 40. Then the I scale is 500 units long and the V scale 40 units. Therefore we must choose

$$m = \tfrac{40}{500} = 0.08.$$

The first transformation gives

$$\begin{vmatrix} 1 & 0.08\,(100\,I + 1) & 1 \\ 0 & -V & 1 \\ \dfrac{\frac{1}{2}\sin 2\alpha}{0.08+\frac{1}{2}\sin 2\alpha} & 0 & 1 \end{vmatrix} = 0.$$

To make the scales on the same level we make $n = -40$ and obtain

$$\begin{vmatrix} 1 & 40 - 0.08\,(100\,I + 1) & 1 \\ 0 & V & 1 \\ \dfrac{\frac{1}{2}\sin 2\alpha}{0.08+\frac{1}{2}\sin 2\alpha} & \dfrac{20\sin 2\alpha}{0.08+\frac{1}{2}\sin 2\alpha} & 1 \end{vmatrix} = 0.$$

(see figure No. 14).

There is a third type of alignment chart sometimes used for equations of the type $\alpha + \beta\,\gamma = 0$. It is given by the determinant form

$$\begin{vmatrix} \beta & -1 & 1 \\ \alpha & \gamma & 1 \\ 0 & 0 & 1 \end{vmatrix} = 0,$$

which we have already used in connection with the Z-type of chart just discussed. It may be said, however, that these charts are more difficult to construct and are also more confusing during the solution of problems. They will not be dealt with further for this reason, but a summary of forms of these determinants is given in Appendix B.

(*To be continued*)

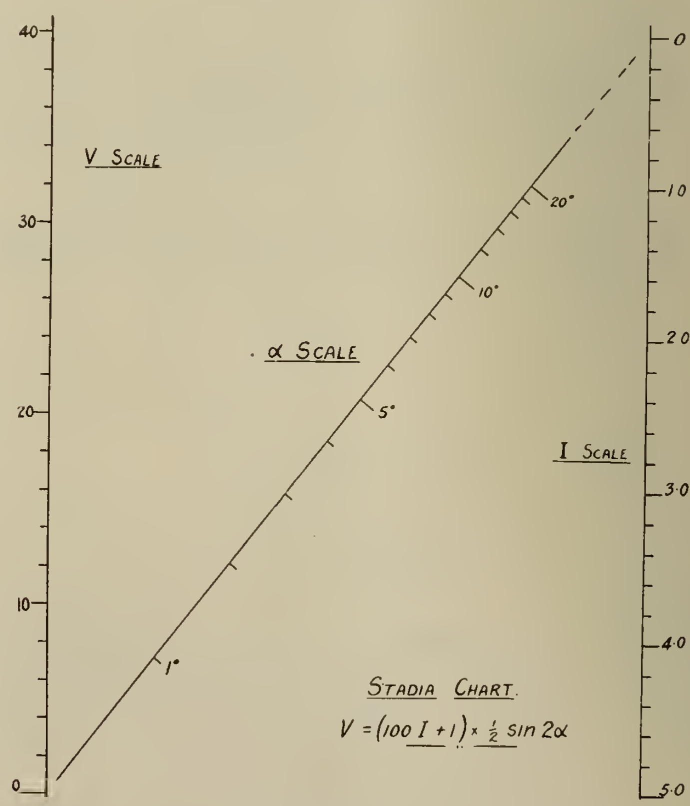


Figure No. 14.

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THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

VOLUME XIII JUNE 1930 No. 6

A Question Frequently Asked

Our members, when confronted with one of the Secretary's periodical communications regarding annual fees, or when discussing the affairs of The Institute, often ask themselves or their fellow members, "What do I get out of The Institute?" A question which would naturally follow, "What do I do for The Institute?", does not occur so frequently. The stereotyped answer to the first query is, that one gets out of any organization like The Institute the equivalent of what one puts into it — and with interest. This is undoubtedly stereotyped, but absolutely true.

Every member has now the opportunity of rendering a service to The Institute which will only take a few minutes of his time, but which will enable him to give real help in the preparation of a review of the present situation as regards the remuneration of himself and his fellow engineers in Canada. While it cannot be definitely undertaken that immediate benefit will result to each individual member, the benefit to the profession at large must react in favour of the membership generally. The service desired is the filling in of a questionnaire, supplying information regarding the member's career and remuneration for the benefit of the recently appointed Committee on Classification, Remuneration and Tariff of Engineers, in order that basic data may be at hand on which that committee can work.

It will be recalled that in 1920 a committee was appointed by Council to study the same subject, its report having been published in the Engineering Journal for October 1923. That report, which is now out of print, has been widely circulated, and has been of considerable utility to public bodies and other organizations responsible for the employment of engineers, as well as to our own members. This being the case, Council has thought it advisable to appoint a committee to review the question and make new recommendations, if necessary, to meet present-day requirements.

As a first step in the committee's investigations, a questionnaire is being sent to all members of The Institute, asking for specific information regarding their careers and remuneration, the object being to collate the particulars received from individuals and obtain a broad picture of the conditions now existing. As in all statistical questions, the utility of the information received will be in proportion to the number of individuals replying. The returns will be handled in the same way and with the same secrecy as a letter ballot, and there will be no attempt in any way to identify the member with the form he returns, which of course will not bear his signature.

For its work the committee needs collective results, trends and averages, and there will be no prying into individual cases. Every member is therefore earnestly requested to give his personal assistance by filling in and returning the questionnaire, which will be in his hands at about the same time as this number of The Engineering Journal.

The Work of the Canadian Engineering Standards Association

This Association has now completed the eleventh year of its activities, and the record of its progress, as shown in its Year Book for 1929, which has just been received, is very satisfactory.

The Year Book contains the latest information regarding the activities of the Association, its finances, organization and method of work, and it is interesting to note that during the past year six new specifications, revised editions of two existing specifications, and the second edition of the Canadian Electrical Code, have been completed. An encouraging number of projects for further work are in progress, and the practical interest in the movement which has been shown by industry has been evidenced by substantial contributions to the working funds of the Association.

The Association very properly emphasizes the policy and method of work which has been adopted from the beginning. The idea that a standardizing body of this kind can assume the role of a dictator and enforce its findings is quite foreign to the principles of the Canadian or any of the other national standardizing bodies. In all cases the association organizes working committees on which manufacturers and users nominate the majority of the members who take part in the actual discussion of the problem and handle the technical work. The results, on which all interests concerned are thus in agreement, carry with them no idea of compulsion, and are adopted and used by reason of their inherent suitability.

Further, it is the practice of the Association to take action only on subjects for which no industrial standards or schemes of simplified practice have yet been adopted in Canada, or where the limitations imposed by Canadian requirements have not been adequately recognized by the standards of their allied bodies.

The expenditure of the Canadian Engineering Standards Association, amounting last year to some $15,000, is covered by contributions from industry, and by a grant from the National Research Council, of which body the Association acts as one of the advisory committees. This figure may be compared with the larger sums expended in Britain, where a government grant of $25,000 per annum is received, or in the United States, where the American Standards Association contemplates an expenditure of $450,000 during the next three years. From the record of the Association's work, however, it is evident that Canada and its industries are receiving real value for the money expended.

The Year Book touches briefly on the topic of international standardization, a subject on which some progress has been made, although there is naturally great difficulty in co-ordinating the work of more than twenty national standardizing organizations, representing industrial communities whose commercial competition is sometimes very keen.

It may be noted that the Association now has five hundred and fifty individual members, has published twenty-nine standards, has twenty-six standardization projects under way, and is supported by the National Research Council and by sixty-eight organizations as sustaining members.

Meeting of Council

A meeting of Council was held on Tuesday, May 6th, 1930, at eight o'clock p.m., with President A. J. Grant, M.E.I.C., in the chair, and seven other members of Council present.

The minutes of the meeting held on April 11th, 1930, were taken as read and confirmed.

It was decided that the 1930 Plenary Meeting of Council should be held on Monday, Tuesday and Wednesday, September 22nd, 23rd and 24th, 1930.

It was noted with much appreciation that an engraving of the late Sir John Fowler, President of The Institution of Civil Engineers, 1868, had been presented to The Institute by Mrs. Wilfrid Bovey, in memory of her father, Mr. J. G. Macklin, who became a member of the Canadian Society of Civil Engineers in 1887, and who died in 1917. The Secretary was directed to convey to Mrs. Bovey the sincere thanks of Council for this gift.

A copy of the revised Engineering Profession Act of the Province of Alberta, which received assent on April 3rd, 1930, was noted, and the Secretary was directed to congratulate the members in Alberta on securing such effective legislation.

A letter was presented from J. G. Desbarats, C.M.G., M.E.I.C., Deputy Minister, Department of National Defence, advising that special arrangements would be made for representatives from The Engineering Institute of Canada to visit the mooring tower at St. Hubert and H.M. Airship R. 100 during her stay in Montreal. The date of arrival and other items on the programme were not yet known, so that it was impossible to set an exact date or time for this visit. Probably from forty to fifty members could be admitted on board

Scrutineers were appointed to canvass the ballot for the amendments to the By-laws, returnable on May 12th, 1930.

Six resignations were accepted.

A number of applications for admission and transfer were considered, and the following elections and transfers were effected:

Elections		Transfers	
Assoc. Members	3	Assoc. Member to Member	4
Juniors	1	Junior to Assoc. Member	5
Affiliates	1	Student to Assoc. Member	3
Students admitted	8	Student to Junior	6

The Council rose at eleven fifty-eight p.m.

The Scientific Development of Aeronautics

Public attention is naturally attracted by the commercial rather than by the scientific progress of aviation. Statistics as to the number of miles flown, the increase in the use of the air-mail and the safety of travel by air, while impressive, give no information as to the intensive experimental and scientific study which has made these achievements possible. The Reports of the Aeronautical Research Committee of Great Britain,(1) dealing with hundreds of complex problems occurring in connection with aeronautics, give the reader some idea of the way in which such questions are being attacked there. Other countries, particularly the United States, France and Germany, are equally active in investigation, and all are carrying on research along lines undreamt of twenty years ago.

In connection with airships, the British investigations in progress include such topics as a general research on the structure of the wind, dealing with the variation of wind force and direction, particularly during the passing of squalls and storms; the question of the factors of safety required in airship construction; protection of airships from electrical discharges; fire prevention; model tests in connection with the strength of the envelope and structure, and many other points related to the air-worthiness of airships.

In aero-dynamics much work has been done on "scale effect," for which an allowance has to be made in the prediction of full-scale resistance from model data, and studies have been made with a view to the reduction of the head resistance of aeroplanes, as affected by the interference of projections from the body. From this point of view it is particularly desirable to improve the performance of aeroplanes having air-cooled engines, and a considerable reduction in total resistance has been obtained by placing stream-line rings in front of a body having radial air-cooled cylinders. Such work is of importance in connection with the development of aeroplanes having extremely high speeds. It is hoped to bring the performance of an aeroplane with an air-cooled engine to within a few miles per hour of that of an aeroplane with a water-cooled engine.

In regard to propellers, it has been necessary to consider the mutual interference of the air-screw and the aeroplane body, the effect of air-screws running at high tip speeds, and the flow of fluids near models, both from the experimental and the theoretical standpoint.

Routine tests as to stability and control are, of course, made on all new types of aeroplane, and it has been a difficult problem to design and construct research instruments which will be suitable for test purposes and which will give automatic records of the motions of an aeroplane during test flying, so that a judgment may be formed as to fore and aft and lateral stability and control. It is hoped to develop a recording system which will give definite information as to the flying qualities of a new type of aeroplane, independently of the test pilot's opinion as to the merits of the machine.

There are, of course, many other problems in connection with stability and control which await solution. Among these may be mentioned that presented by the aeroplane which will not come out of a long spin; the effect of auto-slots and pilot planes, and the flutter of aeroplane wings.

In connection with engines, the more important matters dealt with have been the torsional vibration of crankshafts, the development of a compression-ignition engine, economy in fuel consumption, and investigations on air-cooled cylinders. It would obviously be a great advantage if a compression-ignition engine could be employed for aeroplanes, as in this case it would be possible to dispense

(1)Technical Report of the Aeronautical Research Committee, 1928-29. H. M. Stationery Office, 1929. Price, 30/- net.

with the elaborate electrical ignition system which gives rise to so many difficulties in connection with radio reception on aeroplanes in flight.

Much experimental work has been done in connection with materials, particularly in connection with elasticity and fatigue. Corrosion of alloys used in aeroplane construction is greatly affected by the fatigue of the material due to repeated alternating stress, and there are many aspects of this question which still require investigation.

Researches are contemplated which will be directed towards the avoidance of noise, both as affecting the passengers in the cabin of an aircraft and persons living in the neighbourhood of aerodromes. Such noises are due to a variety of causes, including the propeller, the engine exhaust, and engine clatter. Types of instruments are being developed for noise measurement.

It is interesting to note that the Aeronautical Research Committee carries on its work in close consultation with the aircraft industry in Great Britain, and that friendly relations also exist between that Committee and the United States National Committee for Aeronautics. This is particularly desirable, as it affords an opportunity for avoiding unnecessary overlapping of experimental work and, in important researches, makes it possible to exchange instruments, methods of work and information.

Recent Graduates in Engineering

Congratulations are in order to the following Students and Juniors of The Institute who have recently completed their course at the various universities.

Queen's University

Governor-General's Medal in Applied Science

Leavens, John Wright, B.Sc., (Me.), Bloomfield, Ont.

The E. T. Sterne Prize for a summer essay

Dore, Jackson Ira, B.Sc., (Chem.), Ottawa, Ont.

Degree of B.Sc. (with honours)

Hall, Donald Dixon, B.Sc., (Me.), Fenwick, Ont.
Leavens, John Wright, B.Sc., (Me.), Bloomfield, Ont.
Miller, Charles, B.Sc., (Ci.), Kingston, Ont.
Revell, George Alfred, B.Sc., (Chem.), Kingston, Ont.
Thomas, James Leslie, B.Sc., (Me.), Ottawa, Ont.

Degree of B.Sc.

Dickey, Herbert Patrick, B.Sc., (Mi. and Met.), Hamilton, Ont.
Dore, Jackson Ira, B.Sc., (Chem.), Ottawa, Ont.
Franklin, Gordon Alexander, B.Sc., (Chem.), Vankleek Hill, Ont.
Franklin, Robert Lawrence, B.Sc., (Me.), Kingston, Ont.
Harrison, William Edwin, B.Sc., (Me.), Parkhill, Ont.
Houston, James Curtis, B.Sc., (Mi. and Met.), Kingston, Ont.
Keddie, William Morgan, B.Sc., (Me.), Ottawa, Ont.
Little, Willis Clayton, B.Sc., (El.), Leamington, Ont.
Munger, Kenneth Holmes, B.Sc., (Me.), Hamilton, Ont.
Orwell, Albert Edward, B.Sc., (El.), Kingston, Ont.
Reid, John Norman, B.Sc., (Me.), Belleville, Ont.
Russell, Omer S., B.Sc., (El.), Kingston, Ont.
Spence, Gerald Hadley, B.Sc., (Chem.), Ottawa, Ont.
Walker, Robert Samuel, B.Sc., (Ci.), Kingston, Ont.

University of Alberta

Prize in Civil Engineering

Lucas, John William, B.Sc., (Ci.), Edmonton, Alta.

Degree of B.Sc.

Kostash, John Frederick, B.Sc., (Mi.), Edmonton, Alta.
McDougall, John Frederick, B.Sc., (Ci.), Edmonton, Alta.
Olekshy, Mike Dymtro, B.Sc., (Ci.), Edmonton, Alta.
Smith, Eugene Lloyd, B.Sc., (Chem.), Edmonton, Alta.

Dalhousie University

Degree of B.Sc.

Harrigan, Mayo Arthur Perrin, B.Sc., Halifax, N.S.

Nova Scotia Technical College

Alumni Medal

Lusby, Thomas Putnam, B.Sc., (Me.), Amherst, N.S.

Degree of B.Sc.

Ayer, Thomas Haliburton, B.Sc., (El.), Moncton, N.B.
Black, John Alfred, B.Sc., (Ci.), Truro, N.S.
Clark, Charles Gordon, B.Sc., (Me.), Berwick, N.S.
Cooke, William Greig, B.Sc., (Me.), Halifax, N.S.
Davidson, Gilbert Donald, B.Sc., (Ci.), Saint John, N.B.
Lewis, Edmund Keith, B.Sc., (Me.), Belmont, N.S.
Lusby, Thomas Putnam, B.Sc., (Me.), Amherst, N.S.
McLeod, Wilson Churchill, B.Sc., (El.), Caledonia, N.S.
Zwicker, Bertram Henry Crawford, B.Sc., (El.), Bridgewater, N.S.

University of New Brunswick

The Ketchum Silver Medal

Stratton, Leslie Robertson, B.Sc., (Ci.), Saint John, N.B.

Degree of B.Sc.

Campbell, Hugh Lester, B.Sc., (El.), Salisbury, N.B.
Lingley, Harold Percival, B.Sc., (Ci.), Saint John, N.B.
MacDermott, Kenneth Weston, B.Sc., (El.), Gagetown, N.B.
Seely, Wallace Errol, B.Sc., (Ci.), Montreal, Que.
Stratton, Leslie Robertson, B.Sc., (Ci.), Saint John, N.B.

OBITUARY

Edward Francis Troughear Handy, M.E.I.C.

It is with deep regret that we record the death of Edward Francis Troughear Handy, M.E.I.C., which occurred at Halifax, N.S. on May 4th, 1930.

Mr. Handy was born in Dublin, Ireland, on June 1st, 1871, and, coming to Canada at an early age, received his education at Upper Canada College, Toronto, and matriculated at Trinity University in 1893. He attended the School of Practical Science, University of Toronto, during the years 1893 to 1895.

In 1896-1897, Mr. Handy was chainman and rodman on the construction of the Ottawa, Arnprior and Parry Sound Railway and from 1898 to 1899 he was doing the same work on the construction of the Crow's Nest Pass Railway. From June 1899 to June 1900 he was engaged on prospecting for minerals. Returning to railway work in 1900 Mr. Handy became leveller on surveys for the Algoma Central Railway, and was later leveller and resident engineer for the Canada Northern Railway. From March to June 1902 he was front picket on a survey of the Toronto-Parry Sound line for the Canadian Northern Railway, and from 1902 to 1904 he was connected with the Halifax and South Western Railway as leveller, transitman and resident engineer. From 1904 to 1906 Mr. Handy was resident engineer for the Canadian Northern Railway, and subsequently was engaged on locating on Holston river branch, Virginia and South Western Railway, in 1907 and 1908 he was an assistant engineer on the same line. From May to October 1908 Mr. Handy was engaged on fruit farming in British Columbia. From October 1908 to April 1909 he was with the B.C. Electric Railway Company, and from June to September 1909 he was building a logging railway for the Heaps Lumber Company at Ruskin, B.C. From that time until 1910 Mr. Handy was with the Western Canada Power Company on contour work, and located and built their railway from Ruskin to Stave Falls, B.C. Becoming connected with the Canadian Northern Pacific Railway he was in charge of a party locating on the mountain section, and in August 1911 Mr. Handy was appointed division engineer on the construction of the same road.

For the past ten years Mr. Handy has been connected with the highways department of Nova Scotia, and at the time of his death he was inspecting engineer for the department.

Mr. Handy joined The Engineering Institute as a Student on December 17th, 1896, transferred to the class of Associate Member on October 12th, 1905, and became a full Member on July 20th, 1915.

PERSONALS

A. R. Decary, D.A.Sc., M.E.I.C., has been elected president of the Montreal branch of the Aviation League of Canada.

Major E. C. G. Chambers, A.M.E.I.C., who since 1925 has been located at headquarters, Military District No. 1, London, Ont., has been transferred to West Point barracks, Victoria, B.C.

G. W. Babbitt, S.E.I.C., who graduated from the University of New Brunswick in 1928 with the degree of B.Sc., is now with the Canadian and General Finance Company Ltd., Toronto, Ont.

W. F. Dechman, S.E.I.C., who has been office engineer for the New Brunswick International Paper Company at Dalhousie, N.B. since 1929, has joined the staff of the Bolivian Power Company, Ltd. at La Paz, Bolivia.

E. W. Dill, S.E.I.C., who graduated from the University of Toronto in 1928 with the degree of B.A.Sc., and has since that time been on the engineering staff of the Gatineau Power Company at Ottawa, Ont., has now become connected with the Beauharnois Construction Company at Beauharnois, Que.

W. E. Adlington, Jr.E.I.C., has been appointed assistant chemist of the Forest Products Laboratories, Montreal. Mr. Adlington, who graduated from the Massachusetts Institute of Technology in 1927 with the degree of B.Sc., was formerly chemical engineer with J. T. Donald and Company Ltd., Montreal.

Engineer-Commander G. L. Stephens, M.E.I.C., has been appointed to a position in England which will detain him there for a year or more, and will be located at the Woolston works of Thornycrofts Ltd., at Southampton. Commander Stephens has been engineer officer of H.M.C.S. Patriot at H.M.C. Dockyard, Halifax, N.S., since 1926.

J. A. McCoubrey, A.M.E.I.C., formerly resident engineer for the Canadian Pacific Railway at Shaunavon, Sask., has been transferred to Coronation, Alta. as assistant engineer. Mr. McCoubrey has been conected with the Canadian Pacific Railway Company since 1904 with the exception of the period from April 1915 to July 1919, when he was engaged on municipal work.

J. J. Macdonald, M.E.I.C., is at present associated with Major J. R. Grant, M.E.I.C., consulting engineer for the Burrard street bridge, Vancouver, B.C. From April 1928 until recently Mr. Macdonald was in charge of the design and construction of the Nova Scotia Public Cold Storage Plant, at Halifax, N.S., for F. W. Cowie, M.E.I.C., the consulting engineer for that project.

F. L. Grindley, Jr.E.I.C., is resident engineer with the Northern Alberta Railways. Mr. Grindley graduated from the University of Alberta with the degrees of B.A. and B.Sc. in 1925 and 1926 and has since that time been engaged on railway work, with the exception of the period October 1st, 1926 to May 1st, 1927, when he was with the Aluminum Company of Canada at Arvida, Que.

J. J. Freeland, A.M.E.I.C., is with the engineer department of the E. B. Eddy Company at Hull, Que. Mr. Freeland graduated from McGill University in 1915 with the degree of B.Sc. From 1927 to March 1930 Mr. Freeland was with the Lake St. John Power and Paper Company Ltd., and just prior to accepting his present position he was for several months with the Fraser-Brace Engineering Company at Montreal.

P. J. MacDonald, A.M.E.I.C., formerly a member of the firm of Reilly and MacDonald, engineers and surveyors, Swift Current, Sask., has been appointed district engineer for the Saskatchewan Department of Highways at Swift Current. Mr. MacDonald has been located at Swift Current since 1910 when he entered business as a contractor, installing sewer and water works, etc. In 1913 he became a member of the firm of Martyn and MacDonald, consulting engineers.

C. H. Speer, M.E.I.C., formerly works engineer with Algoma Steel Corporation at Sault Ste. Marie, Ont. has gone to England, where he will identify himself with steel interests there, taking up residence in London for a time. Mr. Speer has been connected with the Algoma Steel Corporation at Sault Ste. Marie since 1909, except for a short period in 1913 when he was with the Bethlehem Steel Corporation at Buffalo, and during the war period when he was in charge of a shop engaged in the manufacture of shells at Midland, Ont.

Norman B. McLean, M.E.I.C., has been appointed chief engineer of the St. Lawrence ship channel, Department of Marine and Fisheries. Mr. McLean, who was formerly assistant chief engineer, has been on the staff of the St. Lawrence ship channel since 1901, with the exception of the years 1915 to 1918, when he was overseas with the 124th Battalion. Mr. McLean graduated from the Royal Military College, Kingston, in 1892, and from 1892 to 1898 was assistant engineer on the Soulanges canal. From 1898 to 1901 he was assistant engineer with the Department of Public Works, engaged on surveys, wharf construction, and the survey of French river.

R. M. Legate, A.M.E.I.C., is now electrical engineer with G. D. Peters and Company of Canada, Montreal. Mr. Legate graduated from the University of New Brunswick in 1924 with the degree of B.Sc., and secured the degree of M.Sc. in 1928. From July 1928 to 1929 Mr. Legate was resident engineer in charge of construction of the outdoor station and station building of the Atwater avenue sub-station of the Montreal Light, Heat and Power Company, and from January 1929 he was working on transmission line and synchronous condenser and system short-circuit studies for various companies owned by the International Power Company. He spent four months in Porto Rico as resident engineer in charge of design and construction of a hydro plant, for the Montreal Engineering Company Ltd.

R. R. Duffy, A.M.E.I.C., has been appointed district sales manager for Price Brothers Sales Corporation, at Montreal, Que. Mr. Duffy graduated from Acadia University in 1910 with the degree of B.Sc. in arts, and from McGill University in 1913 with the degree of B.Sc. in applied science. He was overseas from 1915 to 1919 as a lieutenant in the Canadian Engineers, and on his return became outside manager and vice-president of W. H. Duffy, Sons, Ltd., at Hillsboro, N.B. In 1923-1924 he was with the logging division of the Bathurst Company at Bathurst, N.B., and from February to November 1924 he was with the Brompton Pulp and Paper Company at East Angus, Que. In November 1924 Mr. Duffy became connected with Price Brothers and Company Ltd., being in the engineering division at Kenogami, Que., assistant land surveyor and later assistant logging engineer at Chicoutimi, Que.

P. G. Gauthier, A.M.E.I.C., has joined the engineering staff of the Beauharnois Construction Company at Beauharnois, Que. Mr. Gauthier graduated from McGill

University in 1921 with the degree of B.Sc. and was demonstrator in engineering at the same university sessions 1921-1922 and 1922-1923. From 1923 to 1925 Mr. Gauthier was with the Quebec Development Company at Isle Maligne, Que. being in charge of a field party in connection with the development of the Duke Price Power Company at that point. In 1925-1926 he was in charge of a party taking topography for the location of the Aluminum plant and city of Arvida, and in charge of field engineering for the construction of roads, water lines, sewers and houses for the city of Arvida. From December 1926 to July 1927 Mr. Gauthier was in charge of field location in connection with a transmission line from Isle Maligne to Mistassini. In 1927 he joined the staff of the Alcoa Power Company and until 1928 was located at Chute-à-Caron. From 1928 to the present time he has been with the same company at Kenogami, Que.

ELECTIONS AND TRANSFERS

At the meeting of Council held on May 6th, 1930, the following elections and transfers were effected:

Associate Members

CARR-HARRIS, Gordon Grant Macdonnell, assistant professor, civil engineering, Royal Military College, Kingston, Ont.

GILLESPIE, James, B.A.Sc., (Univ. of Toronto), Director of Department of Engineering, Central Technical School, Toronto, Ont.

PRENDERGAST, Ralph Macauley, B.A.Sc., (Univ. of Toronto), sales engr., apparatus sales divn., Canadian General Electric Co. Ltd., Ottawa, Ont.

Junior

McDONALD, Donald John, B.A., B.Sc., (Queen's Univ.), engineering department, Bell Telephone Company of Canada, Montreal, Que.

Affiliate

LEGATE, John James de Conlay, with Arthur Surveyer & Company, Montreal, Que.

Transferred from the class of Associate Member to that of Member

BOWMAN, Henry Alexander, chief engineer, reclamation branch, Department of Public Works Manitoba, Winnipeg, Man.

DESSAULES, Henri, B.A., B.Sc., (Ecole Polytech.), local agent and resident engr., Shawinigan Water & Power Company, Shawinigan Falls, Que.

McCOLL, Charles Ross, B.Sc., (Queen's Univ.), engineer of Town of Sandwich and general practice as Ontario Land Surveyor and Civil Engineer, Windsor, Ont.

TAYLOR-BAILEY, Frank Whitham, B.Sc., (McGill Univ.), Vice-President in charge of sales Dominion Bridge Company, Limited, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

JULIAN, Fennell T., B.A.Sc., (Univ. of Toronto), supt., with J. A. Vance. A.M.E.I.C., General Contractor, Woodstock, Ont.

MARCH, Joseph Wade, B.Sc., (N.S. Tech. Coll.), instr'man and dftsman., International Paper Company, Gaspe Basin, Que.

MITCHELL, John Clarence, M.C., B.A.Sc., (Univ. of Toronto), engr. in charge of constrn. and mtce., Domestic Storage & Forwarding Company, Ltd., Toronto, Ont.

WALKER, Melvyn Lothian, B.Sc., (McGill Univ.), mech'l. engr., Dominion Rubber Co., Montreal, Que.

WOOLWARD, Charles Desmond, B.Sc., (McGill Univ.), engr., Foundation Company of Canada, Ltd., Montreal, Que.

Transferred from the class of Student to that of Associate Member

GOOD, Earl Franklin, B.A.Sc., (Univ. of Toronto), struct'l. designer, Messrs. Harkness & Hertzberg, Toronto, Ont.

HAGUE, Edward Cousins, B.Sc., (McGill Univ.), research engineer, Victor Talking Machine Co. of Canada, Montreal, Que.

STEEVES, Samuel Merritt, B.Sc., (Univ. of Man.), topog'l. engr., Department of Mines, Ottawa, Ont.

Transferred from the class of Student to that of Junior

BOULTON, Beverley Knight, B.Sc., (McGill Univ.), elect'l. engr., Beauharnois Construction Co., Beauharnois, Que.

BOWMAN, Ronald Fraser Patrick, B.Sc., (Univ. of Alta.), transitman, mtce. of way, C.P.R., Lethbridge, Alta.

BRYANT, James Sanborn, B.Sc., (McGill Univ.), student apprentice, Southern Canada Power Company, Montreal, Que.

CRAIG, James William, B.Sc., B.E., (Univ. of Sask.), ceramic engr., National Research Council, Ottawa, Ont.

MITCHELL, James Murray, B.Sc., (McGill Univ.), central district traffic supt., Bell Telephone Company of Canada, Montreal, Que.

STYLES, Hugh John, B.Sc., (Queen's Univ.), elect'l. inspr., Welland Ship Canal, St. Catharines, Ont.

Students admitted

BRYDEN, Donald Charles, B.A., B.Sc., (Univ. of Alta.), engrg. apprentice, Canadian Westinghouse Company, Hamilton, Ont.

CAMPBELL, Hugh L., (Undergrad., Univ. of N.B.), Salisbury, N.B.

LINGLEY, Harold Percival, (Undergrad. Univ. of N.B.), 24 High Street, Saint John, N.B.

MacDERMOTT, Kenneth Weston, (Undergrad., Univ. of N.B.), Gagetown, N.B.

PIDOUX, John Leslie, (Undergrad., Univ. of Alta.), University of Alberta, Edmonton, Alta.

STRATTON, Leslie Robertson, (Undergrad., Univ. of N.B.), 28 Exmouth Street, Saint John, N.B.

SINCLAIR, Donald Bellamy, (Undergrad., Mass. Inst. Tech.), 205 Cambridge Street, Winnipeg, Man.

STEPHENSON, Stephen, (Oxford and Cambridge local exam.), asst. field engr., Bell Telephone Company of Canada, Kingston, Ont.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- Corporation of Quebec Land Surveyors: Roll of Members, 1930.
- The Asphalt Association: Eighth Annual Asphalt Paving Conference.
- American Society of Civil Engineers: Year Book, 1930.
- The Royal Society of Canada: Programme of Papers, May Meeting, 1930, at Montreal.

Reports, etc.

Dept. of Mines, Canada:
- Rapport du Ministère des Mines pour l'Année financière se terminant au 31 mars, 1929.
- The Canadian Mineral Industry in 1929.

Dominion Water Power and Reclamation Service, Canada:
- Irrigation series, Bulletin No. 7: Irrigation Practice and Water Requirements for Crops in Alberta.
- Annual Report, 1927-28.

Dept. of National Defence, Historical Section, Canada:
- Map: The Western Front, Situation on Sept. 15, 1918.

Provincial Town and Rural Planning Advisory Board, Alberta:
- Annual Report of the Director of Town Planning for the Year 1929.

City of Winnipeg Hydro-Electric System:
- 18th Annual Report, December 31, 1929.

The Saint John Harbour Commissioners:
- Annual Report, 1929.

Harbour Commissioners of Vancouver, B.C.:
- Annual Report, 1929.

Bureau of Standards, United States:
- Commercial Standard CS7-29: Standard Weight Malleable Iron or Steel Screwed Unions.
- CS9-29: Builders' Template Hardware.
- CS17-30: Diamond Core Drill Fittings.
- Misc. Publication No. 109: Chart for Determining the Helix Angles of Screw Threads.
- Circular No. 381: Socium Oxalate as a Standard in Volumetric Analysis.

Bureau of Mines, United States:
- Technical Paper No. 471: How Leakage of Current from an Electric Shot-Firing Circuit Causes Misfires.
- Bulletin No. 319: Coal Mine Fatalities in the United States, 1928.

Geological Survey, United States:
- Bulletin No. 788: Topographic Instructions of the United States Geological Survey.

Engineer Dept., United States:
Statistical Report of Lake Commerce Passing Through Canals at Sault Ste. Marie, Michigan and Ontario, during Season of 1929.

The Port of New York Authority:
Ninth Annual Report, Dec. 31, 1929.

Illinois State Water Survey:
Bulletin No. 38: Illinois River Studies, 1925-1928.

City of Boston, Mass.:
Annual Report of the Public Works Department for the Year 1928.

Ohio State University:
Engineering Experiment Station Bulletin No. 54: Cold Crushing Strength of Fire Brick. Circular No. 20: A Decade of Progress in Highway Research.

Technical Books, etc.

Purchased:
H. M. Stationery Office, London: National Physical Laboratory. Collected Researches, Vol. 21, 1929, Paper 15-19: (1) "Three Papers on the Investigation of Wireless Waves arriving from the Upper Atmosphere"; (2) "The Cause and Elimination of Night Errors in Radio Direction-Finding"; (3) "The Attenuation of Wireless Waves due to the Resistance of the Earth."

Presented by Canadian Engineering Standards Association:
Standard Specification No. G30: Billet-Steel Reinforcing Bars (2nd ed.).
No. G31: Rail Steel Reinforcing Bars (2nd ed.).
No. G32: Steel Wire for Concrete Reinforcement (2nd ed.).

American Railway Association, Signal Section:
American Railway Signaling Principles and Practices. Chapter 6: Direct Current Relays. Chapter 11: Alternating Current Track Circuits.

Presented by American Institute of Steel Construction, Inc.:
Facts and Figures about Structural Steel, March, 1930 (2nd ed.).

Summer Convention

The American Institute of Electrical Engineers will hold its annual summer convention at the Royal York Hotel, Toronto, Ont., June 23rd to 28th, 1930, and have extended to the members of The Engineering Institute a cordial invitation to attend any or all of the events of the convention in which they may be interested. Mr. W. L. Amos, Secretary of 1930 Summer Convention Committee, is located at 190 University Avenue, Toronto, Ont.

Third International Congress for Applied Mechanics

The Third International Congress for Applied Mechanics is taking place at Stockholm, Sweden, on August 24th to 29th, 1930.

In September 1922 there was a private meeting between several scientists interested in hydrodynamic and aerodynamic questions. As the conference had an unexpected measure of success, the idea was conceived of issuing the invitation to an international congress of applied mechanics at Delft in 1924. The second congress was held at Zurich in 1926.

Further information regarding this third international congress can be had by applying to Professor W. Weibull, Tekniska Hogskolan, Valhallavagen, Stockholm.

Ferranti Electric Limited, 26 Noble street, Toronto, Ont., have just issued a new 52-page bulletin on instrument transformers. It embodies all general information on current and potential transformers, testing standards, etc., used. Diagrams are given for all ordinary connections of meters and indicating instruments with current and potential transformers. There is also a complete listing of indoor and outdoor types of instrument transformers with ratings, photographs, weights, dimension drawings and tables. Two-colour accuracy curves of ratio and phase angle are given for each type and rating. Outdoor metering equipments are also described. Copies will be gladly furnished upon request to the company.

The establishment of Whiting Corporation (Canada) Limited, with head office at 129 Adelaide street, West, Toronto, Lieut.-Col. James Mess, president, has added a third unit to the present engineering and sales organizations, known as Dominion Flow Meter Company, Ltd., and Diesel Power, Limited. The new company, with its own engineering and sales organizations, will specialize in the sale of Whiting cranes, foundry and railway equipment, Swenson evaporators, and pulp mill and sugar machinery, and Grindle pulverized coal system.

BRANCH NEWS

Halifax Branch

R. R. Murray, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Halifax Branch was held on March 20th in the St. Julien room of the Halifax hotel, at 6.15 p.m.

There were thirty-six present and the meeting was presided over by Prof. W. P. Copp, M.E.I.C.

The minutes of the February meeting were approved after which Chairman Copp introduced Mr. W. L. Davies, manager of the Starr Manufacturing Company in Dartmouth, N.S., who, he said, would deliver an address on the "Manufacture of Skates."

Mr. Davies began by describing the evolution of the skate from the first skates made from the bones of animals; next came the skate of wood with an iron runner or blade affixed, which came about the third century. There was no change in method until in 1867 the "Acme," the first all metal skates, was invented by Mr. John Forbes of Dartmouth, N.S. Next came the skeleton type of skate until the tubular type was introduced in England in 1887. This style of skate came on the Canadian market in 1889. And, finally, we have the "figure" skate for fancy skating.

During twenty-five years approximatively 2,000,000 pairs of "Acme" skates were made and were widely popular. In fact the Starr Company had control of the world's markets in skates. Their manufacture was stopped 7 or 8 years ago and today but few pairs are sold.

Shortly after the Acme was invented it was copied by German makers and was, ironically enough, called the Halifax. The competition was not very keen, however.

The skeleton skate weighs only 22 ounces and will carry a load of 250 lbs. They are blanked out in three operations. To effect this in one operation would require a pressure of 180 tons. Only one pair in 1,000 is rejected as below standard.

The principal cost in a skate is the finish. Hot rolled steel is used because cold rolled steel does not finish well. Twelve hundred pairs per day are polished. Crucible steel is used in the best grades of skates but sometimes cast steel is used in the cheaper grades. The crucible steel has a hardness factor of 80 to 85 per cent and it holds a keen edge.

Only five years ago 70 per cent of skates made were of the blade type but today only about 20 per cent are made, the balance, 80 per cent, are the tubular type.

These tubular skates weigh but 11 ounces each. A few years ago two men were required to manufacture 4 pairs per day; today 35 men produce 1,000 pairs daily. These skates are made from straight carbon steel. The runners of these skates were formerly soldered; later welded. Now no solder or weld is used.

The company are testing for improvements all the time and it is hoped, shortly, to be able to burnish tubular skates as well as flats, instead of polishing them.

Chromium plating is not favoured by the company. It is expected that they will be able to use a new plating material containing only 18 per cent chromium and 8 per cent nickel. Corrosion is found to be a great difficulty in this climate.

The Starr Manufacturing Company are the largest skate producers in the world. Their markets are everywhere besides in Canada and the United States, which latter country absorbs about 30 to 40 per cent of the output.

Skates are manufactured automatically, the only hand work being on the finish. The figure skate is a one-piece skate and is made solely by hand work. It is modeled after the European type. Their best customer is Australia.

Due to artificial ice rinks skates have a market in all countries, no matter what the climate.

Mr. Davies described the method of plating skates and remarked that, whilst the output was 40,000 pairs annually five years ago, this year the output is 200,000 pairs.

They have also gone into the production of roller skates and will turn out 25,000 pairs this year.

Mr. Davies concluded his well delivered and interesting address with the observation that there are 59 operations in the making of a skate and while they have some difficulty at times in getting the correct grade of steel they continue to experiment for the best results.

Lt.-Col. Simmonds, president of the Starr Company, in a few remarks gave Mr. Davies great credit for the progress of the company and considered him a most valuable man.

Lt.-Col. Simmonds gave us some reminiscences of earlier days in skate making and stated that Russia is the only country where Starr skates are not sold.

He finally invited the members to visit the plant at a future date and Chairman Copp said that the invitation would be accepted and a visit arranged for.

A very hearty vote of thanks was tendered Mr. Davies for his address.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.
J. R. Dunbar, A.M.E.I.C., Branch News Editor.

Chamber of Commerce Meeting

The members of the Hamilton Branch of The Engineering Institute of Canada were invited by the Hamilton Chamber of Commerce to attend their annual meeting at the Royal Connaught hotel on April 22nd. The speaker of the evening was R. O. Sweezey, B.Sc., M.E.I.C., of the Beauharnois Power Development, who spoke on "Waterpower Developments Along the St. Lawrence River." He strongly advocated the development of the St. Lawrence waterways as an entirely Canadian project.

Waterpower of Canada has been rapidly developed within the past 25 years, Mr. Sweezey pointed out. Ontario is now using 2,000,000 h.p., whereas eight years ago consumption was but half that total. He predicted that within 10 years the amount will have increased to 4,000,000 h.p. The Beauharnois development now generates 500,000 h.p., and Mr. Sweezey estimated a maximum of 2,000,000 h.p. in 10 years.

Emphasizing the importance of the development of waterways and energy, the speaker referred to the advantage of easy access to the markets of the world. When navigation is open from tidewater to inland ports, shown to be a possibility as far as Niagara falls, ships from all parts of the world will carry raw materials and create a demand for diversified industry.

Joint Meeting with the A.I.E.E.

The annual joint meeting of the Hamilton Branch of The Engineering Institute of Canada and the Toronto section of the American Institute of Electrical Engineers was held in the Westinghouse auditorium on Friday, April 25th. H. A. Lumsden, M.E.I.C., chairman of the Hamilton Branch, called the meeting to order and then handed it over to F. F. Ambuhl, chairman of the Toronto Section, A.I.E.E., who introduced E. F. W. Beck of the Westinghouse Electric & M'fg. Co. of East Pittsburgh. Mr. Beck's address was on "Lightning Studies and Field Surge Investigations."

Mr. Beck dealt with the status of lightning studies in the United States and showed lantern slides of portable laboratories and other equipment that were used in the studies.

Mr. Beck had a portable laboratory set up on the platform of the auditorium and gave a demonstration of the effects of the artificial lightning. The total voltage of each lightning bolt was recorded on a photographic plate by a Klydonograph, invented by L. R. Peters of the Westinghouse Electric and Manufacturing Company in 1923.

An accurate history in millionth of a second intervals told the characteristics of each bolt. The oscillograph, which made this possible, was developed by the Westinghouse Electric and M'fg. Co. under the Harald Norinder patents.

Mr. Beck concluded his talk with a demonstration of the latest development in the devices to stop the ravaging effects of lightning, the porous block lightning arrester. It reduces the mighty stroke of millions of volts to a quiet unobstrusive filtering of numerous sparks the size of a pin-head.

At the conclusion of his talk, Mr. Beck was tendered a hearty vote of thanks by the joint meeting. Refreshments were served by the Westinghouse Company to all present.

Annual Meeting

The Annual Meeting of the Hamilton Branch was held at the Tamahaac Club, Ancaster, on Wednesday, April 30th. H. A. Lumsden, M.E.I.C., occupied the chair and after dinner called for the Executive Committee report and the report of the Scrutineers. W. F. McLaren, M.E.I.C., the Secretary-Treasurer, presented the Executive Committee report which is given below.

Report of Executive Committee for the Year ending May 31st, 1930

The Branch held 9 meetings during the year as follows:—

1929

Sept. 27.—"Institute Affairs" by E. G. Cameron, A.M.E.I.C. Attendance 35.

Nov. 6.—"Machine Tools" by Graham Bertram, M.E.I.C.
"Coke Ovens" by J. E. Grady, A.M.E.I.C.
"Power Factor" by J. R. Dunbar, A.M.E.I.C. Attendance 36.

Dec. 5.—"Engineering Developments in the Army" by Maj. Gen. McNaughton, M.E.I.C. Attendance 50.

1930

Jan. 14.—"Leaside Transformer Station" by C. F. Publow and H. E. Brandon, A.M.E.I.C. Attendance 60.

Feb. 21.—"Engineering in Europe" by Prof. R. W. Angus, M.E.I.C. Attendance 30.

Mar. 19.—"Recent Developments in Arc Welding" by R. E. Smythies, M.E.I.C. Attendance 40.

April 22.—Chamber of Commerce—"St. Lawrence Power" by R. O. Sweezey, M.E.I.C. Attendance 12.

April 25.—Joint A.I.E.E. "Lightning Studies" by E. F. W. Beck. Attendance 320.

April 30.—Annual. "Hudson River Bridge" by F. W. Skinner Attendance 76.

A total of nine meetings were held with an average attendance of 70 and an average cost of $35.00 per meeting.

Special attention might be called to the Branch meeting of September 27th when Institute affairs were discussed. The speaker called attention to the vote taken last year or increase of fees, only about 900 members voting out of some 3,600. Following this up on December 2nd, your executive proposed an alternative method of increasing the funds of The Institute by equalizing the fees, that is, requiring Branch non-residents to pay the same fees as Branch residents and also requiring Associate Members to pay the same fees as members after 10 years. They also proposed to revise method of financing the Branches, by giving each Branch $150.00 and a 10 per cent rebate on fees, instead of the present rebates of 20, 25 and 30 per cent.

This proposal was sent to all Branches for comments, but only five acknowledged same. None of the Branches approved the proposal. The Lethbridge Branch preferred their proposal of financing Branches to ours. Their proposal was $15.00 per meeting approved by Council and 10 per cent rebate of fees. The chief difficulty with the Lethbridge scheme was that Council had to approve programme of meetings in advance.

The Saskatchewan Branch preferred to await "report of committee appointed by headquarters."

The Niagara Peninsula Branch opposed the proposal and thought Associate Members would resign rather than pay an increased fee after 10 years.

Headquarters, however, stated that their proposal to increase fees would again be put up to the membership and requested us to withhold action; besides drawing our attention to Section 75 of the by-laws requiring the signatures of 20 corporate members to any proposed change in by-laws. We agreed to postpone action.

A long questionnaire from headquarters re publications, occupied the attention of your executive on January 27th.

Altogether 9 executive meetings were held with an average attendance of 5 out of 9.

Class	Membership Resident	Non Res.	Total	Last Year
Members	25	6	32	27
Associate Members	47	10	57	62
Juniors	8	6	14	14
Students	32	6	38	38
Affiliates	3	0	3	0
Branch Affiliates	21	0	21	24
Total	136	28	164	165

Financial Statement as of May 31st, 1930.

Receipts		
Brought forward	$1,022.85	
Rebates 30 per cent fees	246.00	
Branch News	27.40	
Branch Affiliates	60.00	
Bank Interest	35.94	
Re-sale April 1929 Journal	1.00	
		$1,393.19
Expenses		
Printing	$ 57.82	
Postage and Stationery	25.88	
Cafeteria and Dinners	96.95	
Speakers' Expenses	11.05	
Telegrams and Miscellaneous	3.67	
Stenographer	50.00	
Annual Dinner	93.75	
	$ 339.12	
Balance	1,054.07	
		$1,393.19

The scrutineers reported that the following officers had been elected for the ensuing year:

Chairman..........W. F. McLaren, M.E.I.C.
Vice-Chairman..........F. P. Adams, A.M.E.I.C.
Secretary-Treasurer..........J. R. Dunbar, A.M.E.I.C.
Committeemen..........E. M. Coles, A.M.E.I.C.; G. A. Colhoun, A.M.E.I.C.

With the continuing members of the Executive Committee, this leaves the branch with the following officers to carry on its affairs for the coming year:

Chairman..........W. F. McLaren, M.E.I.C.
Vice-Chairman..........F. P. Adams, A.M.E.I.C.
Secretary-Treasurer..........J. R. Dunbar, A.M.E.I.C.
Committeemen..........J. B. Carswell, M.E.I.C.; H. S. Phillips, M.E.I.C.; E. M. Coles, A.M.E.I.C.; G. A. Colhoun, A.M.E.I.C.
Past-Chairman..........H. A. Lumsden, M.E.I.C.
Councillor..........E. H. Darling, M.E.I.C.

After dinner the meeting adjourned to the lounge.

Frank W. Skinner, consulting engineer, New York city, the speaker of the evening, discussed the Hudson river suspension bridge, and illustrated special design, features and comparative data on other notable bridges with lantern slides.

The Hudson river bridge will have a span of 3,500 feet, double that of the great suspension bridge, which was built when construction commenced, and nearly double the longest span of any description in the world, namely, the 1,800 foot Quebec bridge, being the most magnificent of all cantilevers and a monument alike to its engineers and to the Dominion.

The Hudson river bridge, he continued, would cost a total of $75,000,000, and would carry at first eight traffic lines of the heaviest automobiles and trucks, a capacity of more than 30,000,000 vehicles annually, which might be practically doubled by the making of a second lower roadway. This bridge, he said, exemplified the inherent beauty of the suspension bridge, as well as the great strength, durability, rapidity and economy of construction, etc. that makes it a successful competitor with all other types for spans exceeding 1,000 feet, and the only type which with present materials and machinery, could be built to at least a length of 5,000 or 6,000 feet with regard to economical considerations, while its possibilities, regardless of financial reasons, would permit of still longer spans.

Each of the four great cables of the Hudson river bridge contains more than six thousand parallel steel wires, forming 62 endless skeins reaching continuously from anchorage to anchorage, nearly a mile apart.

R. K. Palmer, M.E.I.C., of the Hamilton Bridge Works, moved a vote of thanks to the speaker which was carried with hearty applause.

London Branch

F. C. Ball, A.M.E.I.C., Secretary-Treasurer.
Jno. R. Rostron, A.M.E.I.C., Branch News Editor.

A paper on "Harbour Engineering" was given by H. B. R. Craig, M.E.I.C., at the regular monthly meeting of the Branch on April 16th in the Public Utilities Commission's board room, twenty-six members and guests being present.

The chair was occupied by W. G. Ure, O.L.S., A.M.E.I.C., who in introducing the speaker called attention to the extensive experience Mr. Craig had had in the subject on which he was going to speak as he had for a large number of years held the post of divisional engineer in the Public Works Department of Canada and had been located at Windsor and latterly London, Ont.

Mr. Craig had now left the Department and had commenced private practice as a consulting engineer. Further introduction from him was unnecessary as he, Mr. Craig, was so well known.

Mr. Craig opened by saying that he was pleased to have been asked to speak before the Branch and although he had given a paper some five or six years ago he had collected different data for this occasion. A humourous collection of engineering maxims taken from the "Canadian Engineer" of 1908 was then read by him by way of an "entrée" to the substantial meal which was to follow.

Harbour engineering could be classed as one of the oldest forms of engineering and the speaker traced the building of harbour works from the time of the Egyptians, Greeks and Romans to the present day. Mention was made of the artificial harbours of Tyre and Sidon, Alexandria, Athens, Carthage, Vestria and various British and Scottish harbours.

With regard to harbour works authorities mention was made at some length of the Stevenson family, Dr. Cunningham and others. Particular reference was also made to David Stevenson's "Civil Engineering in North America."

Harbours for the most part were built at natural outlets of rivers and streams and, owing to the sand bars, training walls were necessary, likewise piers and jettys. Sometimes these latter constituted themselves into groynes and possibly reconstruction would be necessary.

Artificial harbours were formerly usually constructed of timber which has now given place to concrete.

The drift of Lake Erie is from the west and there are three harbours on the north shore, viz. Port Stanley, Port Bruce and Port Burwell, that are costly, requiring breakwaters and a good deal of dredging. Lake Huron is more rocky and the littoral drift less, therefore the cost is not so great as on Lake Erie.

There can be no definite layout or standard for any harbour, the engineer must use his skill and judgment in each particular case and make his scheme fit in with the existing physical conditions to get the best and most economical results. Surveys must be made, soundings and borings taken, investigations made as to the direction and magnitude of currents, character of bottom for anchorage purposes, etc. before definite plans of the work can be made.

Formulae were given for determining the height and strength of the waves under storm conditions and instances were cited showing the lifting force of the water under these conditions, blocks of stone or rock weighing from two to ten tons having been lifted and carried up slopes inland.

There are two kinds of waves known as "oscillatory" and "translatory," the former being those at right angles to and caused by the wind over deep water and the latter those waves which turn over at the crest and break owing to the feet of the waves being retarded by some obstruction notably on reaching shore. However, translatory waves may occur in deep water owing to unseen obstructions or undulations on the bed of the ocean or lake.

Mention was made of ocean currents, particularly the Gulf Stream, and the evaporation of water under head conditions. Also of the wind and methods of locating the storm centres.

Harbour engineering covered a large variety of work and it was up to the engineer to study cause and effect very closely before designing his structure.

A number of questions were asked of the speaker and discussion centred round the problem of harnessing the power of the tides. A short description of one of the proposals for doing this at the Bay of Fundy was given by G. E. Martin, A.M.E.I.C., of the Public Works Department.

During the latter part of the evening an exhibition of moving pictures was given by E. V. Buchanan, M.E.I.C., manager for the Public Utilities Commission.

These movies had been taken by Mr. Buchanan himself and so were doubly interesting. The first set consisted of views of the Windsor-Detroit tunnel works and the Ambassador bridge. These were taken on the occasion of the visit of the Branch last year and depicted a number of the members in various antics in their efforts to see the works, besides views of the works themselves. Needless to say some of these created a hearty laugh and were much enjoyed.

The second set were pictures taken on and during the visit of Mr. Buchanan and his family to the Old Country, also last year. Pictures were shown, taken at the ports of sailing and during the voyages, both on the outward and return journeys, and the many places visited in Scotland and England. The first of the pictures in this category were taken at Hamilton, Scotland, a modest mining town with picturesque surroundings and chiefly notable as the birthplace of E. V. Buchanan. Following this, views were shown of places and people in Scotland at Stirling, Braemor, Edinburgh (including the Forth bridge), Loch Lomond, the Clyde and Greenock. In England at London, Hampton Court, the Thames river and Eton College, Windsor and the exhibition at Newcastle. Notable amongst the views shown at Edinburgh were those of the Scottish National War Shrine. Mr. Buchanan laid particular stress on the beauty and impressiveness of this edifice.

The pictures were beautifully clear and distinct and were greatly enjoyed even to that of a close-up of a black specimen of an Aberdeen terrier viewing the operations with an unperturbed dignity all his own. The exposition was given by Mr. Buchanan in his own inimitable style and was full of running and piquant yet descriptive comment. To a facetious remark that his father was a better looking man than he was Mr. Buchanan got back by saying "that might be just possible."

The evening was thoroughly enjoyed by all present and a cordial vote of thanks was moved to the speakers by the chairman and unanimously carried.

Hudson River Suspension Bridge

A well-attended extra meeting of the London Branch was held on May 1st in the city hall assembly room, F. W. Skinner, consulting engineer of New York, N.Y., being the speaker and his subject, "The Hudson River Suspension Bridge."

W. G. Ure, A.M.E.I.C., city engineer of Woodstock, Ont., chairman of the Branch, presided and after disposing of the minutes and other business of the Branch, called upon D. M. Bright, A.M.E.I.C., consulting engineer, of London, Ont., to introduce the speaker.

Mr. Skinner said that the Hudson river bridge connecting the states of New York and New Jersey was unique, inasmuch as the centre span is the longest ever erected in the world. Long spans, Mr. Skinner said, had been perfected only within the last fifty years, one hundred years ago what were considered to be long spans were now hardly worth the name. In pioneering days, timber-framed structures were built up to two hundred feet span and later up to three hundred feet with the aid of supplementary iron rods. Later again, spans of five hundred feet were accomplished by the use of wrought iron trusses and by the advent of structural steel the spans of bridges increased by leaps and bounds.

There might be said to be three types of long span bridges—(1) trussed arches, (2) steel cantilever trusses and (3) suspension bridges. Two examples were mentioned of the first class, one at Hellgate of 1,016 feet span and another (in construction) at Staten Island of 1,050 feet. The Canadian structure at Quebec and the Forth bridge in Scotland come into the second class, both of them being around 1,800 feet span. The economic length of span of this type of bridge is 2,500 feet with a dead load five times the weight of the live load. In the third class the Brooklyn bridge with a span of 1,696½ feet was not exceeded until about four or five years ago by the design of the Ambassador bridge between Detroit, Mich., and Windsor, Ont.

Arch and cantilever bridges are rigid and suitable for smaller spans, suspension bridges develop greater flexibility and permit of much larger stresses and overloads. They are graceful and light in appearance and furthermore cheaper, for spans over 1,000 feet. They can be built in places where it would be impossible to erect other types of bridges, such as over raging torrents or yawning chasms. This was illustrated by a view of the Royal George suspension bridge with a span of 880 feet, 1,053 feet above the Colorado river. The Hudson river bridge with a span of 3,600 feet is now well advanced and it is expected, will be complete and ready for opening to traffic by 1932.

Contrary to usual practice, the contractor was made responsible not only for carrying this work out according to the specifications, but was also held responsible for the design of the structure. Messrs. John A. Roebling and Successors of Trenton, N.J., who obtained the contract for the cables therefore had to verify all the data and calculations necessary for the design, and conduct an exhaustive number of preliminary tests. This preliminary work cost the firm in the neighbourhood of $330,000 for laboratory and mechanical tests. Special machines and equipment were laid down at their Trenton plant for this work. Owing, however, to this preliminary work, which included minute planning of operations in advance, the work on the ground was proceeding with unparalleled rapidity.

The four cables, having a diameter of 36 inches, contain 107,000 miles of steel wire. Each cable is a mile long between anchorages and is made up of 62 strands, containing about 432 cold drawn steel wires of .196 inch diameter each. Each large cable carries a dead load of 39,000 pounds and a live load of 9,000 pounds per lineal foot.

The cables are supported at either bank by two steel towers, 650 feet high and containing 20,000 tons of steel each. There is a proposal for encasing these towers in concrete, much to the speaker's disgust, for Mr. Skinner considers that the tracery work of the steel is far more preferable on aesthetic grounds than a mass of opaque concrete.

The anchorages on the New Jersey side are embeded in solid rock and an elaborate system of tunnelling and shafting was carried out in forming the anchorage. On the New York side the concrete anchorage contains 140,000 cubic yards of concrete and is contained in a handsome structure 200 feet square and 155 feet high. The weight of this anchorage block is around 520,000,000 pounds and the tension exerted by the anchor cables is about half of that weight.

Mr. Skinner's remarks were illustrated by a large number of photographs and diagrams etc., shown upon the screen, and some of these views depicted very clearly the placing of the nine working cables and the frames and gear fixed upon them for spinning the cables. Exhaustive tests were made of these cables beforehand and precautions taken to ensure uniform elongation under stress. They were drawn across the river on barges and slung over the steel towers and afterwards elaborate platforms were slung from them to accommodate the workmen. The carbon, cold drawn, steel wires (.196 inch diameter) were then drawn (or spun) in units at an even tension across the span and adjusted with mathematical precision to the exact curve and sag required to give perfectly uniform tensions in the large cable of which they formed the units. An interesting feature was the splicing of these wires. They were placed end to end in a steel sleeve two and a half inches long and enormous pressure exerted all around the sleeve. In tests made afterwards the wire itself failed away from the joint. Every eight minutes six loops of these wires were drawn across the span, this constituting a speed of construction four times as rapid as any previous operation of the kind. Electric light and power installations were installed for this work together with an elaborate signalling system for synchronizing the operations. Four hundred and thirty-two wires constituted a strand and when one strand was completed the wires were bound together by adhesive tape. Each strand when complete was heptagonal in form and the sixty-two strands formed the whole cable of 36-inch diameter. Circular rings of steel were then placed in position, then rings carrying a number of powerful jacks which exerted an enormous pressure evenly over every part of the circumference of the 36-inch circle. So highly were the wires compressed together that a photographic section of the cable after this treatment gave all the appearance of a section of a solid 36-inch steel bar.

The temporary working cables were afterwards cut up as required and used for the vertical hangers from the main cables. The steel stiffening trusses carrying a roadway 130 feet wide and accommodating eight lanes of heavy highway traffic were slung from these hangers. Provision is also made for the instalment at a later date of a lower steel deck to carry steam and electric railroads.

The speaker referred in high terms to the efficiency of the Roebling plant and of their success in developing the manufacture of high tension steel wire to its present strength of from 220,000 to 280,000 pounds per square inch.

The Hudson river bridge will constitute the longest span up to date, but the speaker hinted at still greater achievements for this type of structure in the near future, one of 4,400 and another of over 5,000 feet span.

The total cost of the bridge will be in the neighbourhood of $75,000,000 of which the cables alone absorb $12,000,000.

In answering a question Mr. Skinner said that contraction and expansion in the cables was taken care of by their rise and fall which would amount to from two to three feet under different temperatures.

A hearty vote of thanks was proposed by J. Ferguson, A.M.E.I.C., seconded by J. R. Rostron, A.M.E.I.C., and unanimously carried.

Inspection Tour

The regular May meeting of the London Branch held on May 10th, 1930, took the form of an inspection tour of the rail relaying operations of the Canadian Pacific Railway on the company's main line between Windsor and London. This visit was made possible by the courtesy of S. W. Crabbe, division superintendent, and A. O. Wolff, M.E.I.C., and was well attended by members and guests, amongst the latter being several from the Canadian National Railways and the Michigan Central Railway.

The party was taken to the scene of the present rail-laying job on the main line between London and Windsor, near Caradoc, on the work train. The Canadian Pacific is replacing the 85-pound rail with 100-pound rails on the main line and are doing so by methods new to railroad construction engineering.

On other railroads and formerly on the Canadian Pacific, the rails are replaced one at a time, 18 men lifting one rail into place, coupling and spiking it. By the new method the rails are first rolled off flat cars along the track, then one small gang couples them in lengths of three and sets them on the edge of the ties.

When the actual replacement is to take place one group of men walk along the track loosening spikes on the inside of the old rail. They are followed by a group who pry the old rail to the inside of the track, the outside spikes being left in the ties as a guide for the new rail. The new rails, in lengths of three, are then pried over in an upright position and lifted into place by means of six tripods and levers. With this equipment they are easily swung into place. Another group follow and spike the new rails and another to bolt the joints.

A crew with an air compression bolt tightener apparatus follow, tightening the joints at the rate of 17 seconds a joint.

One crew described as above proceeds along the south rail of the track and are followed by a similar crew on the north track. Then following both crews is the work train. The old rails, which remained coupled for the distance of almost a mile, are pried over the new rail at one end and then shoved over to one side by the work train so that the old rail is left to the outside of the track ready for uncoupling, the new rail is in its place and another page of history written.

The crews walk right along the track and average nearly 12 miles daily. The insertion of rail anchors and new tie plates, as well as other minor adjustments, are done later by the regular section crews.

All the old rails are graded and marked and will be used in spurs, branch lines and sidings and for repair purposes where 85-pound rails are still in use. The manner in which the rails are "closed" to allow a train to pass is very interesting, a tapered rail being jointed from the new to old rail in a very few minutes and the train passing with little or no delay.

Canadian Pacific road engineers explained that while the saving of time on the entire job is worthy of consideration, the operating of regular trains, according to regular schedule while the work is in progress on a one-line track, is permitted only by use of this new, rapid and improved method.

The work train which follows the men along the track is made up of tool cars, sleeping cars for the men and their regular dining cars. S. W. Crabbe, division superintendent, and A. O. Wolf, division engineer, explained the details of each operation to the party of visitors.

A rock ballasting crew, working on the same line, was also seen by the party. The laying of new heavy rails and rock ballasting of the line is part of a programme costing $500,000, being done on the London division in preparation for heavier equipment and traffic. When the London division work is completed the railway will have heavy rail and rock ballasted track from Quebec to Chicago.

W. J. Shaw, A.M.E.I.C., St. Thomas division track engineer of the Michigan Central Railway, and J. Ferguson, A.M.E.I.C., with a similar position on the Canadian National, thanked Mr. Crabbe and Mr. Wolf for their hospitality on the inspection trip and said that the work being done by the Canadian Pacific on this job was something new in their experience.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

At a supper meeting of the Branch, held on April 14th, a very interesting address on the subject "Some Aspects of Clay and Burned Clay Products" was delivered by G. S. Stairs, B.Sc., A.M.E.I.C., Director of L. E. Shaw, Ltd., Avonport, N.S., and Chipman, N.B. L. H. Robinson, M.E.I.C., Vice-Chairman of the Branch, presided. Immediately following the supper several enjoyable clarinet selections were rendered by Dr. F. E. Burden, after which the Chairman introduced the speaker of the evening.

Some Aspects of Clay and Burned Clay Products

The outstanding properties of clay are its plasticity and imperviousness to water when moist and the ease with which it can be converted into a stone-like mass when heated to a high temperature. In the process of manufacture, the clay is moulded by any one of three methods. In the soft mud process, water is added until the clay is of the consistency of soft paste and is pressed into wooden moulds. In the stiff mud process less water is added — the clay is less plastic and must be forced into the moulds. In the dry press process the moisture content is reduced to twelve or fifteen per cent. The clay is then granulated and screened and conveyed to a pressing machine and pressed in steel moulds.

Having been moulded by whatever process used the product is then dried. For this purpose use is made in modern plants of waste heat from the kilns. The drying period varies from a minimum of eight hours to several days.

The final process of manufacture is the "burning" of the product. The speaker referred to the impurities occurring in clay and the heat treatment necessary for their elimination. Aided by charts and diagrams, Mr. Stairs described in detail the various types of kilns in use. Finally a motion picture film was shown illustrating the operation of a modern clay product plant.

Mr. Stairs' address was followed by an extended discussion.

A vote of thanks moved by H. J. Crudge, A.M.E.I.C., seconded by C. S. G. Rogers, A.M.E.I.C., was tendered the speaker by the presiding Chairman.

Visit of the General Secretary

A special meeting of the Branch was held on April 29th, on the occasion of the annual visit of R. J. Durley, M.E.I.C., General Secretary of The Institute. M. J. Murphy, A.M.E.I.C., presided. Mr. Durley outlined the progress being made towards co-ordination of provincial associations and The Institute. Considerable interest was aroused on learning of the proposal to send out to the membership a secret questionnaire dealing with the matter of remuneration.

Following a round-table discussion, the proceedings were brought to a close with the serving of "smokes" and light refreshments.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

On April 3rd, A. W. K. Billings, M.E.I.C., vice-president in charge of Operations for the Canadian and General Finance Corporation, addressed the Montreal Branch, taking as his subject "Water Power in Brazil."

Mr. Billings told how that country which is estimated as being the richest in the world in potential water power has been and is being developed largely by Canadian capital and enterprise. Thirty-two years ago, Fred S. Pearson, a noted American engineer, who later went down with the Lusitania, visited the south in search of health. He was attracted by the possibilities of the country and on his return interested a group of Canadian capitalists. These men, headed by Sir William Mackenzie, and ably assisted by Sir Alexander Mackenzie as resident executive in Brazil, and F. A. Huntress who directed the technical end for twenty-five years.

"To-day," Mr. Billings continued, "the light, power and transportation, gas and telephone service of Sao Paulo, Rio de Janeiro, Santos and the surrounding region, representing over two-thirds of the water power developed in Brazil are directly due to the courage and enterprise of this one Canadian company, known there as the 'Light' or the 'Canadian Company'."

After a brief sketch of Brazil, drawing attention to the fact that in area it was comparable to the United States or Canada, and that it had a population of 39,000,000, the lecturer went on to say that only a small part, namely the plateau of the southern portion, temperate in climate, well populated with five types of Brazilian and European settlers, was of interest in connection with the water power. This region, he explained, produces 70 per cent of the world's supply of coffee and has many important towns and cities, Rio de Janeiro with a population 1,300,000 and the modern Sao Paulo with 1,050,000 as well as the important seaport of Santos.

An outline of Brazil's physiography made clear the peculiar structure to which it owes its water power potentialities. The great inland plateau, the Serra do Mar, rose slowly ages ago, breaking along faults parallel to the present coast, but few of the rivers could keep pace with the rise by cutting down their courses to the ocean. The result is that with few exceptions the rivers of this region flow to the interior forming the great river basin of the Parana and Paraguay. These rivers in their courses cross many beds of harder rocks usually basalt, and the resulting cascades and rapids cut long canyons in these beds.

Added to this unusual physiographical structure of the region must be added another feature, the climate, which is abnormally rainy. At the crest of the plateau of the Serra do Cubatao development of the Brazilian Traction Company, the average rainfall is about sixteen feet. Last year it was twenty-two and a half feet, and in each of two months, February and December, was fifty-two inches.

Estimates of the available horse power in Brazil range from 20,000,000 to 600,000,000 h.p., the usually accepted figure being in the neighbourhood of 43,000,000. It was pointed out by the speaker however, that extreme caution was advisable in considering the available statistics in this country.

After discussing in some detail the different falls and water power sources in the region, Mr. Billings turned his attention to some of the typical power plants. At the time the earliest ones were built, the largest water wheel units were only 5,000 kilowatts while now 70,000 to 80,000 h.p. is the maximum in single units and steam turbines have been built in units up to 260,000 h.p. Details were given of the plants at Marmelos, Parahyba, Bananeiras, Alberto Torres, Itatinga, Usina Isabel, etc. The largest development in South America is the Serra do Cubatoa near Sao Paulo, with two units producing a maximum of 96,000 h.p. and an ultimate projected capacity of 750,000 h.p. The second largest plant is on the lower portion of the Parahyba river, while another important plant belonging to the Brazilian Company is at Riberroa das Lages, where 85,000 h.p. is developed.

The speaker next discussed the question of markets and went on to tell of other potential sources of wealth. This portion of Brazil is largely dependent on coffee production and textile manufacturing for its prosperity. Little is known of the mineral wealth but indications are that this is by no means small. In this connection Mr. Billings said that bauxite which to-day is so essential as the raw material for the production of aluminum and which seems principally in semi-tropical countries like Brazil, is known to exist over wide areas but has not yet been prospected or developed. Manganese, lead and silver, some gold, diamonds in quantity, phosphate rock, nickel and other minerals of importance are known to exist, even comparatively close to the thickly-settled portions, but so far have received too little attention.

In conclusion, Mr. Billings spoke in optimistic vein of the future possibilities of Brazilian development, and of the pride which Canadians should take in the fact that an important part of the past development has been and is still being led by Canadian interest.

P. S. Gregory, M.E.I.C., occupied the chair, and a large number were in attendance.

C.N.R. Shops, Point St. Charles

A very interesting description of the new locomotive shop and power house of the Canadian National Railways at Point St. Charles was given by Mr. J. Roberts, supervisor of shop methods, in a paper delivered before the Montreal Branch on April 10th.

By means of slides, Mr. Roberts traced the history and development of locomotives from the early days of the old Grand Trunk at Longueuil in 1853. He then went on to show how the development in motive power had been met in the construction of the modern shop with its huge cranes and many other facilities necessitated by present-day conditions.

It was pointed out by the speaker that the locomotive shop was only the first step in a five-year construction programme. During the present year a grey-iron foundry, material storage midway and light repair shop were contemplated. In 1931 the construction of a new passenger shop was to be undertaken, in 1932 a large machine shop and wood mill was scheduled, while in 1933 a freight car shop would complete the programme.

The power house was completed on December 1st, 1928, and is located on the south side of the locomotive shop. It consists of a four storey red brick building with reinforced concrete foundations and a water tank providing 150,000 gallons storage adjoins it at the west end. The boiler room contains 2 large pulverized fuel fired boilers, built for 400 pounds pressure, while the engine room equipment consists of one 1,000 k.w. d.c. turbo-generator, one 500 k.w. a.c. steam driven auxiliary generator and two 2,500 cubic foot steam-driven air generators and two 2,500 cubic foot steam driven air compressors together with switchboards and auxiliaries.

A very comprehensive description of the details of the locomotive shop was also given by Mr. Roberts and this was accompanied by a large number of well selected slides which gave the audience a clear conception of all the details.

J. T. Farmer, M.E.I.C., occupied the chair.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

The Branch held a dinner meeting on April the twenty-ninth, at the Leonard hotel, St. Catharines, and thirty-six members attended. The speaker was Frank W. Skinner, consulting engineer, of New York City. The subject was "The 3,500-foot Span of the Hudson River Bridge, and Comparative Construction Features of Largest Typical Spans."

Mr. Skinner asserted that the suspension type becomes economic for heavy traffic when spans exceed 1,000 feet, and is imperative where the longest span bridges are necessary. He also appears to believe that John A. Roebling was the very finest of artisans, and his successors and associates were foremost in developing, manufacturing and constructing steel wire ropes and cables. Despite these prejudices, or perhaps on account of them, he gave one of the most instructive discourses on methods of construction that we have had the pleasure of listening to for some time. His slides were equally perfect, showing the different steps of spinning the immense cables in place, also other construction details such as the anchorages and cofferdams for the main piers, and winding up with notable examples of almost every other conceivable type of long span bridge, comparative advantages, disadvantages and limitations, and especially their erection methods and equipment, that are important elements of cost and difficulty.

The Hudson river suspension bridge has four main cables, each 36 inches in diameter, and nearly one mile long, containing 26,474 individual wires. These wires are 0.196 inches in diameter, and are cold drawn from acid open hearth carbon steel with an ultimate strength up to more than 288,000 pounds per square inch. To get this strength a very careful selection of the ore is made, but no alloy is used, as experience has shown that any subsequent form of heat treatment is unnecessary if not actually undesirable. The quality of the cable wire much exceeds specification requirements, that call for 150,000-pound yield point and 220,000 ultimate strength. The working stress is 82,000 pounds per square inch.

After the wires are drawn and hot galvanized in the shops, they are shipped to the bridge site on reels and, as the spinning progresses, the end of one wire is pressure-welded with a sleeve to the end of the wire on the next reel, thus insuring 100 per cent splices.

One end of the continuous wire is made fast to the strand shoe at the anchorage, and a bight is carried at a constant tension over the two towers and down to the anchorage at the other side where it engages another strand shoe, thus building up for each cable 61 434-wire endless wire strands 4½ inches in diameter. Each strand with its anchor eye-bar thus has 217 bights of straight parallel wires which, when completed, are placed in the saddles and adjusted with pulling jacks and shims to give exactly the same tension (and consequent sag of about 225 feet) to each strand. The final operation consists of compressing these 61 strands into the circular cable, and binding this with soft wire covered with a weather-resisting preparation.

A $600,000 working platform was built under the main cables, and this of itself, was no mean engineering feat. After much experiment, a method was evolved for sway bracing by means of heavy cross struts and wire ropes attached to the main piers, which was nearly perfect, and steadied the platform under the most violent wind conditions. The 36 2-15/16-inch supporting cables were all pre-stretched, thus ensuring an equal amount of sag thereafter. This pre-stretching is an entirely novel feature, and one which will probably have a great influence in future suspension bridge construction. It was the fact that no two twisted cables would stretch exactly the same amount after a period of service which instigated the spinning of cables *in situ*. With pre-stretched cables this defect is now overcome and main cables may be built up much more rapidly and at less cost by hauling across large diameter strands composed of twisted wire ropes.

The east anchorage consists of mass concrete 150 feet high based on rock, and weighs nearly 260,000 tons; other than this, it had few remarkable features, but the westerly one was constructed in two rock tunnels, driven while other work was going on overhead. A shaft and drift were sunk below the tunnels, and, from the drift, excavations proceeded in a diagonal upward direction, the muck gravitated to the feet of the tunnels, and was then removed through the horizontal drift, and hoisted through the shaft.

The contractor for the main piers adopted the unusual course of using open cofferdams, rather than caissons, for this work. Despite an 80-foot hydrostatic head, which necessitated sheet piles 89 feet in length, the operation was quite successful. Rectangular cells built up of steel sheet piling enclosed the 98 x 108-foot pier area across which heavy timber bracing was placed as the water level was lowered. The cells were filled with concrete at the bottom, and rock or sand fill towards the top. There was only one accident when some piles of a cell blew in at the base, but this breach was speedily mended with little trouble.

The cost of the cables alone amounts to nearly $13,000,000, and this contract was awarded to the firm of John A. Roeblings Sons Co., whose name has been associated with wire and cable manufacture for nearly a century. In the year 1843 John A. Roebling constructed the 196-foot Aqueduct bridge in Pittsburgh, one of the first suspension bridges in America, and later he built the Brooklyn suspension bridge, the first one to be built with steel wire cables; also the famous Niagara 800-foot railroad suspension bridge, and his successors have built many more notable ones, and have furnished cables for most of the suspension bridges in the United States.

The speaker gave a few statistics concerning the Hudson river bridge, which are noted below:

Total estimated cost $75,000,000.
Span between main towers 3,500 feet.
Sag of cables between towers 325 feet.
Height above water of towers 635 feet.
Height above water of lower deck 213 feet.
Dead load per lin. ft. 37,000 lbs.
Design live load per lin. ft. 9,000 lbs.
Width of deck 117 feet.
Yearly capacity of upper deck, more than 30,000,000 vehicles.
Estimated amortization period 22 years.
Estimated revenue in 23rd year $12,000,000.
Total weight of cables, 28,000 tons.
Maximum daily rate of cable laying, more than 123 tons.

Messrs. Grant, Little, Gisbourne, Jackson, and others plied the speaker with questions at the close of the meeting, in answer to which he stated that no definite life can be placed on this type of steel structure. The Brooklyn bridge has been in use for over 50 years, and is now safely carrying more than its designed load; the steel work in the roof of the Madison Square Garden had not been painted for 40 years, and yet a recent examination showed it to be in perfect condition. With proper design and careful maintenance, steelwork has an unlimited life.

In Mr. Skinner's opinion, no esthetic advantage will be gained by encasing the steel towers with concrete as proposed. Such a casing would be unlikely to crack, as the cables are not moored to the towers, and therefore any tower movement due to expansion or contraction will be but slight. The rise and fall of the deck due to temperature changes will be several feet. The bridge will be opened to traffic with one deck only in 1932; a lower deck and stiffening trusses will be added at some later date.

At the conclusion, president A. J. Grant, M.E.I.C., and Walter Jackson, M.E.I.C., moved and seconded a vote of thanks. This was tendered to the speaker by E. G. Cameron, A.M.E.I.C., who was in the chair.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

The Engineer in Japan

A popular illustrated lecture was given by the Ottawa Branch in the lecture hall of the National Museum on the evening of April 16th, 1930, at which John Murphy, M.E.I.C., of the Department of Railways and Canals, delivered an illustrated address entitled "A Trip to Japan." The meeting was presided over by J. E. Noulan Cauchon, A.M.E.I.C., in the absence of John McLeish, M.E.I.C., the regular chairman of the Branch.

Mr. Murphy during the autumn of 1929 was the official representative of the Railway Commission and of the Department of Railways and Canals at the World Engineering Congress and the World Power Conference meetings which were held at Tokyo at the same time that the meetings of the Relations Conference were being held in Kyoto. During the course of his address Mr. Murphy related incidents in connection with these various conferences. Three thousand delegates from all parts of the world attended the engineering meetings, the Japanese engineers themselves taking a very active part in all the proceedings. Nine hundred technical papers, prepared in thirty different countries and dealing with every branch of engineering and allied undertakings, were presented.

The visiting delegates were welcomed by members of the Imperial Japanese family, the Prime Minister and his cabinet, as well as by a small army of Japanese engineers and their families. Their stay was made pleasant by the residents, as well as profitable. Free railway transportation was presented to the delegates and their families over the 8,300 miles comprising the government railway system.

The organizing abilities of the Japanese were well illustrated by the manner in which all matters relating to these most extensive conferences were arranged. The extent of the conferences may be realized when it is stated that concurrently 14 sectional sessions took place during the ten days of meeting. An immense amount of work was accomplished, and the "proceedings" will constitute a great engineering library of the world's present up-to-date practice.

Nor was the social side of the conference neglected. In all, there were some 91 functions—receptions, garden parties, musicales, theatre parties, luncheons, dinners and various forms of Occidental entertainment. A unique feature, for instance, of the garden parties was the millions of chrysanthemums which were on display in the public park during the course of the sessions.

The reconstruction work in Tokyo and Yokohama, stated Mr. Murphy, has been carried out with great completeness and has made these two cities marvels of beauty. Of the disastrous earthquake and fire of seven years ago few traces are left.

Many of the beautiful hand-coloured lantern slides exhibited by Mr. Murphy of Japan and her people created as much interest as his references to the engineering meetings.

It is worthy of note that all the proceedings at the meetings were carried on in the English language. The study of English is compulsory in the schools. Even the "stop" and "go" traffic signals used on the streets and the names of all the railway stations are posted in English.

In conclusion Mr. Murphy stated that engineering and educational progress in Japan are equal to that of any other country anywhere. Many of their young men have visited other parts of the world and by energetic study and apprenticeship have acquired a marvellous store of knowledge relating to all walks of life. These men are now working with great success for the glory of their island empire.

Industrial Development of the Sudbury Area

At a noon luncheon at the Chateau Laurier on May 8th, the guest speaker was Mr. E. A. Lapierre, member of Parliament for the constituency of Nipissing in the House of Commons for the past ten years and for the past thirty-five years a resident of northern Ontario. John McLeish, M.E.I.C., chairman of the local Branch of The Institute, presided and among the guests at the head table was R. J. Durley, M.E.I.C., of Montreal, secretary of The Institute.

Mr. Lapierre stated at the commencement of his remarks that possibly no other mineral area had commanded greater attention, not only from mining men but also from financiers, industrialists and those engaged generally in commercial pursuits, than had the Sudbury basin. The first recognition of the possibilities of this region was given in a report of the Geological Survey, then under the directorship of William Logan, later Sir William Logan, in 1857. This report was by Alexander Murray who found copper at a point indicated by S. C. Salter, Ontario provincial land surveyor, who was engaged on meridian line surveys in the vicinity.

Mr. Lapierre then traced the development of the mining area. At the time of the construction of the Canadian Pacific Railway, in 1883, the vicinity of the present Murray mine was reached. Traces of mineralization had been found in the neighbourhood while the construction was going on, which gave rise to the aforesaid Murray mine. This mine was most spectacular in its development but was overshadowed later by the Creighton mine. These and other mining properties passed successively through different hands and some were abandoned.

In the early days of the Sudbury basin the country was looked upon almost entirely as a copper producing area. But as nickel began to be used more and more as an alloy in the manufacture of steel, the nickel-producing feature of the district assumed a greater importance and abandoned copper properties became active as nickel producers.

The speaker referred to the importance of nickel in the manufacture of armaments during the War and recalled the exploit of the German submarine "Deutschland" which in 1916 took over to Germany a cargo of nickel for use in armament manufacture, repeating the performance four or five months later.

At this time the British Government decided to take an interest in and to finance the construction of an extra refinery in Canada, under a company known as the British America Nickel Company. On account, however, of a cutting down of the prospective demands for nickel, looking forward to a World Disarmament Conference and also on account of the high cost of labour, the operations were carried on at a loss for one year and as a result the British America Nickel Company closed its doors. Shortly afterward the International Nickel Company curtailed their operations considerably.

Fortunately, however, the future of this great industry was not entirely lost sight of. Immense sums of money were spent in experimentation, the results of which have transformed an industry from one of war purposes to one of ordinary peace-time business.

In investigating properties that had been abandoned, no more spectacular discovery as the result of diamond drilling has been made than in the old abandoned Frood mine. Following upon this, other investigations have been made and discoveries have taken place on properties which a generation ago would not have been considered of any potential value. The International Nickel Company have been finding the demand for monel metal has been increasing, so that it has been decided to retain the Creighton mine and re-open the Frood mine as further supplies. At a depth of 2,800 feet at the latter mine it was realized from a study of the cores from the drills that this mine possessed the richest single copper ore body on the American continent.

This extraordinary occurrence gave rise to further diamond drilling on the adjoining property with a result that the reserves of copper ore under the combined holdings of the two properties are the largest on the American continent. These spectacular developments give a feeling of permanency to the Sudbury region and ensure its place as one of our largest mining centres.

Figures were quoted regarding expenditures already made due to the mining activities of the Sudbury region, Sudbury itself as a result having grown in recent years from a population of 9,000 to 18,000.

The speaker thereupon expressed the hope that the new discoveries taking place from time to time are merely sign-posts of what the future will bring. For instance, only within the last week or so, stated the speaker, important discoveries have taken place, the importance of which have not yet been fully realized. Samples of norite and schist have been brought in by prospectors from a certain region in the vicinity of Sudbury that have been found upon analysis to contain cinnabar and mercury itself in a metal form. The samples showed 2.54 per cent of mercury which gives a market value to the ore of $70.20 per ton.

From 1896 to 1907 there was considerable agitation for the refining of the copper nickel ores in Canada. Ores mined by the Canadian Copper Company were partially refined at Sudbury and then forwarded in a matte form to New Jersey where they were completely refined by the Orford Copper Company. The International Nickel Company decided to build at Port Colborne a refinery for the treatment of these ores and millions were spent for this purpose.

Coming now to the future of northern Ontario, Mr. Lapierre elaborated upon the great possibilities of the pre-Cambrian shield of northern Canada. He referred to the opinion expressed by Dr. Corliss who stated that Canada holds within this pre-Cambrian formation the greatest potential wealth of all our natural resources and that the time is not far distant when mining in Canada will have superceded agriculture as the greatest source of Canada's natural wealth.

On the eve of this development, Canada with over 90 per cent of the world's nickel—having long since out-distanced New Caledonia in nickel production—holds a pre-eminent position in regard to nickel production. The mines with depth reveal a tremendous increase in copper content as seen by the production of the Frood mine. The speaker stated that within the city of Sudbury undoubtedly the next three or four years would witness the greatest transformation ever seen in any northern Ontario city.

The future which he saw in Sudbury itself would be repeated in other sections of northern Canada, particularly in northern Manitoba, Quebec and British Columbia.

Peterborough Branch

S. O. Shields, Jr.E.I.C., Secretary.

B. Ottewell, A.M.E.I.C., Branch News Editor.

Aluminum

At the regular meeting of the Branch held April 10th, 1930, Mr. H. H. Richardson, chief of the technical staff of the Aluminum Company of Canada, Limited, gave an address on the "Development of Aluminum as an Engineering Material."

Spectacular applications like its use for aircraft construction have advertised the case of aluminum and its alloys so that it has long since outgrown the cooking untensil field.

Aluminum alloys are available with strengths comparable to soft steels. However in its application the burden of proof is on the aluminum manufacturer, since the average engineer is not prone to make use of materials of which he has very little knowledge and experience.

When investigating the use of aluminum there are two vital points of interest, viz., the methods used by the producer and the manufacturing facilities available. Producers of aluminum alloys are prepared to furnish all the data on aluminum alloys that are ordinarily available for steel alloys.

As regards manufacturing facilities, sheets are produced of such a size that 3 make a tank car and structural shapes are rolled identical to those of the steel mill, i.e. 90 ft. long and 12 sq. in. cross section. Aluminum is alloyed, heat treated and worked.

Soft aluminum sheet has a tensile strength of approximately 14,000 lbs. per sq. in. and an elongation of 40 per cent. Cast aluminum has less tensile strength and very much less elongation. By rolling commercially pure aluminum it is possible to increase the tensile strength from 14,000 to 25,000 lbs. per sq. in.

An increase in the strength of castings is obtained by alloying. By adding copper, etc. there is an increase in the casting strength up to 30,000 lbs.

Heat treatment has been practised in both the cast and wrought forms for 8 or 10 years. The heat treatment of aluminum and its alloys is somewhat similar to that of steel. The best heat treated aluminum alloy has a tensile strength of 50,000 lbs. per sq. in. However with the duraluminum type 60,000 lbs. is reached. By heat treating a variety of results are possible. For instance adding 8 per cent copper to aluminum casting gives 20,000 lbs. strength whereas adding only 4 per cent copper and heat treating gives 40,000 lbs.

In the use of structural shapes it is of interest to note that the stiffness depends upon the modulus of elasticity and the cross section used, as a consequence for a given loading it is possible to use lighter beams of aluminum than of steel. Roughly, the saving in weight in truck bodies and railway cars (with aluminum at cost of 20 cents per lb.) results in operating cost reductions so that the added cost is returned in a year.

A hearty vote of thanks was accorded Mr. Richardson for his interesting lecture.

Rural Power Service

The distribution of electricity to the country districts of Ontario was the subject of an address by J. W. Purcell, of Toronto, engineer of the Hydro Electric Power Commission of Ontario, before the Peterborough Branch, April 24, 1930.

Mr. Purcell was introduced by R. L. Dobbin, M.E.I.C., Chairman for this meeting.

Tracing the birth of hydro power back to the year 1902, when a small group of men in Berlin (now Kitchener), who were having trouble with their electric light plant, petitioned Brigadier-General Mitchell to address them on the subject of obtaining power from Niagara Falls, the speaker went on to pay tribute to the memory of Sir Adam Beck, whose foresight and ability has been responsible for the rapid and phenomenal development of hydro power.

From the idea of these men originated the system which supplies power on a co-operative basis. The power turned on in Kitchener in 1910 was 1,000 h.p., and to-day the Commission is generating 1,300,000 h.p. for the whole province. The growth in twenty years has exceeded that of any other industry with the possible exception of the radio and automobile industries.

During 1929, 1,150 miles of rural lines were constructed at a cost of $2,500,000 to serve the needs of 6,700 consumers, bringing the total to 5,280 miles serving 38,000 consumers. The province is doing a great deal for the farmer in order to give him the benefit of cheap electric power. It is hoped thus to prevent or at least reduce, the continual exodus of people from the rural districts to the cities.

The speaker dealt thoroughly with the question of rates and showed how the present low rates to the consumer had been derived. Many fine slides were used to illustrate the address, including statistical data, and photographs of rural lines and installations, showing the many applications of electric power on farms.

After a number of questions had been ably answered by the speaker, V. S. Foster, A.M.E.I.C., conveyed the appreciation of the meeting in a hearty vote of thanks for this interesting address.

Joint Meeting with A.S.M.E. and Toronto Branch, E.I.C.

A new departure was made by the executive of the Peterborough Branch, in the organization of a most successful joint meeting with the Ontario Section of the American Society of Mechanical Engineers and the Toronto Branch of The Institute on Thursday, May 8, 1930.

Under the chairmanship of R. C. Flitton, several sub-committees had charge of the arrangements and the following programme was prepared:

3.00 p.m.—Visitors will meet at the Empress hotel where they will be divided into groups by the excursion committee, according to the excursions they wish to take, as follows:
Plant of Canadian General Electric Co. Ltd.

Plant of Western Clock Company Ltd.
Plant of Quaker Oats Company Ltd.
Plant of De Laval Company Ltd.
Peterborough water filtration plant.
Peterborough lift lock.
5.00 p.m.—Bowling tournament at Duffus' alleys.
7.30 p.m.—Dinner at Empress hotel.
Address by Mr. R. O. Sweezey, M.E.I.C.—"Water Powers."

The visitors to the number of 25 arrived by car about 3 p.m. and were met at the Empress hotel by the reception committee. With the choice of several industrial plants and other points of interest to visit, all elected to see the works of the Canadian General Electric Company. They were received at this received at this plant by Mr. E. G. Patterson, works manager, and were divided into several parties with members of the engineering staff as guides.

In the short time at disposal, a comprehensive tour of the works was undertaken, and the visitors expressed great interest in many special machines and processes.

Following this a 5 pin bowling tournament at the Duffus alleys occupied the attention of the visitors and members, the prizes being graciously provided by the A.S.M.E. executive.

At 7.30 p.m. approximately 125 members and guests gathered at the Empress hotel for the banquet. Prominent guests included R. O. Sweezey, M.E.I.C., president of Beauharnois Power Corporation, Hon. E. C. Drury, former premier of Ontario, His Worship Mayor Denne and numerous ladies.

In view of the prominence of Mr. Sweezey as a water power authority, his address on the Beauharnois development was followed with close interest, and is quoted in part as follows:

Mr. Sweezey said that in 1912 he was sent to western Canada to investigate the possibilities of water power for the western cities. It was a disappointing trip. He found that the rivers in the west, which are fed from the glaciers in the Rockies, drop to a very low point in the winter and are inclined to flood in the summer time. It was not an attractive proposition at all. In 1913 he was attracted by the possibilities on the St. Lawrence river, and wondered why he had gone west, when at Canada's front door existed the greatest water power in the world. He was sent to investigate the stretch of the river between Lake St. Francis and Lake St. Louis, and was amazed at the simplicity with which that stretch could be developed. After some time he found that there were difficulties in the way of development—three difficulties, physical, political and legal.

In discussing the question with engineers he found that while they realized the physical possibilities they would not contemplate the legal and the political difficulties, and when speaking with the politicians or legal men they would stress the physical difficulties. It was difficult to get them to see the same point of view. Men of finance did not wish to undertake any development and the war came along and the matter was shelved. After the war Mr. Sweezey was able to make a deal with the rightful owners of this stretch of water way, and at an expenditure of $100,000 was able to overcome the legal and political difficulties.

The speaker stated that the St. Lawrence river has a drainage area of 300,000 square miles. The stretch between Prescott and Montreal is the neck of the bottle wherein is the greatest water power flow in the world.

It takes only one per cent of water of the St. Lawrence for navigation purposes, and obviously the other 99 per cent is for power. The speaker thought that the greater part of the waterway development has been saddled with too high a cost, and that dams should be paid for in proportion.

Mr. Sweezey continued to speak of the enviable position which Canada holds in the world, which is simply demanding more power, and explained the value of tide water power over inland water power.

In the development of the St. Lawrence, he continued, we are aware of our responsibility resting upon us. We have tried to approach this problem as Canadians in an effort to develop Canada's resources, and there are a great many Canadians who are alive to the importance of this undertaking and are glad to follow us through to a successful conclusion. When we approached the public to finance us just a few weeks after the greatest financial collapse the world has known we set out to sell $30 million securities and were over-subscribed inside of 24 hours.

Since that issue made in December last, half a million found its way into the States, two million to Great Britain, and one million to the continent. We are quite satisfied that in future financing we can place all in Canada. It is an entirely Canadian undertaking.

During the evening an orchestra composed of student members of the Branch provided musical entertainment and the film "There's always room at the top," produced by the Branch, was shown and received with its usual success.

Saint John Branch

A. A. Turnbull, A.M.E.I.C., Secretary-Treasurer.

In an address before the Saint John Branch of The Engineering Institute of Canada on April 10th, 1930, Major E. M. Slader, commanding officer of the 4th Medium Brigade outlined the history of artillery.

Mr. Slader said that artillery may be described as a missile-throwing weapon which even in the ancient periods was very efficient. Both the balista and catapult were then used with the former more efficient than the latter and more effective. The balista was known to throw a stone of 600 pounds a distance of one-half mile.

Speaking of the general construction of artillery, the speaker said that most guns of today were called wire guns, which was true of practically every type of gun in the British service. He stated that the shells formerly were used in mortars but that in the guns no shells were used. In 1824 General Paixham, of the French army, advised the introduction of shell guns. The shrapnel shell was invented in 1805. The first shell was round and it had a base which was set off. The modern shell differs to this inasmuch as it has powder at the base and the bullets spread out cone-shaped.

Up until the time of Galileo, Mr. Slader continued, the principles of the shell in the air was a complete mystery. Galileo discovered the laws of falling bodies and wrote several articles on trajectory. The first man to apply mathematical reasoning to gunnery was Fastaglia. Alexander Robins in his day tested the effect of air resistance on shell and invented the balistic pendulum for measuring muzzle velocity. Up until 1890 all artillery were direct fire, he said, and in the beginning of the present century the matter of indirect fire began to receive attention.

Quoting the great French Emperor, Napoleon, who said that the man who is clever enough to bring an unexpected battery up is the man who will win the day, Mr. Slader stated that this principle was adopted in the last 100 days of the war and proved effective, showing that the artillery played a great part in bringing about victory for the Allies. He spoke also of the final period with the attack of Cambrai when the artillery came as a complete surprise to the Germans.

A vote of thanks, moved by G. N. Hatfield, A.M.E.I.C., and seconded by J. A. W. Waring, A.M.E.I.C., was tendered the speaker by W. J. Johnston, A.M.E.I.C., who acted as chairman.

Annual Meeting

The annual meeting of the Saint John Branch of The Engineering Institute of Canada was held at the Riverside Golf and Country Club on April 28th, 1930. The Entertainment Committee provided us with a turkey dinner for the occasion and we had as guests, The Hon. John B. M. Baxter, Premier of the Province; R. J. Durley, M.E.I.C., General Secretary of The Institute; Mr. O. J. Fraser, Mr. J. S. Hoyt and Major E. M. Slader.

The meeting, which was largely attended, was presided over by W. J. Johnston, A.M.E.I.C., chairman of the Branch. In addition to the toast to the province, toasts to the guests and to The Engineering Institute of Canada were proposed by H. I. Mulligan, S.E.I.C., and C. C. Langstroth, A.M.E.I.C., respectively. E. M. Slader, J. S. Hoyt, O. J. Fraser and W. H. Swift, Jr., responded to the first, as guests of the Branch, while Mr. Durley honoured that to The Institute. The toast to the press was proposed by J. L. Feeney, A.M.E.I.C.

The election of officers for the ensuing year resulted as follows: Chairman, W. J. Johnston, A.M.E.I.C.; vice-chairman, J. N. Flood, A.M.E.I.C.; secretary-treasurer, A. A. Turnbull, A.M.E.I.C. G. A. Vandervoort, A.M.E.I.C., was made a member of the executive committee.

The annual report of the chairman covered the activities of the local Branch during the past year. He made passing mention of the improved business conditions generally throughout the Maritime provinces, in which he pointed out that building permits issued in Nova Scotia for 1929 amounted to an increase of 86.7 per cent over 1928, while an increase of 61.5 per cent was shown in New Brunswick for the same period, and a small increase registered in Prince Edward Island.

Among the various reports submitted during the business session which followed the address was the report of the auditors, submitted by H. I. Mulligan, S.E.I.C.; the report of the executive submitted by the secretary, E. J. Owens, A.M.E.I.C.; the report of the programme and meetings committee by G. A. Vandervoort, A.M.E.I.C.; the report of the entertainment committee by J. H. McKinney, A.M.E.I.C.; the report of the employment committee by J. D. Garey, A.M.E.I.C.; report of the fuel committee by Professor Stephens; report of the salaries committee by S. R. Weston, M.E.I.C.; the report of the publicity committee by J. M. Lamb; the report of the natural resources and engineering industries committee by C. C. Kirby, M.E.I.C.; and the report of the town planning committee by G. G. Hare, M.E.I.C.

A vote of thanks was tendered to the Board of Trade, the New Brunswick Power Company and the press, on motion of J. L. Holman, Jr.E.I.C., and V. S. Chestnut, A.M.E.I.C.

In reply to the toast to the province, proposed by Charles M. Hare, S.E.I.C., Premier Baxter told of the importance and dependence placed in the members of the engineering profession. In praising the work of the skilled engineer, he held out as examples the plant of the Saint John dry dock, the Grand Falls power plant, and the new mills of the New Brunswick International Paper Company at Dalhousie. He also spoke of the engineering skill that would be brought out in the construction of the proposed bridge across the Saint John harbour.

The bridge across the gorge at the falls was a tribute to the late A. R. Wetmore, he said.

Governments everywhere, said Dr. Baxter, are helping the resources through their administration but they are not able to do it without the training of the skilled intellect, and in this connection they must depend upon the judgment of the engineer first, last and for all time.

In connection with the province, Premier Baxter said that some years ago when the finances of New Brunswick were not in the fair state they are today, he believed that there was mineral wealth under the crust of this part of the country that would prove a big reward for the trouble in mining it, and under his administration during the last few years steps had been taken for the encouragement of the development of this industry. While he expressed the hope that mineral value would be found, he was of the opinion that the basic minerals, rather than gold or silver, would prove more beneficial, as they would result in more real development and more employment.

"It is not the intention of any government to undertake themselves to develop the minerals, but in my view a government can help to encourage and assist others in the development," said the Premier.

In an address which dealt with the administration of the Branches and parent body of The Institute, Mr. Durley told of the organization being first launched in London more than a hundred years ago for the purpose of utilizing the great powers of nature for the use of mankind. Speaking of the Canadian Institute, with Branches from Sydney, N.S., to Victoria, B.C., comprising 5,000 members, he gave credit to the Branch officials for a great deal of the success obtained by the parent body.

In connection with the work accomplished during the last year he told of some 200 members having been placed in positions by the employment bureau of The Institute.

He urged for the unification of the examinations of engineers in the various provinces of the Dominion with the view that the results obtained would be beneficial to all, and in this connection reported that a commission appointed by the council of The Institute had made a study of the legislation governing the registration in the different provinces during the last three years, and have been authorized to determine what steps are necessary for a uniform law.

Following the business meeting, cards and a social evening was enjoyed at the club by the members.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting of the Sault Ste. Marie Branch was held in the Y.M.C.A., on April 25th, when Mr. James Govan, registered architect of Toronto, and research engineer for the Gypsum, Lime and Alabastine Company, addressed the meeting on the subject, "Recent Research Studies of Fire, Heat, Sound and Condensation Problems." Previous to the meeting the speaker of the evening and his assistant Mr. Wright were entertained at dinner by the members of the Branch.

In his opening remarks, Mr. Govan gave it as his opinion that we in Canada need to appreciate the influence of our climatic conditions on newcomers to our country. Again, travelling through northern Ontario he was impressed by the number of buildings erected due to some industrial development which had finished and passed on. We should study the probable length of life of a building, for example, the life of a mining town is short and the population not dense. In planning a building, the designer should ask himself how long he wants the building to last. Even in the largest cities where buildings are built of such durable materials as stone, concrete and steel they are soon obsolete. Modern research shows that buildings soon become obsolete and inefficient.

Tests have shown that the most efficient wall in resisting heat flow is one with thin structural material with a thick space filled with a cheap insulating material. The problem then is to make frame materials fireproof. Experiments have been successful in fireproofing with dry material. It has been found that you cannot ignite woodwork behind gypsum until all the water of crystallization has been driven off which requires long and continuous heating at high temperatures. Steel which bends at comparatively low temperatures may be protected by a layer of gypsum.

The speaker showed a number of slides illustrating the efficiency of this heat insulating and fire-proofing which showed that a very great economy in heating may be so obtained.

Experiments in sound-proofing show that the most efficient walls are the stiffest and thickest. A frame wall where material on the side is not in contact with material on the other side even by nailing has proved very efficient.

In concluding Mr. Govan stated that the Gypsum Company deserve great credit for contributing building comfort and safety in Canada.

An interesting discussion followed and a vote of thanks for his instructive talk was tendered Mr. Govan.

Detroit-Windsor Tunnel

On April 30th, at the Y.W.C.A., a special meeting of the Sault Ste. Marie Branch was addressed by Mr. R. B. Value, on the Detroit-Windsor tunnel which is under construction. Mr. Value drew the attention of those present to the special problems and methods of construction in connection with this tunnel which it is expected will be completed about the end of 1930.

Toronto Branch

J. J. Spence, A.M.E.I.C., Secretary-Treasurer.
A. B. Crealock, A.M.E.I.C., Branch News Editor.

It is the usual custom of the Toronto Branch of The Engineering Institute of Canada to close the winter season with the annual meeting, but as a most interesting lecture was available which could not be procured in the fall Mr. Traill, the new Chairman, called an extra meeting for the evening of Thursday, April 24th. The speaker was A. W. K. Billings, M.E.I.C., who gave a very interesting and instructive illustrated address on the water power development of Brazil. He dealt particularly with the south eastern portion which includes Rio de Janeiro, Sao Paulo and Santos which district contains the bulk of Brazil's population and wealth and where Mr. Billing's Company serves all the light, power, tramway, telephone and gas utilities. Mr. Billings also described other remote parts of Brazil where abundant potential power exists but is too far from civilization to be commercially developed.

The most interesting development described was at Serra near Santos, the power house of which is practically on sea level and its storage is on a plateau some 2,400 feet above. The plateau slopes gently inland and is covered with lakes. Dams are being built and pumping equipment is being installed to raise the water from some of the lower inland lakes to the higher ones near the coast. By raising the water 80 feet it becomes available for power under a head of 2,400 feet or a return of nearly 30 times the energy required for pumping.

The meeting was well attended by Institute members and guests, among the latter were several officials of the Brazilian Traction Company and the Mexican Light and Power Company. The lecture was thoroughly enjoyed by all and at the conclusion a hearty vote of thanks was tendered to Mr. Billings.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada
2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Wanted

CIVIL AND MECHANICAL ENGINEER, aggressive practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mill, desires change. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal engineering, construction work, inspection, estimating. Apply to Box No. 107-W.

Situations Wanted

CIVIL ENGINEER, B.Sc., Jr.E.I.C., with general engineering experience in construction, estimating, draughting, preliminary designing and building maintenance, desires position with opportunities. At present employed as buildings supervisor in public utility company. Available on short notice. Apply to Box No. 173-W.

CIVIL ENGINEER. A.M.E.I.C., graduate, R.P.E.P.Q. Twenty years experience surveying and construction hydro-electric, railways, and paper mills, desires position. Will go anywhere if terms satisfactory. Apply to Box No. 294-W.

Situations Wanted

CIVIL ENGINEER, B.A., B.Sc., with six years experience on surveys; layout and construction of hydro-electric works; design of highway bridges and construction of highways; desires position as assistant engineer on design and construction of reinforced concrete and steel structures. Available on short notice. Location immaterial. Apply to Box No. 301-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country; twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Province. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, B.Sc., fifteen years experience, including surveying, construction,

Situations Wanted

mining and tunnelling. Available at once. Will go anywhere, but prefer Eastern Canada. Apply to Box No. 346-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., is open for engagement. Twenty-four years general experience both as engineer and as contractor. Has specialized in the construction of wharves, dams, foundations, etc. Apply to Box No. 358-W.

MINING ENGINEER, graduate, age 32, A.M.E.I.C., ten years experience in design, construction, erection and maintenance of paper mill and mine buildings and machinery. Several years on hydro-electric work in charge of surveys and investigation; desires permanent connection with mining or paper company. Apply to Box No. 362-W.

MECHANICAL ENGINEER, B.A.Sc., Univ. of Toronto 21, A.M.E.I.C., married. Pulp and paper mill maintenance experience: draughting, layout of buildings, machinery and piping, mechanical design. Also experienced in reinforced concrete and steel building design and construction work. Desires position of permanency in plant engineering or maintenance work with reliable organization offering opportunities for advancement. Apply to Box No. 370-W.

CONSTRUCTION SUPERINTENDENT, with twenty-five years experience on hydro-power developments, paper mills and general building construction. Apply to Box No. 372-W.

ELECTRICAL ENGINEER, B.Sc. '23, A.M.E.I.C., experience, estimating pole line, cable and wire layouts, supervising estimates, in charge of cost inventory and appraisal work, in charge of draughting, records and budget control work, instructing engineering principles. Seven years with one company. Four years instructing in electrical engineering at evening classes, desires position along the above lines with opportunities. Best of references. Apply to Box No. 376-W.

STRUCTURAL DRAUGHTSMAN, age 31, well educated, with experience in designing and supervision, desires a change of position and location. Preferably north western Canada. Apply to Box No. 378-W.

CONSTRUCTION ENGINEER, Canadian, speaking and writing French and English, A.M.E.I.C., P.E.Q. Twenty years experience in water power development, roadway, water and sewer works, as engineer in charge or superintendent, desires position. Available on short notice. Apply to Box No. 380-W.

GRADUATE ENGINEER, N.S. Tech. Coll., age 25, desires permanent position with industrial concern. Since graduation has spent two years apprenticeship with Can. Westinghouse Co. Apply to Box No. 382-W.

COST ACCOUNTANT, graduate civil engineer who has specialized in construction costs, desires new connection. Especially familiar with hydro-electric and paper mill construction accounting, including preparation of cost statements, installation of stores and time-keeping systems, etc. Apply to Box No. 389-W.

EXECUTIVE, B.Sc. McGill, M.E.I.C., comprehensive experience, with clean and successful record, desires permanent position, preferably in or near Montreal. Experience covers research, design, installation, operation, purchasing, organization and responsible management. Apply to Box No. 401-W.

CIVIL ENGINEER, B.Sc., '24, Jr.E.I.C., C.P.E.Q., Canadian, age 30, married. Experience: Construction power developments, railways, highways, pulp and paper mills, maintenance pulp and paper mills, railways, desires permanent position with opportunity for advancement. Apply to Box No. 402-W.

Situations Wanted

MECHANICAL ENGINEER.—Any organization which can use the services of an aggressive and practical engineer is requested to open negotiations by communicating with the advertiser. Canadian, university graduate, age under 30. Experience as mechanical superintendent, chief draughtsman, estimating, purchasing, construction, costing, stores control, etc. Qualified for engineering, production, purchasing, sales, or in a business capacity. Accustomed to responsibility, proven ability in the industrial field. Apply to Box No. 406-W.

CIVIL ENGINEER, D.L.S., graduate, experience in surveying, calculating and municipal work, and in charge of office and field parties. Best of references. Apply to Box No. 413-W.

Situations Vacant

RECENT GRADUATE, in electrical or mechanical engineering, for general industrial work. Work part in office and part in the plant. Must be competent to do transit work and levelling in connection with laying out new building sites. Location, Northern Quebec. Apply to Box No. 508-V.

DESIGNING DRAUGHTSMAN. — Excellent opening for right man with large newsprint company, centrally located. Apply, stating age, experience and salary expected, to Box No. 527-V.

ELECTRICAL ENGINEER, recent graduate. One who has taken General Electric or Westinghouse students' course. Apply to Box No. 536-V.

MECHANICAL ENGINEER, with four or five years experience for plant maintenance. Canadian, graduate engineer. Apply to Box No. 541-V.

WATERWORKS ENGINEER, with experience on the design of filtration plants. Please state experience and salary expected in first application. Interviews will be arranged with suitable applicants. Apply to Box No. 543-V.

CHEMICAL ENGINEER, experienced man preferably with college training as chemical engineer, desired to form and organize a control department in a large paper mill. This position will offer great opportunities for the right man. Previous training or experience in research work or control essential. Please state particulars of education, experience, together with salary required. Apply to Box 545-V.

STEAM POWER ENGINEER. Young man with college training and experience in handling of steam power desired to fill permanent position with a large and progressive paper company. Previous experience in analysis and investigation of production and distribution of steam essential. Must be agreeable to start at a reasonable salary. This position offers splendid opportunities with favourable chance for advancement. State particulars, history and salary desired. Apply to Box No. 546-V.

DESIGNING DRAUGHTSMAN wanted by a large pulp and paper mill. Should preferably be a graduate with experience in design of structural steel and reinforced concrete, but pulp and paper mill experience not essential. State in detail age, education, experience and salary desired and when could report and other particulars. Apply to Box No. 550-V.

MECHANICAL ENGINEER OR DRAUGHTSMAN, preferably with experience in rolling mills, wire drawing and cabling machinery, for position as draughtsman in plant manufacturing cable. Location eastern Quebec. Apply to Box No. 551-V.

MECHANICAL ENGINEER, with machine shop training, to take charge of the Montreal sales office of a well known company

Situations Vacant

manufacturing gears, speed reducers, flexible couplings, and silent chains. Must be well recommended. Apply to Box No. 552-V.

SALES ENGINEER, with knowledge of and experience in the heating and power plant field. Salary and commission. State age, experience and qualifications to Box No. 553-V.

DRAUGHTSMEN—one or two draughtsmen experienced in general pulp and paper mill work and construction, for a company in the province of Quebec. Apply at once to Box No. 554-V.

MECHANICAL DRAUGHTSMAN AND DESIGNER wanted by large pulp and paper mill. Should have technical education and mechanical experience, but pulp and paper mill experience not essential. State in detail, age, education, experience, and salary desired, and when could report and other particulars. Apply to Box No. 560-V.

ELECTRICAL ENGINEER, preferably graduate Canadian university, with test floor experience. Opening offers permanent employment for right applicant along lines of plant maintenance and with every possibility of considerable new construction work in the near future. Please give complete information in first letter, stating age, experience, and salary expected, to Box No. 561-V.

MECHANICAL ENGINEERS. Two young graduate engineers with sales ability wanted by a well-known Canadian company. Apply, giving full particulars, to Box No. 562-V.

DRAUGHTSMEN, with three or four years experience in design of machine parts and piping layouts, for a company in the province of Quebec. Apply at once giving particulars of experience, to Box No. 563-V.

TOWN ENGINEER, for a town in Maritime Provinces. Electrical and civil engineer, or electrical engineer with sufficient knowledge of civil engineering to take charge of water and sewerage system, building of roads and sidewalks, etc. Must be able to speak French. Apply to Box No. 565-V.

INSTRUCTOR—Wanted for a technical high school, in western Canada, an instructor in electricity, capable of handling either shop work or theory, duties to begin September 1, 1930; Canadian preferred; salary $1,800 to $3,300. State qualifications, including details of academic standing and practical training, also teaching experience, if any, and present position. Applications received up to June 24th, 1930. Apply to Box No. 566-V.

STRUCTURAL ENGINEERS, wanted in B.C. for the positions of structural engineer, structural senior assistant engineer, and structural assistant engineer, experienced in the design of reinforced concrete and steel structures. Applicants not holding a B.C. Engineering Act license will be eligible subject to their qualifying for registration. Apply to Box No. 568-V.

MINING ENGINEERS—Graduate mining engineers. Applications from young mining engineers able to do surveying surface and underground in B.C. Apply to Box No. 569-V.

TECHNICAL GRADUATE, for work in concentrating mill. Applicants will be expected to qualify for intermediate or final registration under terms of the Engineering Act of B.C. Apply to Box No. 570-V.

SQUAD LEADERS—Two or three assistant engineers as squad leaders in making plans for large transoceanic pier in B.C. Should be Canadian college graduates. Expected to carry out such design as may be assigned by designing engineer, and oversee preparations of plans, and well founded in structural mechanics and in particular reinforced concrete and steel design. Apply to Box No. 571-V.

Preliminary Notice

of Applications for Admission and for Transfer

May 22nd, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in July 1930.

R. J. Durley, *Secretary.*

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* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for a least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDERSON—WILLIAM GALLOWAY MACDONALD, of 1194 Mackay St., Montreal, Que., Born at Glasgow, Scotland, Feb. 27th, 1905; Educ., 1921-25, Technical College, Dundee, and St. Andrews Univ.; A.M.I.C.E.; 1921-24, ap'tice engr. to Robert Killie & Son Ltd., Dundee; 1925-29, chief asst. engr., to the Dundee Waterworks Engr.; 1929-30, field engr. on constrn. of alterations and additions to Corner Brook, Nfld., paper mill, by W. I. Bishop Ltd.; Mar. 1930 to date, asst. engr. to W. S. Lea, M.E.I.C., Consltg. Engr., Montreal.
References: A. B. McEwen, S. H. Hawkins, H. A. Morey, W. I. Bishop, R. S. Lea.

ANDERSON—YNGVE RAGNVALD, of Prince Albert, Sask., Born at Kennedy, Minn., U.S.A., Apr. 30th, 1902; Educ., B.E., Univ. of Sask., 1924; 1922, instr'man., Sask. Dept. of Highways; 1923-24, ceramic work, Dominion Fire Brick & Clay Products, Ltd., Claybank, Sask.; 1924-25, ceramic lab. and plant work, Evans & Howard Fire Brick Co., St. Louis, Mo.; 1925-26, foreman in charge of dept. mfg. hand moulded refractory shapes, and 1926-27, engr. on constrn. of modern fire brick plant with railroad tunnel kiln, for same company; 1927-28, ceramic engr. i/c production and new constrn. at plant of The Dominion Fire Brick & Clay Products Ltd., Claybank, Sask.; 1928-29, instr'man. and i/c party on land surveys, mining claim surveys, municipal engrg. and sewerage works with Underwood & McLellan, Consltg. Engrs., Saskatoon, May 1929 to date, ceramic engr. and manager in charge of Prince Albert Branch of The International Clay Products Ltd., of Estevan, Sask.
References: J. E. Underwood, C. J. Mackenzie, W. G. Worcester, H. B. Brehaut, J. J. White.

ANDREWES—WILLIAM EDWARD, of Halifax, N.S., Born at Beamsville, Ont., Oct. 28th, 1902; Educ., 1920-24, R.M.C., B.Sc., McGill Univ., 1927; 1927-29, School of Military Engineering, Chatham, England; March 1929 to date, Lieut., Royal Canadian Engineers, Halifax, N.S.
References: J. L. H. Bogart, F. R. Henshaw, H. L. Sherwood, H. M. MacKay, J. Weir, R. DeL. French.

DURNIN—EDWARD JAMES, of 27 Holton Avenue So., Hamilton, Ont., Born at Dauphin, Man., Mar. 3rd, 1903; Educ., B.Sc., Univ. of Man., 1928; 1923-27, aviation with Royal Can. Air Force; 1928 to date, ap'ticeship course, Canadian Westinghouse Co. Ltd., Hamilton, Ont.
References: W. F. McLaren, G. W. Arnold, E. P. Fetherstonhaugh, C. J. Mackenzie, N. M. Hall.

ELLIS—NORMAN THOMAS, of Qualicum Beach, V.I., B.C., Born at Erdington, England, Nov. 8th, 1888; Educ., 1902-06, King Edwards College, Birmingham. London Matric., 1915; School of Military Engrg., Chatham, Eng.; Member, Assn. Prof. Engrs., B.C., 1921; 1908-11, chainman, rodman, instr'man., roads, irrigation lands, etc.; 1911-13, rodman and instr'man., 1913-14, dftsman. and asst. to divn. engr., C. Nor. Rly.; 1915-19, Royal Engrs., Major, M.C. and Star; 1920-21, various survey and engrg. work; 1921-23 (seasonal), topographic and triangulation work, Yukon Territory, Dom. Govt.; 1924, asst. engr., rlys. and bridges, Thomsen & Clark Timber Co., Vancouver Is., B.C.; 1924-27, topographic and triangulation work, Yukon Territory, Dom. Govt.; 1927 to date, res. engr., Thomsen & Clark Timber Co., Bowser P.O., Vancouver Is., B.C.
References: D. O. Lewis, E. F. Cooke, C. C. Lindsay, A. L. Carruthers, E. A. Wheatley.

EVANS—CHARLES DURWARD, of Montreal, Que., Born at Brownsburg, Que., Apr. 2nd, 1902; Educ., B.Sc., McGill Univ., 1924; 1921, tracing, Public Service Corporation, Montreal, and rodman, Walter J. Francis & Co., at Price, Que.; Spring 1922, rodman, Pringle & Sons, on Back River, Montreal; 1924-25, asst. supt. of gas divn., Quebec Power Co. Ltd., Quebec; 1926-29, dftsman., Fraser Brace Engineering Co. Ltd., Montreal, and from May 1929 to date, with same company at Refinery Contract, Copper Cliff, Ont.
References: C. M. McKergow, F. S. Keith, J. B. D'Aeth, T. W. W. Parker, P. C. Kirkpatrick, G. H. Kingan.

FYFE—ROBERT JOHN, of 3079 Angus St., Regina, Sask., Born at Kincardine, Ont., Jan. 18th, 1891; Educ., 1912-15, Univ. of Sask.; 1915-19, overseas; 1912-15, survey work, rodding and chaining; 1919-21, chief dftsman. and instr'man., city engr's. dept., Regina, Sask.; 1921-29, with Sask. Prov. Govt., as follows: 1921-23, highway engr., supervision constrn. under contract; 1923-25, highway inspr., supervision constrn. market roads and small bridges; 1925-27, prov. supt. of highways and chief mtce. engr.; 1927-29, highways supt.; at present, managing director, R. J. Fyfe Ltd., 200 Broder Bldg., Regina, Sask., selling engineers' and contractors' equipment.
References: C. J. Mackenzie, H. S. Carpenter, D. A. R. McCannel, H. R. MacKenzie, L. A. Thornton.

GUILDFORD—JOSEPH REUBEN, of 2870 Robinson Street, Regina, Sask., Born at London, England, April 22nd, 1885; Educ., ap'ticed to plumbing and heating trade, 1898-1903; I.C.S., 1912-14; 1903-04 (London, Eng.), 1904-12 (Canada), journeyman steamfitter; supt., 1912-14; 1914-15, estimator and engineer, A. B. Gehri & Co., Tacoma, Wash., U.S.A.; 1915-20, estimator and engr., Bergh Griggs Co., Tacoma, Wash.; 1920-22, Federal Heating Co., Washington, D.C. With the following plumbing and heating contractors—1922-27, Casey & Co., Washington; 1927-28, Cotter Bros., Winnipeg; 1929, Vagg, Wilson Co., Regina; Jan. 1930 to date, heating, ventilating and sanitary engr., with offices at 412 Westman Chambers, Regina, Sask. (While in Canada, in addition to above, designed the plumbing, heating and power plant for the Prince Albert Sanatorium for the Prov. of Sask. At present consltg. engr. for Regina Public School Board, etc., etc.)
References—R. N. Blackburn, J. N. deStein, T. Inglis, J. H. Puntin, M. W. Sharon, E. W. M. James, J. M. Morton, W. H. Stuart.

MacCARTHY—HENRY BLAIR, of Ottawa, Ont., Born at Ottawa, June 7th, 1906; Educ., B.Sc., McGill Univ., 1928; 1926 (summer), steelman, Fraser Brace Co., at Farmers Rapids; 1927 (summer), operator, Can. Electro Products, Shawinigan Falls; 1928 to date, surveying and estimating for water power developments with Gatineau Power Company, Ottawa, Ont.
References: G. G. Gale, W. Blue, R. H. Reid, E. Brown, R. DeL. French.

MACLEOD—ERNEST M., of Grand Mere, Que., Born at Cleveland, N.S., Dec. 26th, 1899; Educ., B.Sc. (E.E.), N.S. Tech. Coll., 1926; 1926 (June-Oct.), wheelman and control operator, St. Maurice Power Co.; Oct. 1926 to May 1927, elect'n., Shaw. Water & Power Co.; May 1927 to Jan. 1928, relay and meter wireman, Shaw. Engrg. Co.; 1928 (Jan.-Nov.), relay wireman, Gatineau Power Co.; Nov. 1928 to May 1929, supervising relay install'n. at Paugan Falls and May 1929 to Feb. 1930, asst. engr., substation constrn., Hawkesbury, Ont., for same company; Feb. 1930 to date, control wireman, Shaw. Engrg. Co., Grand Mere, Que.
References: F. R. Faulkner, W. F. McKnight, A. W. Gregory, A. Sutherland, H. K. Wyman, R. E. Heartz.

RAMSTAD—IVAR ASBJOERN, of St. Michel des Saints, Que., Born at Ullensaker, Norway, April 17th, 1901; Educ., Civil Engineer, Technical University of Norway, 1928; 1928-29, asst. to chief engr., M/S "Tennessee"; 1929-30, levelman, transitman and gen. dftsman. on transmission, for the Shawinigan Engineering Company, at present, gen. dftsman. on constrn. of Mattawin storage dam, St. Michel des Saints, Que.

References: C. R. Lindsey, H. B. Montizambert, J. W. H. Ford, H. K. Wyman, J. A. McCrory.

STAIRS—DENIS, of Montreal, Que., Born at Halifax, N.S., May 3rd, 1889; Educ., Bach. Engrg., Dalhousie Univ., 1909. Special course in geology, Mass. Inst. Tech., 1920; 1909-12, asst. to res. engr. on constrn. of Stave Falls plant of Western Canada Power Co.; 1912-14, constrn., Acadia Sugar Refinery, Halifax; 1914-19, overseas; 1919-21, constrn. engr., and 1921-22, manager, Keeley Silver Mines, Ltd.; 1922-30, with Montreal Engineering Company, Montreal. At present chief engineer. (Member, Chats Falls Engineering Board).

References: C. W. Allen, G. A. Gaherty, J. T. Farmer, A. C. D. Blanchard, R. W. Tassie, J. H. McLaren.

WALLACE—DAVID GUNMELL, of Pointe Claire, Que., Born at Newmilus, Ayrshire, Scotland, Nov. 17th, 1901; Educ., B.Sc., Glasgow Univ., 1926. Grad. Inst. M.E., 1927; 1920-25, training in fitting and erecting shops, gen. shop practice, with Glenfield & Kennedy, Kilmarnock, Scotland; 1925-28, drawing office training with same company—design and detail of waterworks fittings, pipe lines, etc., estimating, design and detail, hydraulic dock and pumping machy., sluice and regulating gates for irrigation schemes, and operating machinery for same; 1928-29, design and layout of chemical plant and plant structures, checking contractors designs, Synthetic Ammonia & Nitrates Ltd., Stockton-on-Tees, England; 1929 to date, designing engr., sluice gates, head gates, regulating gates for hydro-electric power developments, for Dominion Bridge Co. Ltd., Lachine, Que.

References: F. Newell, F. P. Shearwood, R. M. Herbison, D. C. Tennant, R. H. Findlay.

WILSON—WILLIAM FAIRBAIRN, of Winnipeg, Man., Born at Banff, Scotland, Sept. 10th, 1880; Educ., B.Sc., Univ. of St. Andrews, Scotland, 1900; Military College, Sandhurst; With Indian Army as follows: 1901-02, instr'man. and later i/c party, topog'l. survey of the Chitral Valley; 1903-04, R.R. location, i/c party, Peshwar to Jamrud; 1904-05, rld. constrn. on location above named; 1906-07, locating, designing and constructing bridge at Chapun; 1907-08, bridge constrn. at Mari; 1908-10, designing and constructing magazines at Pindi and Lahore; Retired in 1910 with rank of Capt.; 1911-12, i/c of constrn. of water and sewer system at Moose Jaw, Sask. for Doulton Company, London, Eng.; 1912-14, i/c of party on survey in Churchill Valley, with Proudfoot & Co., D.L.S.; 1914-16, with B.E.F. in France, invalided 1917. Until 1924, war disabilities and unattached; 1924 to date, inspr., ways and structures dept., Winnipeg Electric Company, Winnipeg, Man. (constrn. or reconstrn. of street rly. tracks, mtce. or constrn. of bldgs.).

References: E. V. Caton, A. W. Fosness, W. F. Hobbs, F. H. Martin, J. C. Street.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

BISSELL—HAROLD RUDOLPH, of Stirling, N.S., Born at Trenton, Ont., Aug. 11th, 1896; Educ., B.Sc., 1922, M.Sc., 1923, McGill Univ.; Summer work: 1917, mill work, McIntyre Mines, Ltd.; 1919, underground work, McIntyre Mines Ltd. and Hollinger Mines Ltd.; 1920, i/c topog'l. survey, City of Toronto; 1921, underground work, Dominion Coal Co.; 1922, i/c exploration and mining survey, Northern Quebec; Fall 1921, transitman, Toronto Transportation Commn.; 1923-24, asst. gen. supt., Eustis Copper Mine; 1924-27, efficiency engr., Copper Queen Mine, Bisbee, Arizona; 1927-28, mine supt., Tetreault Mine, 1928-29, manager, Tetreault Mine, and 1929 to date, manager, Stirling Mine, all for the British Metal Corporation (Canada), Limited.

References: J. P. Cotter, S. C. Mifflen, E. L. Ganter, A. L. Hay, W. E. Clarke.

HUGHES—CHESTER ARTHUR, of St. Paul, Minn., U.S.A., Born at Toronto, Ont., Sept. 20th, 1895; Educ., B.A.Sc., 1920, M.A.Sc., 1922, Univ. of Toronto; Following positions held for about 5-month periods (vacations, Univ. of Toronto); 1912, chainman, dept. rlys. and bridges, city hall, Toronto; 1913-15, rodman, dept. of work, city hall, Toronto; 1919, instr'man., Toronto Harbour Commn.; 1920-27, instructor, Dept. Civil Engrg., Univ. of Toronto; 1921-23-25, engr., arch'ts. dept., city hall, Toronto; 1926, engr., Canadian Concrete Ltd. and Toronto Brick Co.; 1927-28, research on welded joints with Prof. Peter Gillespie, M.E.I.C.; 1927 to date, asst. prof. of struct'l. engrg., University of Minnesota, Minneapolis, Minn.

References: C. R. Young, W. B. Dunbar, P. M. Thompson, A. G. Dalzell, W. L. Sagar.

CHISHOLM—JOSEPH DONALD, of Montreal, Que., Born at Antigonish, N.S., March 17th, 1897; Educ., B.Sc., McGill Univ., 1923; 1923-24, Canadian Westinghouse test course; 1924-25, engr. on elect'l. design, Nfld. Power & Paper Co. Ltd., Corner Brook, Nfld.; 1925-26, engr. on elect'l. constrn. and operation with same company; 1926-27, asst. to elect'l. engr. on elect'l. design, Lake St. John Power & Paper Co.; 1927-28, asst. to elect'l. engr. on elect'l. constrn. and operation for same company; 1928-30, elect'l. engr. on design, erection and test paper mill gear, Harland Engineering Co. Ltd., and at present sales engineer with same company.

References: R. N. B. Norris, J. Stadler, C. M. Bang, H. C. Brown, C. V. Christie.

RICHARDSON—RODERICK McDOUGALD, of 24 Patterson Ave., Ottawa, Ont., Born at Eureka, N.S., Apr. 19th, 1896; Educ., B.A. Dalhousie Univ., 1922. B.Sc., McGill Univ., 1924; Summers 1919-23, erection and mtce. of electr'l. machy., power house engr., Intercolonial Coal Mining Co., Westville, N.S.; 1924 to date, with Bell Telephone Company of Canada as follows: 1924-25, asst. field engr., Montreal divn.; 1925-26, mtce. foreman, constrn. dept., Montreal divn.; 1926-27, district engr., Montreal divn.; 1927, coast supervisor, coast dept., Montreal divn.; 1928-29, divn. foreman, Eastern div.; At present divn. constrn. supt., Eastern Ontario divn., Ottawa, Ont.

References: J. A. Loy, A. M. Mackenzie, C. V. Christie, W. P. Copp, B. E. Bayne, G. A. Wallace, W. H. Slinn, G. M. Hudson.

SAINT LAURENT—ADRIEN ARTHUR, of Ottawa, Ont., Born at Winnipeg, Man., Apr. 5th, 1893; Educ., Ashbury College, Ottawa, 1910-13, senior matric.; I.C.S. Private tuition, maths.; 1910, 11 and 13, rodman, etc., Sask. R. Survey and Bay des Chaleurs Survey; 1912 (4 mos.), inspr. of struct'l. steel, Can. Inspection & Testing Labs.; 1914-15, asst. engr. at headwaters of Sask. River, investigation and hydrographic work, office work in Prince Albert, Sask.; 1915-16 (5 mos.), office work in Upper Ottawa River, storage, computing plotting, etc.; 1916-19, overseas. 1916 (Mar.-Oct.), work in England and Scotland, instal'n. of electric plants and special machy., timber bridge bldg., road bldg. and upkeep; Oct. 1916 to Mar. 1917, in France as staff orderly officer, i/c technical stores; Mar. 1917 to July 1919, inspection officer of No. 2 district machine shops, July 1917 acting O.C. of same. Mech'l. design, constrn. and repairs of all kinds. Install'n. of electric power plants and power systems, also water systems. Upkeep of plant, also surveys and layout of bldgs.; 1919 (July-Aug.), rld. work, for Bartram & Morrison; 1919-27, junior engr., survey, design and constrn. work, also office work, and from 1927 to date, asst. engr., on staff of dist. engr., Public Works Dept., Ottawa, Ont.

References: K. M. Cameron, R. deB. Corriveau, C. R. Coutlee, H. M. Davy, J. E. St. Laurent, J. E. Larochelle.

STILES—RAYMOND DONALD, of Swampscott, Mass., Born at Pictou, N.S., Apr. 30th, 1893; Educ., S.B. in Mech. Engrg., N.S. Tech. Coll., 1921; Summers: 1918, instr'man. on layout of temporary barracks and pipe line, Bate McMahon & Co.; 1919 and 1920, repair man, pneumatic tools, Eastern Car Co.; Aug. 1921 to Jan. 1922, appraisal of properties of N.S. Tramways & Power Co. for Jackson Moreland Co., Boston; May 1923 to June 1924, station operator i/c steam generating power stn., including operation of switchboard, reciprocating engines, turbines and generators, Cape Breton Electric Co., Sydney, N.S.; 1924 to date, asst. engr. on instrument transformers, General Electric Company, Lynn, Mass., asst. on design, also engrg. work in respect to shop problems on production of new designs.

References: F. R. Faulkner, K. L. Dawson, H. R. Theakston, C. M. Smyth.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BASTABLE—ROSS WALLER, of 96 44th Ave., Lachine Que., Born at Lachine, June 24th, 1900; Educ., B.Sc., McGill Univ., 1922; Summers 1920 and 1922, mech'l. dept., Dominion Bridge Co.; 1923-25, mech'l. design work, John S. Metcalf Co., grain elevator engrs.; 1925 to date, with Bell Telephone Company of Canada as follows: 1925-28, bldg. mtce. work, heating, etc.; 1928-30, supervisor of bldgs., western divn.; At present, supervisor of bldgs., eastern area.

References: H. Rolph, F. Newell, J. L. Clarke, S. Bonneville.

BOWN—WILLIAM EDMUND, of 11 Aukerville St., Sydney, N.S., Born at Sydney, Feb. 13th, 1902; Educ., B.Sc., McGill Univ., 1923; 1918-19, and summers 1920-24, with Dom. Iron & Steel Company, Limited, and from 1924 to date, asst. supt., coke oven dept. of same company, at Sydney, N.S.

References: K. H. Marsh, A. P. Theuerkauf, R. R. Moffatt, F. W. Gray, W. S. Wilson.

GILMOUR—WILLIAM ALEXANDER TURNER, of 80 Markland St., Hamilton, Ont., Born at Hamilton, Apr. 11th, 1903; Educ., B.Sc. (Mech.), 1925, B.Sc. (Elec.), 1926, McGill Univ.; 1924 (summer), Prov. of Ontario survey, Fort Francis to Kenora; 1925 (summer), inspr. on cement roadwork for county of Wentworth; 1926-28, dftsman., 1928 to date, chief dftsman. and engr., Smart Turner Machine Co. Ltd., Hamilton, Ont.

References: H. A. Lumsden, W. F. McLaren, W. L. McFaul, H. U. Hart, H. Crombie, A. R. Roberts, C. M. McKergow.

MacDONALD—ERVIN D., of Montreal, Que., Born at Milford Station, N.S., Sept. 16th, 1901; Educ., B.Sc., N.S. Tech. Coll., 1924; 1924-25, with B. F. Sturtevant Co., Hyde Park, Boston, Mass., and 1925-26, asst. to district mgr., for same company at Hartford, Conn.; 1927-29, designer and checker, De La Vergne Machine Co., New York, N.Y., and I. P. Morris & De La Vergne Inc., Philadelphia, Pa.; 1929 (Apr.-Oct.), designer, Chicago Pneumatic Tool Co., Franklin, Pa.; Oct. 1929 to date, with McDougall & Friedman, as designing engr., 1221 Osborne St., Montreal, Que.

References: F. J. Friedman, G. K. McDougall, C. P. Creighton, F. R. Faulkner, W. F. McKnight.

POUND—WILLIAM THOMAS, of Sturgeon Falls, Ont., Born at Kingston, Ont., Sept. 6th, 1907; Educ., B.Sc., Queen's Univ., 1929; Summers: 1925, operator on electric furnace and general smelter work, Delora Smelting & Refining Co., Delora, Ont.; 1927, radial drill operator, and assembly shop work, Canadian Locomotive Works, Kingston, Ont.; 1928, engrg. dftsman., at Howard Smith Paper Mills Ltd., Cornwall, Ont., gen. mill install'ns., mtce. work and filing systems; April 1929 to date, engrg. dftsman., Abitibi Power & Paper Co. Ltd., Sturgeon Falls Divn., Sturgeon Falls, Ont., mill install'ns., revisions, mtce., etc.

References: J. V. Fahey, L. T. Rutledge, D. M. Jemmett, A. Macphail, D. S. Ellis.

ROCHESTER—BERTRAM COLE, of Montreal, Que., Born at Ottawa, Ont., April 11th, 1899; Educ., B.Sc., McGill Univ., 1923; 1916-19, overseas, C.F.A. and R.A.F.; 1920-21, Ontario timber investigation; 1922, valuation of Ottawa Electric Ry.; 1923-28, with English Electric Co. of Canada, from 1925-27 as chief estimator, and from 1927-28, on Montreal District Sales; 1928 to date, Montreal manager, for McCarthy & Robinson, in charge of eastern sales, including the following companies, Wellman-Seaver-Morgan Co. of Cleveland; Dominion Bridge Company (sales representatives for Ontario on cranes); Electric Controller & Mfg. Co., Cleveland.

References: N. E. D. Sheppard, H. D. Chambers, L. B. Rochester, F. Newell, C. V. Christie.

SMITH—HAMILTON ELLESMERE, of Mount Vernon, N.Y., Born at Ottawa, Ont., Feb. 10th, 1902; Educ., B.Sc., McGill Univ., 1925; 1922-23-24 (summers), dftsman. and instr'man. C.N.R. Mtce., Dept., Montreal; 1925-28, with Dwight P. Robinson & Co. Inc., 1926, cost engr., 1926-27, asst. res. engr., on constrn. of the New York, Westchester & Boston Rly., from Mamaroneck, N.Y., to Rye, N.Y.; 1927-28, res. engr. for contractor on same job i/c of all field engrg. and design; 1928 (May-Sept.), with same company i/c of constrn. of elevated track structure, platforms and addition to station for above rly. at Harlem River, New York City; Feb. 1929 to date, engr. in charge for F. H. McGraw & Co., gen. contractor on constrn. of Pennsylvania Dock & Warehouse Co. at Jersey City, N.J., a 27,000,000 c.f. Cold and Dry Storage Reinforced Concrete Warehouse.

References: G. W. Burpee, G. H. Burgess, C. D. Howe, H. M. MacKay, R. DeL. French, J. Weir.

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Second World Power Conference

Berlin, Germany, June 1930

Foreword

The World Power Conference, originally inaugurated by Great Britain with a view to improving from technical and commercial aspects the methods of generating and distributing energy in every form and to promoting the use of energy by international collaboration, held its first Plenary Meeting at London in 1924. Since that time sectional meetings have alone been held: the Basle Conference (1926) which dealt with the Utilization of Water Power and Inland Waterways; the London Fuel Conference of 1928; the Barcelona Meeting (May, 1929) on Water Power Utilization, and finally the Tokyo Meeting (October, 1929) on the Development of Power Resources, the latter coinciding with the World Engineering Congress.

Under the auspices of the International Executive Council of the World Power Conference the German National Committee is now organizing the Second Plenary World Power Conference to be held in Berlin, June 16-June 25, 1930. At this meeting the most prominent personalities in engineering science, economics, and industry, in addition to leading statesmen from about fifty different countries, will assemble to participate in a programme of discussions of world wide interest to be followed by a series of carefully organized tours through all parts of Germany.

The Honorary Patron of the 1930 Conference at Berlin is Reichspräsident von Hindenburg, the Honorary President being His Excellency, Dr. Oskar von Miller, the creator of the Deutsches Museum and pioneer of the electrical supply industry, while Dr.-Ing. E.h.C. Köttgen has assumed the duties of Chairman of the Conference. The Members of the Honorary Executive Council include the various German Secretaries-of-State, the political heads of the various German states, as well as leading representatives of science, industry, finance, commerce and of public corporations.

As many as 300 of the most prominent German engineers have been engaged for more than a year in making preparations for the Conference and more than 400 papers have been submitted from the different participating countries. These have been printed and sent out on request to all interested parties in order that the papers may be thoroughly considered and discussions prepared well in advance of the Conference.

Canada took a prominent part in the First Plenary Conference at London in 1924 and just as keen an interest is being taken in the meeting at Berlin. The Honorary Chairman of the Canadian National Committee is the Honourable Charles Stewart, Minister of the Interior, while the Chairman of the Executive Committee having active charge of arrangements for Canadian participation is Dr. Charles Camsell, Deputy Minister of Mines, Ottawa. The Berlin Meeting, like its predecessors, will be an event of the very highest importance to the whole engineering world.

It is gratifying to note that a substantial delegation of Canadian engineers is taking part in the proceedings of the Conference of 1930. The Dominion of Canada has been honoured by the selection of one of these, Dr. O. O. Lefebvre, M.E.I.C., as chairman of Section 13 of the Conference, "Rationalization and the Technical and Economic Problems of Water Power Utilization."

The seven papers presented in this issue of The Engineering Journal form the Canadian contribution to the technical literature of the Conference. All the authors are recognized authorities on their respective subjects, and the papers now published constitute a timely record of engineering progress in Canada since the date of the previous World Power Conference. They are reproduced here by kind consent of the International Executive Council of the World Power Conference and the Canadian National Committee, and with the permission of the respective authors.

— The Editor.

Second World Power Conference

June 16 to June 25, 1930

BERLIN

organized by the German National Committee
under the auspices of the
INTERNATIONAL EXECUTIVE COUNCIL WORLD POWER CONFERENCE

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Meetings of the World Power Conference

THE FIRST PLENARY WORLD POWER CONFERENCE
London, June 30—July 12, 1924

SECTIONAL MEETING ON WATER POWER
Utilization of Water Power and Inland Navigation
Basle, August 30—September 6, 1928

SECTIONAL MEETING ON FUEL PROBLEMS
London, September 24—October 6, 1928

SECTIONAL MEETING ON UTILIZATION OF WATER POWER RESOURCES
Barcelona, May 15—May 23, 1929

SECTIONAL MEETING ON DEVELOPMENT OF POWER RESOURCES
Tokyo, October 29—November 7, 1929

THE SECOND PLENARY WORLD POWER CONFERENCE
Berlin, June 16—June 25, 1930

Technical Programme of the Second Plenary World Power Conference

BERLIN, 1930

Class "A"

SOURCES OF POWER

Division I. Solid Fuels
Division II. Liquid Fuels
Division III. Gaseous Fuels
Division IV. Water Power
Division V. Utilization of Solar Energy and of the Heat Stored in the Earth; Wind Power

Class "B"

POWER PRODUCTION; POWER TRANSMISSION; STORAGE

Division I. Steam Power Plants and Fuels
Division II. Internal Combustion Engine Plants
Division III. Water Power Plants
Division IV. Electric Power Plants
Division V. Mechanical Transmission of Power with Special Reference to Gearing

Class "C"

UTILIZATION OF POWER

Division I. Agriculture
Division II. Domestic Economy and Industry
Division III. Transport
Division IV. Power Utilization in Mines and in Metallurgical Works
Division V. Power Utilization in Building Work and in Factories

Class "D"

GENERAL

Division I. Distribution of Power
Division II. Power and Legislation
Division III. Technical Education Problems
Division IV. Co-operation

Programme of Canadian Papers to be presented at Second World Power Conference

Class "A"

SOURCES OF POWER

(1) **Water Resources of Canada and Their Development.** By J. T. Johnston, B.A.Sc., M.E.I.C., Director, Dominion Water Power and Reclamation Service, Department of the Interior.

(2) **Fuel Investigations and Research in Canada.** By B. F. Haanel, B.Sc., M.E.I.C., Chief Engineer, Division of Fuels and Fuel Testing, Department of Mines, Ottawa.

Class "B"

POWER PRODUCTION; POWER TRANSMISSION; STORAGE

(1) **Recent Trends in Water Power Development in Canada.** By T. H. Hogg, D. Eng., M.E.I.C., Chief Hydraulic Engineer, Ontario Hydro-Electric Power Commission.

(2) **Generation, Transmission and Distribution of Electricity—Recent Practice in Canada.** By Julian C. Smith, LL.D., M.E., M.E.I.C., Vice-President and General Manager, Shawinigan Water and Power Company, Limited, and C. V. Christie, M.E., M.E.I.C., Professor of Electrical Engineering, McGill University.

(3) **Storage Reservoirs in Canada.** By O. O. Lefebvre, D.Sc., M.E.I.C., Chief Engineer, Quebec Streams Commission.

Class "C"

UTILIZATION OF POWER

(1) **Economic Aspects of Electrical Supply in the House and on the Farm.** By F. A. Gaby, D.Sc., M.E.I.C., Chief Engineer, Ontario Hydro-Electric Power Commission.

(2) **Some Economic Aspects of the Hydro-Electric Industry in Canada.** By G. Gordon Gale, M.Sc., M.E.I.C., Vice-President and General Manager, Gatineau Power Company, Limited.

Second World Power Conference

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The Authors

The Hydro-Electric Industry in Canada

G. Gordon Gale, M.E.I.C.

G. Gordon Gale, M.Sc., M.E.I.C., vice-president of the Canadian Hydro-Electric Corporation, Ltd., at Ottawa, Ont., presents a paper on "The Hydro-Electric Industry in Canada." Mr. Gale has had considerable experience in the subject on which he writes, having been at one time vice-president and general manager of the Hull Electric Company and general manager of the Gatineau Power Company.

Fuel Investigations and Research in Canada

B. F. Haanel, M.E.I.C.

B. F. Haanel, B.Sc., M.E.I.C., is the author of the paper on "Fuel Investigations and Research in Canada." He has practically devoted his entire career to the solving of fuel problems, chiefly those of Canada. He is Chief Engineer, Division of Fuels and Fuel Testing Mines Branch, Department of Mines, Ottawa, and as such has been closely associated and in close contact with the development of Canada's fuel resources.

Recent Trends in Water Power Development in Canada

T. H. Hogg, M.E.I.C.

T. H. Hogg, D.Eng., M.E.I.C., Chief Hydraulic Engineer of the Hydro-Electric Power Commission of Ontario, Toronto, is the author of the paper on "Recent Trends in Water Power Development in Canada," a subject on which Mr. Hogg is eminently qualified to write. He was appointed a member of the Lake of the Woods Control Board in 1927, and in the same year received the Honorary Degree of Doctor of Engineering from the University of Toronto.

Storage Reservoirs in Canada

O. O. Lefebvre, M.E.I.C.

O. O. Lefebvre, B.A.Sc., D.Sc., M.E.I.C., Chief Engineer, Quebec Streams Commission, Montreal, is the author of "Storage Reservoirs in Canada." Dr. Lefebvre has been responsible for many outstanding engineering works, notably the large storage works on various rivers in the province of Quebec, for the regulation of the flow of these rivers for power purposes. He is a member of the Joint Board of Engineers appointed by the governments of Canada and the United States to investigate and report on the engineering features of the proposed St. Lawrence river navigation and power project.

Economic Aspects of Electrical Supply in the House and on the Farm

F. A. Gaby, M.E.I.C.

F. A. Gaby, D.Sc., M.E.I.C., is the author of the paper on "Economic Aspects of Electrical Supply in the House and on the Farm." Mr. Gaby presented two papers at the World Power Conference held in London in 1924. As chief engineer of the Hydro-Electric Power Commission of Ontario since 1912, Mr. Gaby has been constantly in touch with the problems presented by the supply of electricity for domestic purposes and for use in rural districts.

Generation, Transmission and Distribution of Electricity in Canada

Julian C. Smith, M.E.I.C.

Julian C. Smith, LL.D., M.E., M.E.I.C., vice-president and general manager of the Shawinigan Water and Power Company, and Professsor C. V. Christie, M.E., M.E.I.C., Professor of Electrical Engineering and Chairman of the Department of Electrical Engineering, McGill University, are joint authors of the paper on the "Generation, Transmission and Distribution of Electricity in Canada."

Mr. Smith has been identified with the development and transmission of hydro-electric power throughout Canada, and particularly in the province of Quebec for more than twenty-five years, notably as hydraulic engineer in charge of the development at Cedar Rapids, Que., as supervising engineer on the development of the Manitoba Power Company at Winnipeg, Man., as well as chief engineer in the developments of the Shawinigan Water and Power Company and allied companies.

Water Power Resources of Canada and Their Development

J. T. Johnston, M.E.I.C.

J. T. Johnston, B.A.Sc., M.E.I.C., Director, Water Power and Reclamation Department of the Interior, Ottawa, has contributed the paper on "Water Power Resources of Canada and Their Development." Mr. Johnston is the originator of the inventory system of water resources compilation and analysis which has been adopted by practically all the provincial power and water administrations in Canada.

C. V. Christie, M.E.I.C.

Professor Christie, M.E., M.E.I.C. is an authority on electrical engineering, and during the course of his career as a consulting engineer has had occasion to study some of the large transmission systems of Canada in detail, so that his knowledge of the subject of electric transmission is an intimate one. His text book on electrical engineering has been widely used by students in the universities in both Canada and the United States.

Wapta Falls, South of Leanchoil, B.C.

(Courtesy of Canadian Pacific Railway)

THE

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Water Power Resources of Canada and Their Development

J. T. Johnston, C.E., M.E.I.C.,

Director, Water Power and Reclamation Service, Department of the Interior, Ottawa, Ont.

Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

I. General Outline

Water power during the present century has been and continues to be the most vital force behind Canadian industrial development. With ample resources evenly distributed from coast to coast water power has enabled Canada to develop into a manufacturing country of the first importance. With energy from this source developed, distributed and sold at low cost, industries have been attracted in increasingly large numbers, mines have been developed which would otherwise have remained dormant and a decided betterment in the standard of living has been effected by its widespread use in the homes and on the farms. With the exception of power for transportation and certain restricted areas, principally in the Prairie Mid-West, water power supplies practically the entire energy requirements of the Dominion.

At the First World Power Conference held in London in 1924 a paper entitled "Water Powers of Canada, Their Nature, Extent and Administration," was presented by Mr. J. B. Challies, c.e., m.e.i.c., at that time Director, Dominion Water Power and Reclamation Service, Department of the Interior, in which the fortunate position of Canada with regard to the nature, extent and location of water power resources was reviewed in considerable detail together with an analysis of the development which had been made up to 1924 and a synopsis of water power administration throughout the Dominion. It is the purpose in the present paper to give a re-analysis of the water power situation in Canada bringing the figures up to the beginning of 1930, the year of the Second World Power Conference, as nearly as may be estimated from the information at present available (October 1929) and to deal particularly with the progress which has been made in the period subsequent to 1924.

Available and Developed Water Power

The water power available in Canada according to the most recent estimates totals 20,347,400 twenty-four hour horse power under conditions of ordinary flow or 33,617,200 twenty-four hour horse power ordinarily available for six months of the year. The favourable distribution of these resources in every province of the Dominion is shown in table No. 1 and is also indicated graphically on figure No. 1. On a commercial basis the available water power resources would probably warrant a total installation of about 43,700,000 h.p. so that with the total existing installation of 5,710,802 h.p. it may be said that slightly more than 13 per cent of the at present recorded resources of the Dominion are developed.

In columns 5 and 6 of table No. 1 figures of population and installation per thousand of population are respectively shown. The total installation for the Dominion averages 583 h.p. per thousand population, a figure which places Canada amongst the leading countries of the world in the per capita utilization of water power. In 1924 this figure was 353 h.p. per thousand.

Outline of Development 1924 to 1930

In the six years period which has elapsed since the First World Power Conference, water power installation has exceeded the most optimistic estimate made in 1924. While the population in this period increased about seven per cent water power installation in horse power increased 79 per cent. In 1924 an estimate based on past growth indicated a total for the beginning of 1930 of about 5,200,000 horse power whereas the figures today show an actual total of more than 5,700,000 horse power. In new development practically every province was represented, Quebec taking the lead with more than 1,437,000 horse power, Ontario next with 563,500 horse power followed by British Columbia with 203,900 horse power, Manitoba 149,900 horse power, New Brunswick 69,000 horse power, Nova Scotia 58,000 horse power, and Alberta 37,400 horse power.

An important feature of the past six years has been the extension and interconnection of transmission systems and the consolidation of numerous systems under single control. This is touched upon in the review by provinces which follows in Section II and is shown graphically on the various plates of transmission systems. An advance was

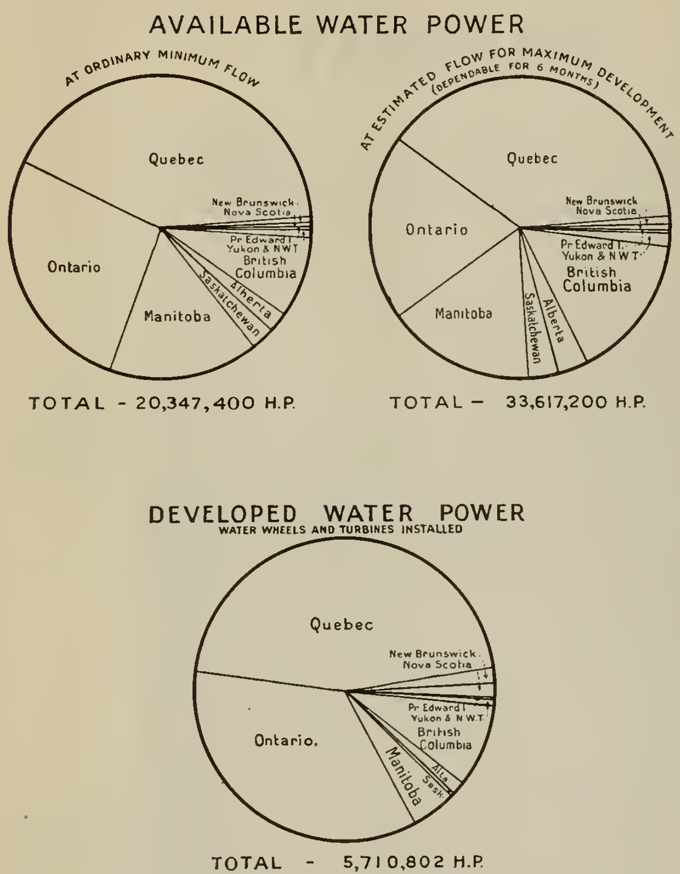

Figure No. 1—Available Water Power in Canada on Basis of 24-Hour Power at 80 Per Cent Efficiency.

also made during the period into higher voltages for long distance transmission. In 1924 lines of 110,000 volts were the highest in operation whereas at the present time there are lines of 134,000, 168,000 and 220,000 volts, thereby considerably extending the availability of hydro-electric energy.

Current Progress

In addition to the large increase in water power installation during the past six years there are a number of undertakings in the course of construction at the present time the total of whose initial installations will amount to 550,000 horse power and when completed to their ultimate designed capacities will add to the Dominion's total more than 2,500,000 horse power. There are, as well, numerous projects in the prospective stage many of which will undoubtedly materialize in the near future and will add very greatly to the programme of development.

Capital Invested in Water Power

The capital invested in water power development in Canada inclusive of that in transmission and distribution systems is estimated to be $1,250,000,000 or more than that for any other single manufacturing industry. The corresponding figure in 1924 was $688,000,000 so that during the past six years an average of about $94,000,000 per year has had to be provided for the purpose of new development. The readiness with which this new capital has been secured is an evidence of the stability of Canadian water power investments. Also the large proportion of such securities held within the country itself affords proof of the confidence Canadians have in this type of investment.

The opportunities for further investment in Canadian water power undertakings are likely to be numerous, the

Table No. 1—Available and Developed Water Power in Canada[1]

Province	Available 24-hour power 80 per cent efficiency		Turbine installation h.p.	Population June 1, 1929	Total installation per 1,000 population
	At ordinary minimum flow h.p.	At ordinary six months flow h.p.			
1	2	3	4	5	6
British Columbia	1,931,000	5,103,500	560,042	591,000	948
Alberta.........	390,000	1,049,500	70,532	646,000	109
Saskatchewan...	542,000	1,082,000	35	866,700	...
Manitoba.......	3,309,000	5,344,500	311,925	663,200	470
Ontario.........	5,330,000	6,940,000	1,959,675	3,271,300	599
Quebec.........	8,459,000	13,064,000	2,572,418	2,690,400	956
New Brunswick..	68,600	169,100	112,131	419,300	267
Nova Scotia.....	20,800	128,300	108,406	550,400	197
Prince Edward Island........	3,000	5,300	2,439	86,100	28
Yukon and N. W. Territories....	294,000	731,000	13,199	12,400	1,063
	20,347,400	33,617,200	5,710,802	9,796,800	583

[1]The estimates of available power are based upon sites where the head is definitely known or well authenticated. They omit many falls, rapids or possible concentrations, regarding which information is not reasonably definite and reliable. The estimates may therefore be looked upon as representing the minimum power possibilities of the Dominion.

All estimates of available power represent continuous twenty-four hour power at an efficiency of generation of eighty per cent. The figures in column 2 are based on "ordinary minimum flow" which is the average, over all the years for which records are available, of the mean flow for the two lowest seven-day periods in each year. Six-month power in column 3 is based on the "ordinary six-month flow" which is the average over all the years for which records are available, of the mean flow for the lowest seven consecutive days in the lowest of the six high months in each year.

The figures in column 4 represent the rated capacities of all water wheels and turbines installed throughout the Dominion. These figures should not be directly compared with the available power figures in columns 2 and 3. The actual water wheel and turbine installation throughout the Dominion averages about thirty per cent greater than the corresponding ordinary six-month figures calculated as in column 3. On this basis, therefore, the available water power resources of the Dominion as at present recorded would permit of a turbine installation of about 43,700,000 h.p. In other words, the present installation represents about thirteen per cent of the present recorded water power resources.

resources are exceptionally well situated and ample for extensive utilization; labour conditions are relatively stable; total manufactures and the proportion of manufactures exported show rapid and sustained increase while for legitimate power projects governmental co-operation is sympathetic and constructive.

Coal Equivalent of Developed Water Power

The development of water power in Canada has had a direct and very great effect in reducing the consumption of coal. While it is difficult to assign a precise figure of the coal equivalent of developed water power, as numerous assumptions must necessarily be made dependent upon conditions under which the power is developed, nevertheless, taking into account all present conditions surrounding water power development in Canada and comparing them with somewhat similar conditions of fuel power development elsewhere, it is reasonable to state that a saving of coal of six tons per annum is capable of being effected by each installed horse power. This means that the total present water power installation of 5,710,800 horse power is capable of effecting a saving of about 34,000,000 tons of coal per annum. With the marked economies that are continually taking place in the coal

Table No. 2—Developed Water Power in Canada—Distribution by Industries

January 1, 1930

Province	Turbine Installation in Horse Power			
	In central electric stations	In pulp and paper mills	In other industries	Total
1	2	3	4	5
British Columbia	418,210	81,000	60,832	560,042
Alberta	70,320	....	212	70,532
Saskatchewan	....	....	35	35
Manitoba	311,925	....	....	311,925
Ontario	1,624,393	240,880	94,402	1,959,675
Quebec	2,216,150	220,810	135,458	2,572,418
New Brunswick	83,910	19,278	8,943	112,131
Nova Scotia	76,979	16,008	15,419	108,406
Prince Edward Island	376	....	2,063	2,439
Yukon and Northwest Territories	....	....	13,199	13,199
Canada	4,802,263	577,976	330,563	5,710,802

Column 2 includes only hydro-electric stations which develop power for sale.

" 3 " only water power *actually developed* by pulp and paper companies. In addition to this total, pulp and paper companies, purchase from the hydro power central electric stations totalled in column 2 approximately 860,000 h.p. A considerable amount of off-peak power is also purchased for use in electric boilers.

" 4 " only water power *actually developed* in connection with industries other than the central electric station and pulp and paper industries. These industries also purchase power from the central electric stations totalled in column 2.

" 5 totals all turbines and water wheels installed in Canada.

consumption of fuel power stations it will be necessary from time to time to adjust this figure of coal equivalent but under existing conditions the foregoing estimate is not unreasonable.

Utilization of Developed Water Power

A broad classification of the present turbine installation of 5,710,802 horse power is shown in table No. 2 and graphically on figure No. 2 under the headings, central electric stations, pulp and paper mills and other industries. A more detailed classification of the ultimate use of the power is difficult because of the large proportion which is accounted for by central electric stations from which power is sold for a multitude of uses.

The classification shows that 4,802,263 horse power or 84.1 per cent of the total is installed in central electric stations for general distribution for all purposes, 577,976 horse power or 10.1 per cent is installed in pulp and paper mills in addition to some 860,000 horse power of electrical energy which these mills purchase from central electric stations and 330,563 horse power or 5.8 per cent is installed in other industries among which are included mines, mineral reduction works, electro-chemical plants, saw, grist and grinding mills, machine shops, municipal pumping plants and street railways all of which also purchase power extensively from central electric stations.

Water Power in the Central Electric Station Industry

In the Canadian central electric station industry over 95 per cent of the primary power equipment is energized by falling water while the diversity of use of hydro-electricity induced by moderate prices results in almost 99 per cent of the total kilowatt hour output being generated in the hydraulic stations.

Of recent years there has been an increasing trend in the proportion of water power developed by central electric station organizations. At the present time 84 per cent of the total water power installation in Canada is so operated, as compared with 75 per cent in 1924.

Figures issued by the Dominion Bureau of Statistics indicate that during the year 1928 the large central electric stations in Canada produced 15,931,204,000 kilowatt hours, of which 15,705,271,000 kilowatt hours were generated by hydraulic stations. These large stations account for more than 99 per cent of the output of all central electric stations. Assuming an annual increase of 10 per cent as shown by the figures for the first eight months of 1929 the total output of hydraulic central electric stations for the year 1929 should amount to 17,300,000,000 kilowatt hours. This indicates a utilization of about 1,765 kilowatt hours per capita, a figure more than double that for the year 1922 and one which places Canada in the forefront of power using nations.

It is of interest to record that in 1928 there were eighteen systems, that is, undertakings in the same district that fall under the control of the same financial interests, which had an annual output of 100,000,000 kilowatt hours or more and whose combined total accounted for over 92 per cent of the total units generated by central electric stations. The largest of these, that of the Hydro-Electric

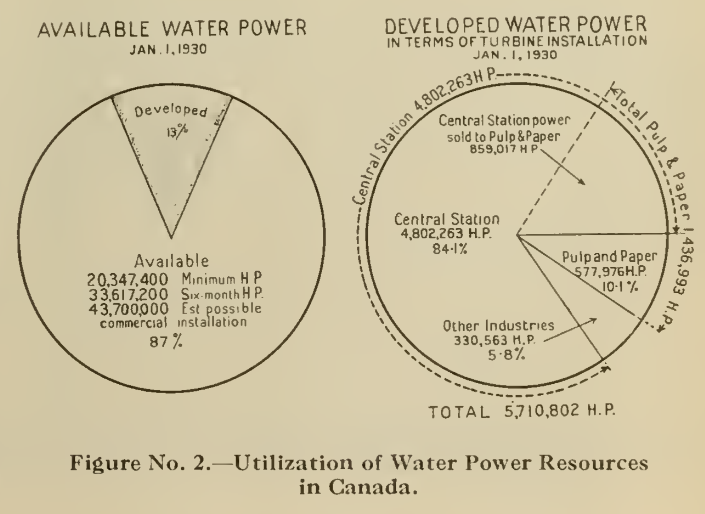

Figure No. 2.—Utilization of Water Power Resources in Canada.

Power Commission of Ontario, generated more than 4,000,000,000 units. In the province of Quebec four systems generated in excess of 1,000,000,000 units each while the remaining systems with lesser outputs were situated in British Columbia, Alberta, Manitoba, Ontario and Quebec. This furnishes direct evidence of the increasing tendency towards the consolidation of systems that is taking place throughout the Dominion.

The extensive economic radius of modern electric transmission combined with the fortunate location of water power in relation to centres of industry removed from supplies of native fuel has led to the development of enormous amounts of hydraulic power for use in manufacturing in established centres where labour is plentiful and of a permanent character and with shipping and distributing facilities readily at hand. The predominance of water power in the industrial life of Canada is indicated by figure No. 3 and table No. 5 which illustrate the sources and character of power for the various industrial centres and districts of the Dominion.

Table No. 3 shows the distribution of hydro-electric generating stations by location and type of ownership. Reference to this table will verify what has been already stated in regard to the effect of lack of indigenous coal supplies upon the location of hydro-electric plants in the provinces of Ontario and Quebec.

Water Power in the Pulp and Paper Industry

The production of pulp and paper is Canada's greatest manufacturing industry, its gross and net values of product and its disbursements for salaries and wages exceed the corresponding figures for those of any of the other manufacturing industries while its output of newsprint for the three last completed census years exceeded that of any other country.

As the production of newsprint requires an installation of approximately 100 h.p. per ton of daily output it is obvious that Canada's supremacy in its manufacture is due no less to her abundant supplies of low priced power than to her extensive forest resources. More than 90 per cent of the motive power in this outstanding industry is derived from water power.

The pulp and paper industry maintains a hydraulic installation of 577,976 h.p. and in addition purchases approximately 860,000 h.p. of electrical energy for power purposes from central electric stations. Considerable off-peak and surplus power is also purchased from central electric stations for use in electric boilers.

The provinces of Ontario and Quebec lead in pulp and paper production and have 240,880 and 220,810 hydraulic horse power respectively installed in connection with the mills and 176,744 h.p. and 622,388 h.p. purchased from hydro-electric central stations, British Columbia being next in order of production, Manitoba and the Maritime provinces also using considerable amounts of hydraulic power for this industry.

Table No. 4 shows in detail the use of hydro-electric power, column 6 being of particular interest as showing the extent to which the electric drive with its uniform speed and possibilities for centralized operation of mills receiving power from a number of different developments, has been adopted by this industry.

Water Power in the Mineral Industries

Canada possesses an active or prospective mineral field covering over three million square miles, comprising over 80 per cent of her total area and mining operations in most of the workings already developed require large amounts of power so that their profitable operation is greatly facilitated by the low cost of hydro-electricity.

Ample power supplies make it possible to conduct large scale operations with consequent lowered cost thereby permitting profitable operation of relatively low grade deposits. Thus the scope of the industry is immensely enlarged and many millions of tons of ore treated which if power were limited and expensive would have no commercial value.

Canada's mineral industries maintain a hydraulic installation of approximately 100,000 h.p. and purchase

Table No. 3—Developed Water Power in Canada—Utilized in the Central Electric Station Industry

Estimated at January 1, 1930

Province	Commercial Stations					Municipal Stations				
	No. of stations	No. of turbines	Total turbine installation h.p.	Average h.p. per station	Average h.p. per turbine	No. of stations	No. of turbines	Total turbine installation h.p.	Average h.p. per station	Average h.p. per turbine
1	2	3	4	5	6	7	8	9	10	11
British Columbia	22	50	408,115	18,551	8,162	8	11	10,095	1,262	918
Alberta	6	19	69,360	11,560	3,651	1	2	960	960	480
Saskatchewan	...	...	......	.....	.....	...	...	......	.....	.....
Manitoba	3	17	206,800	68,933	12,165	2	17	105,125	52,562	6,184
Ontario	69	202	552,358	8,005	2,734	48	140	1,072,035	22,334	7,657
Quebec	90	256	2,189,490	24,328	8,553	14	23	26,660	1,904	1,159
New Brunswick	3	9	71,850	23,950	7,983	3	6	12,060	4,020	2,010
Nova Scotia	13	17	10,166	782	598	21	36	66,813	3,182	1,856
Prince Edward Island	5	6	376	75	63	...	...	......	.....	.....
Yukon and Northwest Territories	...	...	......	.....	.....	...	...	......	.....	.....
Canada	211	576	3,508,515	16,628	6,091	97	235	1,293,748	13,337	5,505

Commercial stations include all privately owned.
Municipal stations include all publicly owned.

Note.—Statistics in this table are based upon a census of the industry made by the Dominion Bureau of Statistics in co-operation with the Dominion Water Power and Reclamation Service. In addition to the central electric station organizations included above certain industrial hydraulic plants sell small amounts of electricity, i.e., the sale of electricity is only incidental to their main industries.

Table No. 4—Developed Water Power Utilized in the Pulp and Paper Industry

January 1, 1930

Province	Installed and Purchased Water Power in Horse Power					
	Turbine installation in the industry			Purchased hydro-electric power	Total hydro-electric power col. 3 and col. 5	Total hydro-power used in the industry col. 4 and col. 5
	Direct drive	Hydro-electric drive	Total			
1	2	3	4	5	6	7
British Columbia	26,155	54,845	81,000	2,550	57,395	83,550
Manitoba	......	......	......	*	*	*
Ontario	93,650	147,230	240,880	176,744	323,974	417,624
Quebec	145,270	75,540	220,810	622,388	697,928	843,198
New Brunswick	1,900	17,378	19,278	*	*	*
Nova Scotia	16.008	......	16,008	6,273	6,273	22,281
Canada	282,983	294,993	577,976	859,017	1,154,010	1,436,993

*The pulp and paper mills of Manitoba and New Brunswick purchase hydro-electricity totalling 51,062 h.p.

Column 2 includes all turbines actually installed in the industry directly driving mill equipment.
" 3 includes all turbines actually installed in the industry transmitting power through electric drive.
" 4 totals the turbine capacity actually installed in the industry.
" 5 includes only power purchased from central electric stations for the operation of pulp and paper mills.
" 6 totals the hydro-electric power used in the industry.
" 7 totals the water power used in the industry.

approximately 380,000 h.p. of hydro-electricity from the central electric stations. This power is used for the extraction of ore, crushing, smelting, refining and other processes. The extraction of the mineral requires power for compressing air for drilling, for stripping, hoisting, hauling and conveying; for pumping water supply and drainage; for lighting, heating and ventilating and for machine, blacksmith and framing shops.

The actual extent of Canada's minerals is not known, every extension of transportation facilities renders fresh mineral fields available. It is believed, however, that wherever mineral deposits may be found the same geological formation that provides for their occurrence may also be expected to supply the necessary water power for their development.

Water Power in the Electro-Chemical and Electro-Metallurgical Industries

One of the recent outstanding developments of Canadian industry has been the application of electricity to many chemical and metallurgical processes. New industries have been established in localities where the large amounts of low-cost electricity essential to their successful operation could be developed from adjacent water powers or procured by purchase from plants already in existence. In some cases chemical loads have been developed to convert surplus or off-peak power into marketable products.

Electric energy is used chiefly for the production of heat or to promote chemical actions or reactions, the application of the energy falling into three main classes: the electrolytic refining of those metals which can be produced of greater purity by electric processes, the electrolytic production of chemicals which are more easily and economically produced electrically than by other means and electric furnace processes where exceptionally high temperatures are required.

The principal Canadian plants which depend wholly upon electric power for the operation of their processes are located in the vicinity of low-cost hydro-electricity: in Ontario, at Niagara Falls; in Quebec, at Hull, Shawinigan Falls and Arvida; and in British Columbia at Rossland. Many smaller plants are located at different points throughout the country but all where hydro-electricity is obtainable at low cost. These industries have at the present time a hydraulic turbine installation in their own plants of approximately 60,000 h.p. and purchase about 132,000 h.p. of electrical energy from central electric stations and there are many indications that this is but the beginning of the utilization of water power for this purpose.

While the utilization of off-peak power will afford opportunity for the development of the smaller electro-chemical industries there are many large undeveloped sites in Canada which offer special advantages for the location of large power-using industries requiring continuous power. It is expected that in the future many of these will be utilized for the development of electro-chemical industries.

Past and Future Growth in Water Power Development

The growth of water power development in Canada from 1900 to 1929 is illustrated in figure No. 4 and the growth in the various provinces from 1910 to 1929 in figure No. 5.

The total installed horse power at the end of the year 1900 was 173,300 horse power. Development was active in the years following so that at the end of 1910 the total had grown to 977,000 horse power. A decided increase in the rate of growth then took place and by the end of 1916 a figure of 2,222,000 horse power was reached. From 1916 to 1920, war and post-war conditions had the effect of retarding development with the result that the total at the end of 1920 amounted to only 2,515,000 horse power. Following 1920 an intensive period of development commenced which has continued to the present time. By the end of 1923 the total had grown to 3,192,000 horse power and at the end of 1929 to 5,711,000 horse power.

During the past six years the average annual increase in installation has been about 420,000 horse power. The curve in figure No. 4 has been projected on the basis of this recent growth and shows that in 1940 the total for the Dominion will probably have reached a figure of 10,300,000 horse power.

Table No. 5—Developed Water Power in Canada—Hydro-Electric Stations Serving Industrial Areas Indicated in Figure No. 3

No.	Plant or System	Owner	Installation
1	Anyox plant	Granby Cons. Min., Smelt. & Pwr. Co., Ltd.	13,400
2	Woodworth lake plant	Power Corporation of Canada	1,650
3	Ocean Falls plants	Pacific Mills Ltd.	26,850
4	Millstone river plant	Nanaimo Elec. L., P. & Heat. Co., Ltd.	450
	Coal Creek plant	Nanaimo Elec. L., P. & Heat. Co., Ltd.	150
	Puntledge river plant	Canadian Collieries Ltd.	12,000
5	Shushwap Falls plant	West Canadian Hydro-Elec. Corp.	3,800
6	Barriere river	Municipality of Kamloops	2,000
7	Goldstream plant	British Columbia Pwr. Corp., Ltd.	3,400
	Jordan river plants	British Columbia Pwr. Corp., Ltd.	27,250
8	Coquitlam-Buntzen plants	British Columbia Pwr. Corp., Ltd.	84,000
	Stave Falls plant	British Columbia Pwr. Corp., Ltd.	77,500
	Alouette plant	British Columbia Pwr. Corp., Ltd.	12,500
9	Powell river plant	Powell River Co. Ltd.	49,860
10	South Slocan plant	West Kootenay Pwr. & Light. Co., Ltd.	75,000
	Bonnington Falls plants	West Kootenay Pwr. & Light. Co., Ltd.	94,000
	" " plant	Municipality of Nelson	6,570
11	Bull river plant	East Kootenay Pwr. Co. Ltd.	7,200
	Elk river plant	East Kootenay Pwr. Co. Ltd.	15,000
12	Kananaskis Falls plant	Calgary Power Co.	11,600
	Horseshoe Falls plant	" " "	20,000
	Ghost Falls plant	" " "	36,000
	Eau Claire plant	" " "	780
13	Point du Bois plant	Municipality of Winnipeg	105,000
	Pinawa plant	Winnipeg Electric Co., Ltd.	37,800
	Great Falls plant	Winnipeg Electric Co., Ltd.	168,000
14	Kenora plants	Keewatin Power Co., Ltd.	30,875
15	Ear Falls plant	Hydro-Elec. Pwr. Comm. of Ont.	5,000
16	Fort Frances, Moose, Mill and Calm Lakes plants	Ont. & Minn. Power Co. Ltd.	51,850
17	Kakabeka Falls plant	Kaministiquia Pwr. Co., Ltd.	35,000
18	Nipigon plant	Hydro-Elec. Pwr. Comm. of Ont.	75,000
19	Sault Ste. Marie plant	The Great Lakes Pwr. Co. Ltd.	28,050
	High Falls plant	Algoma District Pwr. Corp. Ltd.	18,770
20	Smoky Falls Plant	Spruce Falls Pwr. & Paper Co. Ltd.	56,250
21	Wawaitin Falls plant	Canada Northern Pwr. Corp. Ltd.	14,900
	Sandy Falls plant	Canada Northern Pwr. Corp. Ltd.	4,900
	Sturgeon Falls plant	Canada Northern Pwr Corp. Ltd.	8,000
	Indian Chutes plant	Canada Northern Pwr. Corp. Ltd.	4,000
22	Iroquois, Twin and Island Falls plants	Abitibi Pwr. & Paper Co. Ltd.	106,000
23	Hound Chute plant	Canada Northern Pwr. Corp. Ltd.	5,340
	Fountain Falls plant	Canada Northern Pwr. Corp. Ltd.	3,000
	Matabitchuan plant	Canada Northern Pwr. Corp. Ltd.	13,200
	Ka-Ka-Ke Falls plant	Canada Northern Pwr. Corp. Ltd.	40,000
24	Secord plant	Hydro-Elec. Pwr. Comm. of Ont.	3,600
	Dryden plant	Hydro-Elec. Pwr. Comm. of Ont.	6,300
	Long Sault plant	Hydro-Elec. Pwr. Comm. of Ont.	7,000
	Espanola Plant	Abitibi Pwr. & Paper Co. Ltd.	20,800
25	High Falls and Big Eddy plants	International Nickel Co. of Canada Ltd.	50,400
26	South river plants	Hydro Elec. Pwr. Comm. of Ont.	5,700
27	Sturgeon and Smoky Falls plants	Abitibi Pwr. & Paper Co. Ltd.	23,790
28	Swift Rapids plant	Municipality of Orillia	6,360
	Big Chute plant	Hydro-Elec. Pwr. Comm. of Ont.	6,200
	Wasdells Falls plant	Hydro-Elec. Pwr. Comm. of Ont.	1,200
	South Falls plant	Hydro-Elec. Pwr. Comm. of Ont.	5,400
	Tretheway Falls plant	Hydro-Elec. Pwr. Comm. of Ont.	2,200
	Hanna Chute plant	Hydro-Elec. Pwr. Comm. of Ont.	1,550
29	Eugenia Falls plant	Hydro-Elec. Pwr. Comm. of Ont.	8,500
30	Central Ont. System plants	Hydro-Elec. Pwr. Comm. of Ont.	57,980
	Peterborough plant	Peterborough Hydraulic Pwr. Co. Ltd.	6,000
	Campbellford plant	Municipality of Campbellford	3,370
31	Niagara Falls plant	Canadian Niagara Pwr. Co. Ltd.	121,000
	De Cew Falls plant	Dominion Pwr. & Trans. Co. Ltd.	45,000
	Niagara Falls plants	Hydro-Elec. Pwr. Comm. of Ont.	874,700
32	Waltham plant	Pembroke Elec. Lt. Co., Ltd.	3,600
	Bryson plant	Gatineau Power Co.	51,400
33	Bonnechere river plants	Municipality of Renfrew	1,700
	Calabogie plant	Hydro-Elec. Pwr. Comm. of Ont.	6,000
	Galetta plant	Hydro-Elec. Pwr. Comm. of Ont.	1,400
34	High Falls and Carleton Place plants	Hydro-Elec. Pwr. Comm. of Ont.	4,450
35	Paugan plant	Gatineau Power Co.	204,000
	Chelsea plant	" " "	136,000
	Farmers plant	" " "	96,000
36	Chaudiere plants	" " "	36,600
		Ottawa Electric Company	13,100
37	Cedars Rapids plant	Montreal Lt., Heat & Pwr. Cons.	197,400
	Soulanges plant	Montreal Lt., Heat & Pwr. Cons.	16,050
	St. Timothee plant	Canadian Lt. & Pwr. Co.	30,400
38	Chambly plant	Montreal Lt., Ht. & Pwr. Cons.	21,600
	Lachine plant	Montreal Lt., Ht. & Pwr. Cons.	15,800
39	Des Prairies river plant	Montreal Island Power Co.	52,800
40	St. Francois and Magog river plants	Municipality of Sherbrooke	17,050
	Sherbrooke plant	Southern Can. Pwr. Co., Ltd.	4,050
41	Drummondville plant	Southern Can. Pwr. Co., Ltd.	19,500
	Hemmings Falls plant	Southern Can. Pwr. Co., Ltd.	33,600
42	Shawinigan Falls plant	Shawinigan Water & Pwr. Co.	237,000
	Grand Mere plant	Shawinigan Water & Pwr. Co.	176,000
	La Gabelle plant	Shawinigan Water & Pwr. Co.	120,000
	St. Narcisse plant	North Shore Power Co.	22,400
	St. Alban plant	Portneuf Power Co.	4,000
43	St. Gabriel plant	Quebec Power Co., Ltd.	3,000
	Montmorency river plants	" " " "	7,000
44	Chaudiere river plant	" " " "	4,800
	St. Fereol plant	" " " "	24,000
45	St. Raphael and Armagh plants	" " " "	4,900
46	Metis river plant	Lower St. Lawrence Pwr. Co. Ltd.	3,700

(Continued on next page)

No.	Plant or System	Owner	Installation
47	Isle Maligne plant	Duke-Price Power Co....	495,000
	Riviere a Mars plant	Municipality of Bagotville............	1,350
	Garneau Falls plant	Saguenay Elec. Co......	3,500
	Chicoutimi River plant	La Societe d'Eclairage et d'Energie Elec. de Saguenay..............	7,200
	Shipshaw, Chicoutimi river and Au Sable river plants	Price Bros. & Co., Ltd..	70,100
	Ha Ha river plants	Port Alfred Pulp & Paper Corp................	2,100
48	Grand Falls plant	Bathurst Co., Ltd.......	14,000
49	Aroostook Falls plant	Maine & New Brunswick Elec. Pwr. Co., Ltd...	11,400
	Grand Falls plant	St. John River Power Co.	60,000
50	Musquash plant	New Brunswick Elec. Pwr. Comm..........	11,100
51	St. Margaret bay plants	Nova Scotia Power Comm.	15,820
52	East river Sheet Harbour plants	" " " "	11,840
53	Mersey river plants	" " " "	31,050
54	Tusket river plant	" " " "	3,000
	Total for stations listed......................		4,955,705
	Total water power installation in Canada....		5,710,802

With the undertakings now in process of development and with those at present in active prospect there is every reason to believe that this rate of growth will not only be maintained but will be considerably exceeded. Available resources are more than ample to provide for such an expansion.

The foregoing has summarized the water power situation in Canada sufficiently to show the extent and distribution of the resources, the widespread development that has taken place and the outstanding importance of this development in the industrial, commercial and domestic life of the Dominion. In Part II, which follows, a more detailed account will be given of the situation in each province with particular reference to the developments made in the period from 1924 to date.

Part III will summarize the recent water power legislation and tendencies of administrative policy, both of the Dominion and of the provinces.

II. Review by Provinces

The early history of water power development in Canada was briefly sketched in a paper before the First World Power Conference and need not be repeated here, except to emphasize the point that the development of long distance transmission provided the key to release the power contained in large water power sites for useful work. Sites of several thousands of horse power could not be fully utilized while the application of that power was restricted to the area that could be reached by mechanical or low voltage electrical means. When the radius of application widened, the power that could be produced at a single site increased, until now single developments of several hundred thousand horse power are not only quite feasible, but are advantageous because of the economies incidental to large undertakings and, conversely, transmission and distribution systems are spreading across the country so that nearly everywhere from coast to coast, factories, municipal services and homes are energized efficiently and at low cost by electricity produced in hydro-electric developments possibly many miles distant.

The extent and development of water power in Canada varies in accordance with topographical and climatic changes and is also affected by variations of policy in different administrations; for this reason a more extended discussion of the subject can best be given under provincial divisions with, sometimes, further subdivisions into districts.

British Columbia

British Columbia, the most westerly province of Canada, has an area of approximately 356,000 square miles and being traversed by three distinct mountain ranges is for the most part rugged while the climate and precipitation show wide variations, the latter varying from an average of less than 10 inches per annum over the interior plateau to upwards of 100 inches per annum in the coastal belt.

Available Water Power Resources

The available water power resources of British Columbia are estimated at 1,931,000 h.p. under conditions of ordinary minimum flow and 5,100,000 h.p. for six months of the year. These estimates are most conservative as they are based upon head and flow records for individual streams and take no account of the numerous natural opportunities for storage, or make any allowance for the many excellent natural facilities for storing the flow of several streams in one or more reservoirs and releasing it through a single high head power plant.

Developed Water Power

The total hydraulic turbine installation of British Columbia is now 560,042 h.p. of which 418,210 h.p. is developed by central electric station organizations for general industrial, commercial and domestic use, 81,000 h.p. is installed in pulp and paper mills and 60,832 h.p. in other industries, notably mining and smelting and the production of sawn lumber.

Central Electric Station Developments

The principal central electric station developments are those of the British Columbia Power Corporation serving the Vancouver and Victoria districts, the West Kootenay Power and Light Company serving the Nelson and Southern boundary districts and the East Kootenay Power Company serving the Fernie and Eastern boundary districts and extending a considerable distance into the Crow's Nest Pass mining area of Alberta.

Power for the Vancouver area is received from four plants, two on the north arm of Burrard Inlet, 16 miles from Vancouver, drawing water from Lakes Buntzen and Coquitlam, and two on the Stave river, the first at Stave Falls, 36 miles from Vancouver, and the second 10 miles above Stave Falls on the shore of Stave lake and operated by water drawn through a tunnel from Alouette lake whose natural flow was reversed by damming to provide the necessary power for the upper plant and to augment the power already in use at Stave Falls. The Coquitlam-Buntzen plants operate under an average head of 395 feet and have an aggregate installation of 84,000 h.p. The Stave Falls plant operates under an average head of 113 feet and has an installation of 77,500 h.p. while the Stave lake plant which is automatically controlled from Stave Falls has an average head of 125 feet and an installation of 12,500 h.p. The extensive transmission system serving Vancouver and the surrounding district is shown on figure No. 6.

Power for the Victoria district is generated in three stations, one on the Goldstream river, 12 miles from Victoria where under an average head of 670 feet 3,400 h.p. is installed and two at the mouth of the Jordan river 36 miles from Victoria where under an average head of 1,145 feet 25,000 h.p. is installed in one plant and 2,250 h.p. in a second recently completed automatically controlled plant drawing water from the same diversion dam. Figure No. 7 illustrates the transmission systems serving the Victoria area.

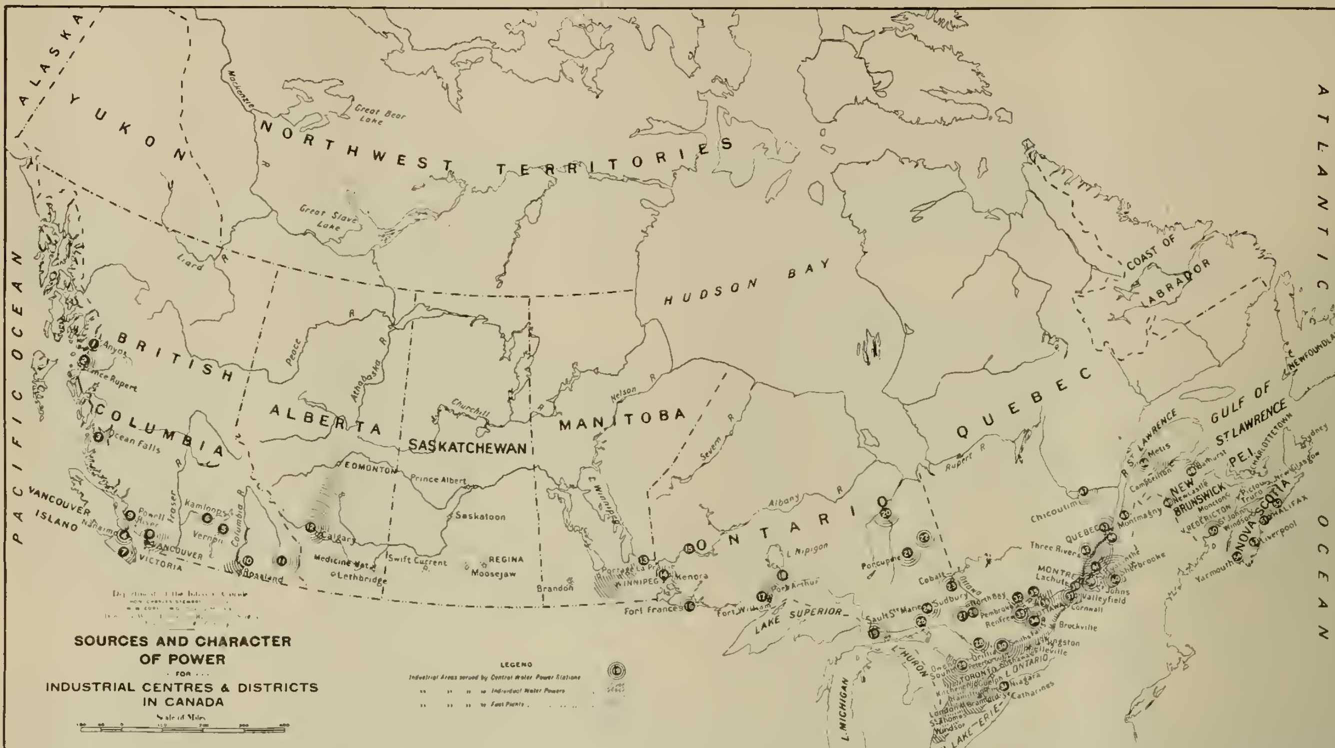

Figure No. 3.
For List of Hydro-Electric Stations serving Industrial Areas Indicated, see Table No. 5.

The British Columbia Power Corporation which controls the above described plants is now engaged upon two extensive developments to augment the supply of power for the Vancouver district. The first of these is a development at Ruskin near the mouth of the Stave river where 42,500 h.p. is being initially installed for operation in the autumn of 1930; the ultimate capacity to be 170,000 h.p. The second project is on the Bridge river where by a series of dams the water is to be diverted through a tunnel 13,200 feet in length and thence through penstocks to a power house on Seton lake where under a head of some 1,300 feet 80,000 h.p. is expected to be in operation by 1932. Further stages involve the construction of additional storage dams, enlargement of tunnel and power house capacity until an ultimate installation of 550,000 to 700,000 h.p. is reached.

Power for the Nelson and southern boundary districts is supplied by the West Kootenay Power and Light Company and more locally by the municipality of Nelson. The former Company operates three plants on the Kootenay river, the first at Upper Bonnington Falls where 34,000 h.p. operates under an average head of 70 feet, the second at Lower Bonnington Falls where the former plant of 4,016 h.p. was replaced in 1925–1926 by one of 60,000 h.p. and the third, completed in the fall of 1928, at South Slocan where 75,000 h.p. is operated under a head of 70 feet. This Company now proposes to develop 80,000 h.p. on the Pend d'Oreille river and is considering another development of 20,000 h.p. on the Adams river.

The municipality of Nelson operates a plant at Upper Bonnington Falls to serve Nelson and some smaller adjacent municipalities. It operates under a head of 60 feet and the installation has recently been increased from 3,570 h.p. to 6,570 h.p.

The Fernie and eastern boundary district receives power from two plants operated by the East Kootenay Power Company, one on the Bull river near Aberfeldie where 7,200 h.p. is operated under an average head of 275 feet and one at Elko on the Elk river where 15,000 h.p. is installed and operates under an 85-foot head. This Company is now investigating the possibilities of a further 15,000 h.p. development on the Elk river at Phillips Canyon.

In addition to the outstanding central electric stations described there are many smaller hydraulic developments utilized for the supply of electricity for public use.

Pulp and Paper Installations

There are seven mills in British Columbia engaged in the pulp and paper industry using hydro-electric power. Two of these operate with purchased power and the remainder produce their own water power to the extent of 81,000 h.p. Amongst the largest is the mill of the Powell River Company Limited on the Powell river which has a total turbine installation of 49,860 h.p., of which 35,460 h.p. is connected to electric generators and the remainder is used directly to drive mill machinery. Another large installation is that of the Pacific Mills Limited on the Link river at Ocean Falls where, of 26,850 h.p. turbine capacity, 9,600 h.p. is directly connected to machinery and the remainder to electric generators. The electric power produced is, in both cases, mainly used in the manufacture of pulp and paper although a small amount is sold for municipal use in their immediate vicinity.

Power for Mining

The mineral industry in British Columbia has large power requirements and furnishes by far the heaviest load in the Nelson-Rossland and Fernie-Cranbrook districts. The Consolidated Mining & Smelting Company of Canada, which operates a number of zinc, lead and copper properties in both the West and East Kootenay areas, is the largest consumer and in addition power is transmitted from the East Kootenay plants for coal mining in the Crow's Nest Pass.

On the Pacific coast the extensive copper and gold areas receive power from a number of important developments, while amongst the water power stations developed solely for mining purposes may be mentioned two owned by the

Granby Consolidated Mining, Smelting and Power Company, with a combined installation of 13,200 h.p. on Falls creek, and two by the Britannia Mining and Smelting Company, totalling 19,070 h.p. on Britannia creek, whilst on Vancouver Island there is a 12,000 h.p. plant on the Puntledge river supplying power to Canadian Collieries Limited for coal mining.

Alberta

Alberta, the most westerly of the Prairie provinces, has a total area of about 225,000 square miles. The southern part of the province is part of the great central plain, the prairie lands extending from the international boundary to approximately the line of the north Saskatchewan river, then follows an area of mixed prairie and woodland succeeded in turn by the northern forests which dense at first thin out towards the northern boundary.

The southern part of the province is drained by the Saskatchewan river system and the northern by the Slave and its main tributaries the Pease and Athabaska. Precipitation is low in southern Alberta but towards the north it increases to about 20 inches per annum.

Available Water Power Resources

The water power resources of the province of Alberta are estimated at 390,000 h.p. under conditions of ordinary minimum flow and 1,049,500 h.p. for six months of the year. The principal power rivers of the southerly portion of the province are the Bow, North Saskatchewan and Brazeau having estimated aggregate power resources of 70,000 h.p. for six months of the year but with advantage taken of natural storage economic capacities it is believed that this figure could be doubled or trebled.

In northern Alberta the Athabaska, Peace and Slave have aggregate power resources estimated at close to 1,000,000 h.p. No power development has yet taken place on these streams, but the rapid northward trend of settlement and mineral discovery is directing attention towards them.

Developed Water Power

The total hydraulic installation of Alberta is 70,532 h.p. all but 212 h.p. of which is installed in central electric stations. With the exception of a 960 h.p. development of the Dominion Parks Branch on the Cascade river and an 800 h.p. installation at Lake Louise the production of hydro-electricity is practically confined to the Bow river developments of the Calgary Power Company which serves a transmission system which covers the whole of the western portion of the province from Edmonton south to the international boundary. The Company owns three developments on the Bow river with 11,600 h.p. installed at Kananaskis Falls, 20,000 h.p. at Horseshoe Falls and 36,000 h.p. at the recently completed Ghost development. This Company also controls the 780 h.p. development formerly operated by the Calgary Water Power Company in Calgary.

Utilization of Developed Power

With the exception of the power used in the Crow's Nest Pass for coal mining and secured from the developments of the East Kootenay Power Company in British Columbia, the power developed is used almost entirely for manufacturing, municipal and domestic use. The Calgary Power Company sells power in bulk to some municipalities and in others has taken over the distribution as well. Many of the municipalities, particularly the larger ones, already possessed fuel power stations and the Company owns or operates some of these or purchases power therefrom to supplement the supply of power to the transmission system when the load is greater than can be met by the hydro-electric supply. Figure No. 8 shows the transmission systems of the province.

Saskatchewan

The province of Saskatchewan has an area of 252,000 square miles and may be divided into the two main divisions of the plain region and the Laurentian plateau. The southern part of the province lies in the great central plain of north America but the northern is of an entirely different character being part of the Laurentian plateau with rocky uneven surface, well wooded and plentifully interspersed with lakes, swamps and muskegs.

The southern portion of the province is drained by the north and south Saskatchewan which unite to form the Saskatchewan while the northern portion is drained easterly by the Churchill and westerly by the Black.

Available Water Power Resources

The water power resources of Saskatchewan are estimated at 542,000 h.p. at ordinary minimum and 1,082,000 h.p. at ordinary six months flow. The water power sites in the southern portion of the province have their values impaired by the low winter flow and summer floods but may possibly be advantageously developed in conjunction with fuel power plants. The more extensive resources of the northerly streams have until recently been too far afield for development but the opening up of new mining fields in Saskatchewan and adjacent portions of Manitoba has already led to the commencement of construction at the Island Falls site on the Churchill river.

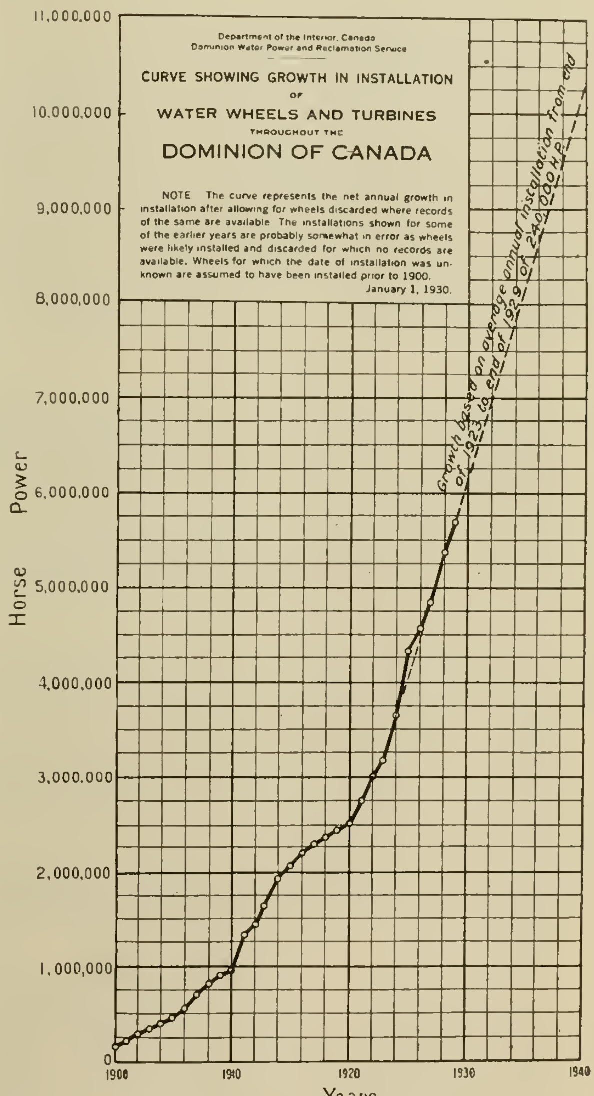

Figure No. 4.

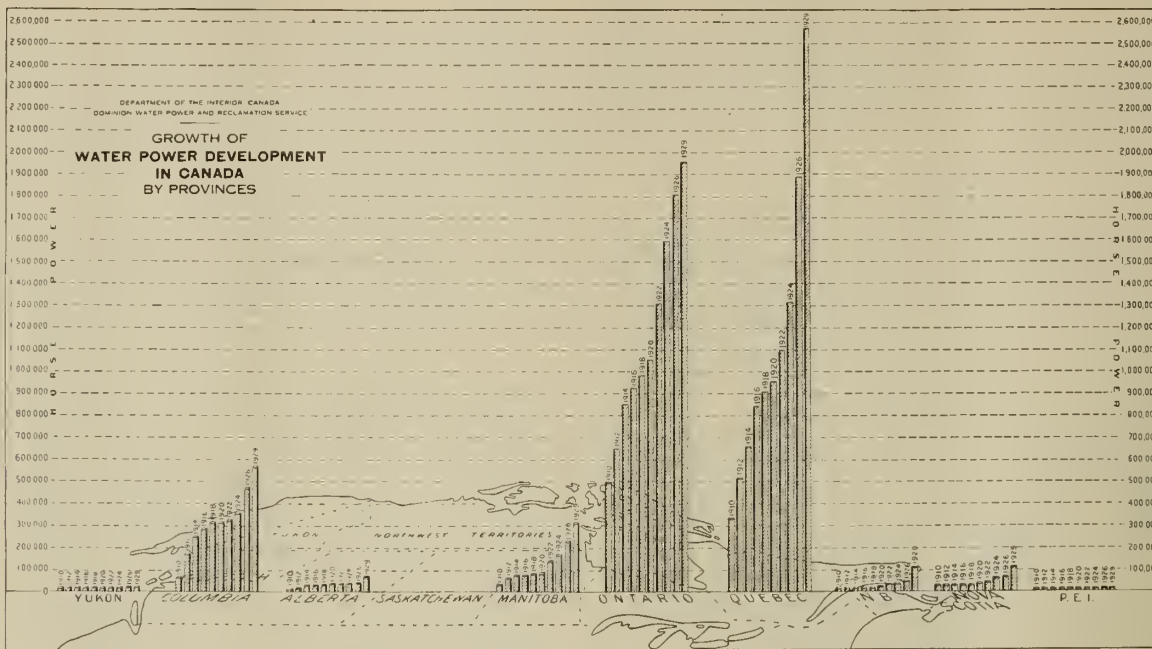

Figure No. 5.

Developed Water Power

Except for a small development of 35 h.p. in connection with an Indian mission the Island Falls site referred to above is the first to be developed in the province. This development which is being made by the Churchill River Power Company will be 84,000 h.p. of which the initial installation of 42,000 h.p. will soon be in place. The power will be transmitted 65 miles to the Flin Flon mine of the Hudson Bay Mining and Smelting Company, the parent company. A stated portion of the power, on requisition of the Government of Saskatchewan, must be made available for public distribution.

Manitoba

The province of Manitoba has a total area of 250,000 square miles and the Nelson river, which lies entirely within its boundaries, drains the vast area which contributes water to Lake Winnipeg. This watershed comprises nearly one-half the area of Alberta and Saskatchewan, a considerable area in western Ontario and northern Minnesota and North Dakota, while about three-fifths of the whole of Manitoba is tributary to the Lake Winnipeg-Nelson river basin.

A line, commencing a few miles west of the Lake of the Woods and extending northward and westward following the east shore of Lake Winnipeg and thence northwesterly to the Saskatchewan boundary, divides the province of Manitoba into two sections. To the west and south of this line is the great central plain of north America, while to the north and east is the great Laurentian plateau, both of which have already been described.

Precipitation in Manitoba ranges from about 18 inches in the south to 15 inches in the north with an average of 20 inches on the watersheds in the eastern part of the province.

Available Water Power Resources

The water power resources of the province of Manitoba are estimated at 3,309,000 h.p. under conditions of ordinary minimum flow and 5,345,000 h.p. for six months of the year. The outstanding power river of the province is the Nelson which, between Lake Winnipeg and Hudson bay has a descent of 710 feet and a power capacity of from two and a half to four million horse power. The most important power river from the point of present utility is the Winnipeg, capable of supporting an installation of about 750,000 turbine horse power and already the chief source of energy for southern Manitoba. Other large power sites exist on the Churchill river and at Grand Rapids on the Saskatchewan river, whilst the smaller rivers possess many sites of a considerable economic value.

Developed Water Power

The total turbine installation in Manitoba is now 311,925 h.p., of which nearly 311,000 h.p. is on the Winnipeg river — 105,000 h.p. at the Point du Bois plant of the City of Winnipeg, 37,800 h.p. at the Pinawa station of the Winnipeg Electric Company and 168,000 h.p. developed by a subsidiary of the same company, the Manitoba Power Company, at Great Falls. Another subsidiary of the Winnipeg Electric Company, the Northwestern Power Company, is now engaged on a 225,000-h.p. undertaking at Seven Sisters Falls, half of which will be shortly brought into operation under reduced head. The Seven Sisters development will bring about the abandonment of the Pinawa development which utilizes water in a side channel, which water will be re-diverted to the main river. The City of Winnipeg has also commenced a development at Slave Falls, on the Winnipeg river, with an ultimate designed capacity of 100,000 h.p. No other power developments in the province can be considered as imminent although a project is under consideration for Whitemud Falls on the Nelson river where a 300,000-h.p. installation has been proposed, whilst a number of smaller sites are being actively considered for the supply of power for mining in the northern sections of the province.

Utilization of Developed Power

The principal use of Winnipeg river power is for transmission to Winnipeg and district for general industrial, municipal and domestic purposes. The transmission systems are illustrated in figure No. 9, which indicates also that is transmitted to the pulp and paper mill of the Manitoba Paper Company, a subsidiary of the Abitibi Power and Paper Company, Limited, at Fort Alexander and for mining in the Central Manitoba area.

Ontario

The province of Ontario has an area of about 407,000 square miles and is divided into two main watersheds, one draining southerly into the Great Lakes and St. Lawrence river and the other northerly into Hudson and James bays. The extreme westerly portion of the province drains to Hudson bay by way of the Winnipeg and Nelson rivers. With the exception of the comparatively small area in the south bounded by lakes Huron, Erie, Ontario and the St. Lawrence and lower Ottawa rivers and an area in the far north comprising the coastal plain, the whole of Ontario lies within the Laurentian plateau and possesses its characteristics which have already been described.

Precipitation in the lower Great Lakes and St. Lawrence basin ranges from 30 to 40 inches per annum, in the upper Great Lakes and northwesterly portions of the province it ranges from 20 to 25 inches and in the far north diminishes to 20 inches or less.

Available Water Power Resources

The water power resources of the province of Ontario are estimated at 5,330,000 h.p. under conditions of ordinary minimum flow and 6,940,000 h.p. for six months of the year. The outstanding resources are situated on the Niagara and St. Lawrence rivers. On the Niagara, the power of which is shared with the United States, the complete power capacity is from five to six million horse power, but by international treaty Canada is restricted to a total diversion of 36,000 and the United States to 20,000 cubic feet per second and the figures given above for the extent of available power resources in Ontario takes account of this restriction. The available power on the St. Lawrence where it forms the boundary is from one and a half to two million horse power. These also are shared with the United States. Another river, the Ottawa, which forms the boundary between Ontario and Quebec, possesses large power resources estimated at from 600,000 to 1,000,000 h.p. which would be shared between the two provinces. To specify every river possessing considerable power capacity would require considerable space and it will suffice to state here that throughout the whole Laurentian area many power rivers are to be found ranging in capacity from the Abitibi of from 230,000 to 335,000 h.p. downwards to those having a capacity of 1,000 h.p. or less.

Developed Water Power

The present total turbine installation in Ontario is 1,959,675 h.p. and virtually the entire energy requirements of the province for industry and for municipal and domestic uses is supplied by this development supplemented by power purchased in bulk from hydro-electric stations on the Gatineau and Quinze rivers in Quebec. Consideration of this development can best be made by treating it under the sub-headings of Central Stations, Pulp and Paper, and Mining.

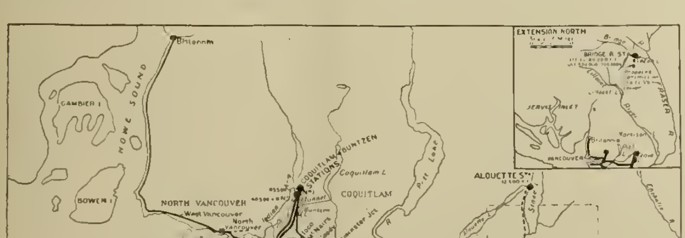

Figure No. 6.

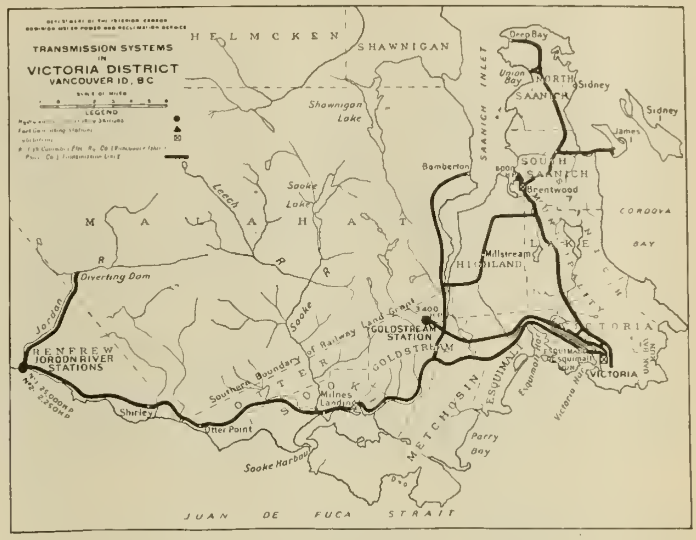

Figure No. 7.

Central Station Developments

By far the largest organization for the production and distribution of central station power is the Hydro-Electric Power Commission of Ontario. The Commission operates eight systems through which it sells power to some 550 municipalities and owns and operates 25 power stations with an aggregate installation of 1,047,879 h.p. In addition it purchases power from the Gatineau Power Company for its Niagara and three eastern Ontario systems. The largest system is the Niagara which serves the whole southwestern peninsula from east of Toronto as far west as Windsor and is supplied by the Commission's Queenston development of 502,000 h.p., the Ontario power station of 208,200 h.p., and the Toronto power station of 164,000 h.p., all three at Niagara Falls. In addition to this installation, totalling 874,200 h.p., the Commission purchases power from the Gatineau Power Company under a contract for the supply of 230,000 to 260,000 h.p. Delivery of this power is taken at the Ottawa river to which the Company transmits it and is conveyed from there over the Commission's own 220,000-volt line to Toronto. The Georgian bay system is served by six stations with an aggregate capacity of 25,050 h.p.; the Nipissing system by three stations totalling 57,000 h.p.; the Ottawa system by power purchased in bulk; the Thunder bay system by a 75,000-h.p. plant on the Nipigon river; the central Ontario and Trent systems by nine plants on the Trent Canal with an aggregate capacity of 57,980 h.p.; the St. Lawrence system by purchased power and the Rideau system by two stations aggregating about 4,500 h.p. and by purchased power.

The Commission is at present providing for the growing demand for power by recent purchases of developed and undeveloped sites, by installing a tenth unit, 58,000 h.p. in its Queenston plant and by a new station of 54,000 h.p. at Alexander Landing on the Nipigon river. A contract has also been made recently with the Beauharnois Light, Heat & Power Company in Quebec, whereby the Commission will purchase 250,000 h.p. at $15.00 per h.p. year, delivery to commence in 1932.

While the Commission operates slightly more than three-fifths of the total central electric station installation of Ontario there are a number of outstanding instances of distribution under joint stock company ownership, particularly of power developed for specific uses such as mining or pulp and paper manufacturing. The largest of

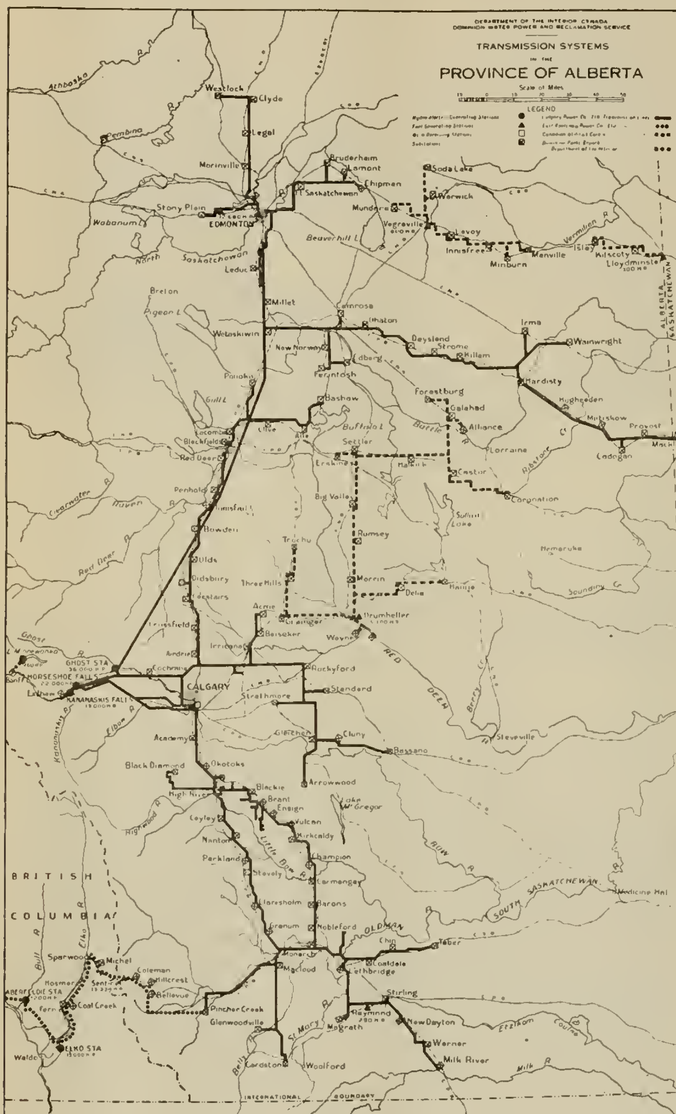

Figure No. 8.

these systems, the Canada Northern Power Corporation, serves the gold and silver mining areas in northern Ontario and north western Quebec from seven stations in Ontario with an aggregate installation of 53,340 h.p. and one in Quebec of 40,000 h.p. This Company has also commenced the construction of a plant on the Montreal river, its fourth on that stream, where 13,000 h.p. will be installed. The International Nickel Company of Canada operates through subsidiary companies five plants on the Vermilion and Spanish rivers with an aggregate installation of 62,500 h.p. much of the output being used in the mining and smelting plants of the parent company although a considerable portion is sold for general industrial and domestic use. The Abitibi Electrical Development Company, a subsidiary of the Abitibi Power and Paper Company, operates a 48,000-h.p. plant at Island Falls on the Abitibi river from which power is sold for general distribution and the remainder used to supplement the supply for the parent Company's Iroquois Falls mills where 58,000 h.p. additional is installed. The Keewatin Power Company has two plants totalling 30,875 h.p. at the outlets of the Lake of the Woods, developed for general distribution and for supplying the mills of its parent company, Kenora Paper Mills Limited. The Ontario and Minnesota Power Company operates four plants totalling 51,850 h.p. on the Seine and Rainy rivers, for general distribution and pulp and paper mill supply. Among the privately owned plants doing a purely central station business may be mentioned that of the Dominion Power and Transmission Company at Decew Falls where 45,000 h.p. is developed for distribution in Hamilton and vicinity, the Great Lakes Power Company's 28,000-h.p. plant at Sault Ste. Marie, the Kaministikwia Power Company's 35,000-h.p. plant at Kakabeka Falls, near Fort William, and the Ottawa Electric Company's three stations on the Ottawa river at Ottawa which have an aggregate installation of 13,100 h.p. Figure No. 10 shows the transmission systems operated in the province.

Pulp and Paper Installations

There are 48 pulp and paper mills in Ontario operated by hydraulic power over half of which develop all or part of the power used in operating them. The mills producing their own power have an aggregate installation of 238,880 h.p. of which approximately 60 per cent is hydro-electric and the remainder direct connected to the mill machinery while much of the power purchased is secured from central electric stations developed under the aegis of the pulp and paper companies supplied. Among the larger installations not specifically referred to in the preceding section may be mentioned those of the Abitibi Power and Paper Company at Smooth Rock Falls, Sault Ste. Marie, Espanola and Sturgeon Falls which total to 68,340 h.p., those of the Spruce Falls Power and Paper Company of Kapuskasing totalling 58,750 h.p. and that of J. R. Booth Limited at Ottawa, 29,000 h.p.

Power for Mining

The province of Ontario ranks first amongst the provinces in diversity and value of mineral production and the mineral industry secures practically all its power requirements from water power. Here again much of the power is developed by central station organizations under the control of the mining companies, the principal producers being the Canada Northern Power Corporation and International Nickel Company of Canada already referred to. In addition the Wahnapitae Power Company which has been recently acquired by the Hydro-Electric Power Commission of Ontario operates three stations in the Sudbury district aggregating 16,900 h.p., the Algoma district is served from two stations aggregating 21,170 h.p. and the Red Lake district by a recently completed plant of an initial installation of 5,000 h.p.

Quebec

The province of Quebec with a total area of some 600,000 square miles is comprised in two main drainage basins, the St. Lawrence river and gulf and James and Hudson bays. There are also smaller areas which drain respectively into the Bay of Chaleur, into the St. John river and thence through New Brunswick and a third, the Koksoak, which flows into Ungava bay.

North of the St. Lawrence practically the whole territory is part of the Laurentian plateau which, as has already been stated, is favourable to the widespread location of water powers both great and small. South of the St. Lawrence and west of a line from the City of Quebec to the foot of Lake Champlain the country is a comparatively flat plain broken only by hills rising abruptly to heights of about 1,000 feet. East of this line the territory becomes more rugged being part of the Appalachian highlands.

Throughout the St. Lawrence basin precipitation ranges from 30 to 40 inches annually while towards the Hudson bay it diminishes to 25 inches or less.

Available Water Power Resources

The total available resources of the province of Quebec are estimated to be 8,459,000 h.p under conditions of ordinary minimum flow or 13,064,000 h.p. ordinarily available for six months of the year.

There are a great many rivers in the province with large power resources — the St. Lawrence with from two to two and a half million h.p., the Saguenay with from one and a quarter to one and a half million and the St. Maurice with upwards of a million h.p., are the largest with many others having capacities of from 100,000 to 1,000,000 h.p., in fact, there is no section of the province far removed from available water power.

Developed Water Power

The present turbine installation in the province is 2,572,418 h.p., more than double what it was at the time of the First World Power Conference, while there is no abatement in construction operations. A 260,000-h.p. initial development is expected to be completed on the Saguenay in 1931 and expanded later to an ultimate installation of 1,000,000 h.p.; another development on the Lievre of 90,000 h.p. initial and 120,000 h.p. ultimate installation is under construction; a 500,000-h.p. development at Beauharnois on the St. Lawrence has recently been commenced and many others are in active prospect.

Utilization of Developed Power

As in Ontario, the use of power is most easily treated under the sub-headings of Central Station, Pulp and Paper, and Mining, bearing in mind that many central stations provide power for the manufacture of paper and for the mining industry, whilst other power plants which were developed primarily for these industries also do a central station business.

Central Electric Station Development

The more notable central electric station developments are those of the Gatineau Power Company which operates 6 plants aggregating well over half a million horse power on the Gatineau and Ottawa rivers in the Hull-Ottawa district and 12 smaller stations serving the district along the north shore of the Ottawa river between Hull and Montreal; the Montreal Light, Heat and Power Consolidated serving the city and district of Montreal from three stations totalling 229,500 h.p. on the St. Lawrence and one of 21,600 h.p. on the Richelieu river; the Southern Canada Power Company serving the district south of Montreal to the International boundary from five stations totalling 58,580 h.p.; the Shawinigan Water and Power Company and subsidiaries serving the districts along the north shore of the St. Lawrence from Montreal to Murray bay east of Quebec City and between the St. Lawrence and the International and New Brunswick boundaries from sixteen stations with a total installation of 647,850 h.p. and the Duke-Price Power Company operating a 495,000 h.p. station at Isle Maligne on the Saguenay river. This latter station serves large pulp and paper and aluminum industries as well as other local demands. The transmission systems of all of the above mentioned organizations are interconnected for the exchange of power. The generating stations and transmission systems of the populated section of Quebec are illustrated on figure No. 11 which serves to show that hydro-electric energy is everywhere available in ample quantity to meet the industrial and domestic demands of the province.

Pulp and Paper Installations

In the province of Quebec there are 53 mills utilizing hydro-electricity in the production of pulp and paper. The mills maintaining and developing their own power have an aggregate turbine installation of 215,736 h.p. of which 145,296 h.p. is direct connected to mill machinery and 70,440 h.p. to electric generators. In addition to the mills purchasing all their power requirements many of the mills developing power supplement it by purchased power. The supply of power for industry will shortly be increased by the completing of a 90,000-h.p. development on the Lievre river to supply a pulp and paper mill being built near Buckingham.

Power for Mining

Under this heading should also be included power used in the production of aluminum and in electro-chemical industries. Comparatively recently the Rouyn mining area has been opened up and is supplied by a development on the Quinze river which has already been mentioned as furnishing power for mining in Ontario. This plant is operating under 70-foot head with an installation of 40,000 h.p. It is proposed to increase the capacity to 56,000 h.p. by raising the head to 90 feet. At Shawinigan Falls on the St. Maurice river there is a substantial electro-chemical industry obtaining power from the St. Maurice river

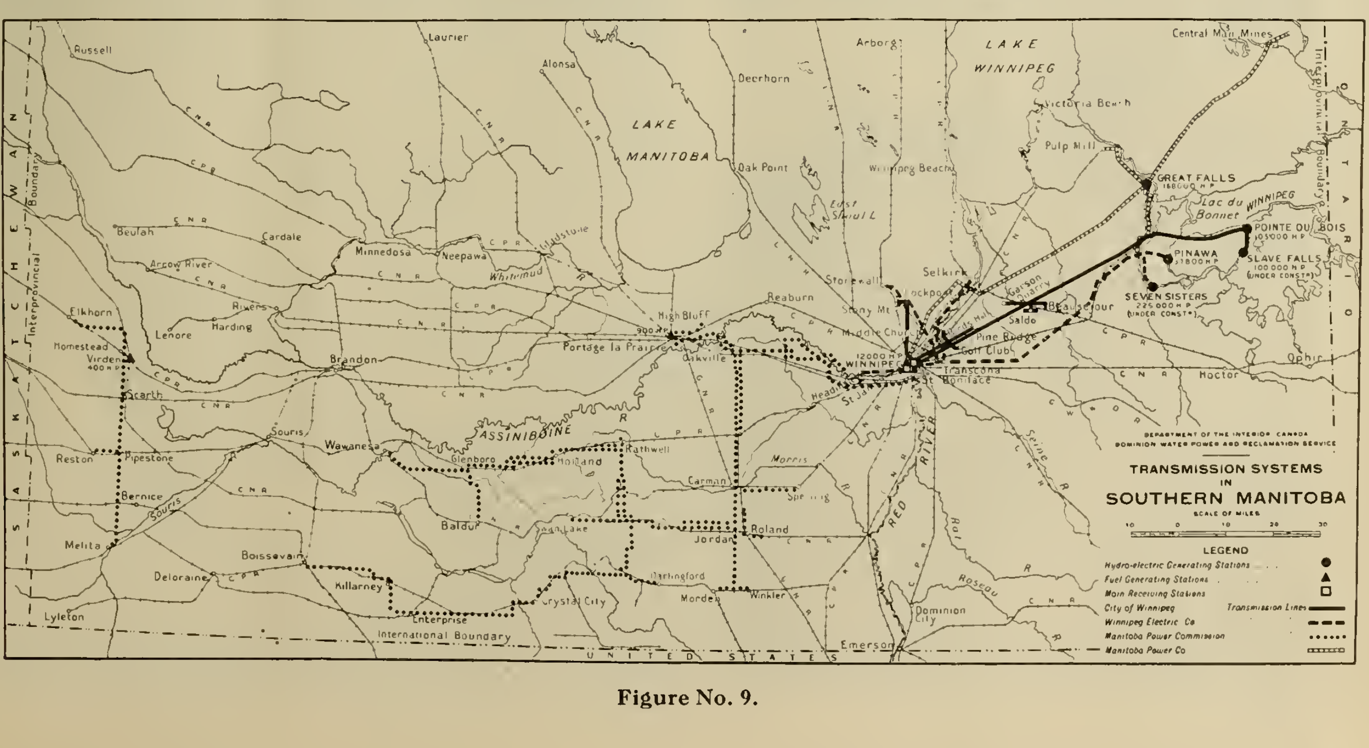

Figure No. 9.

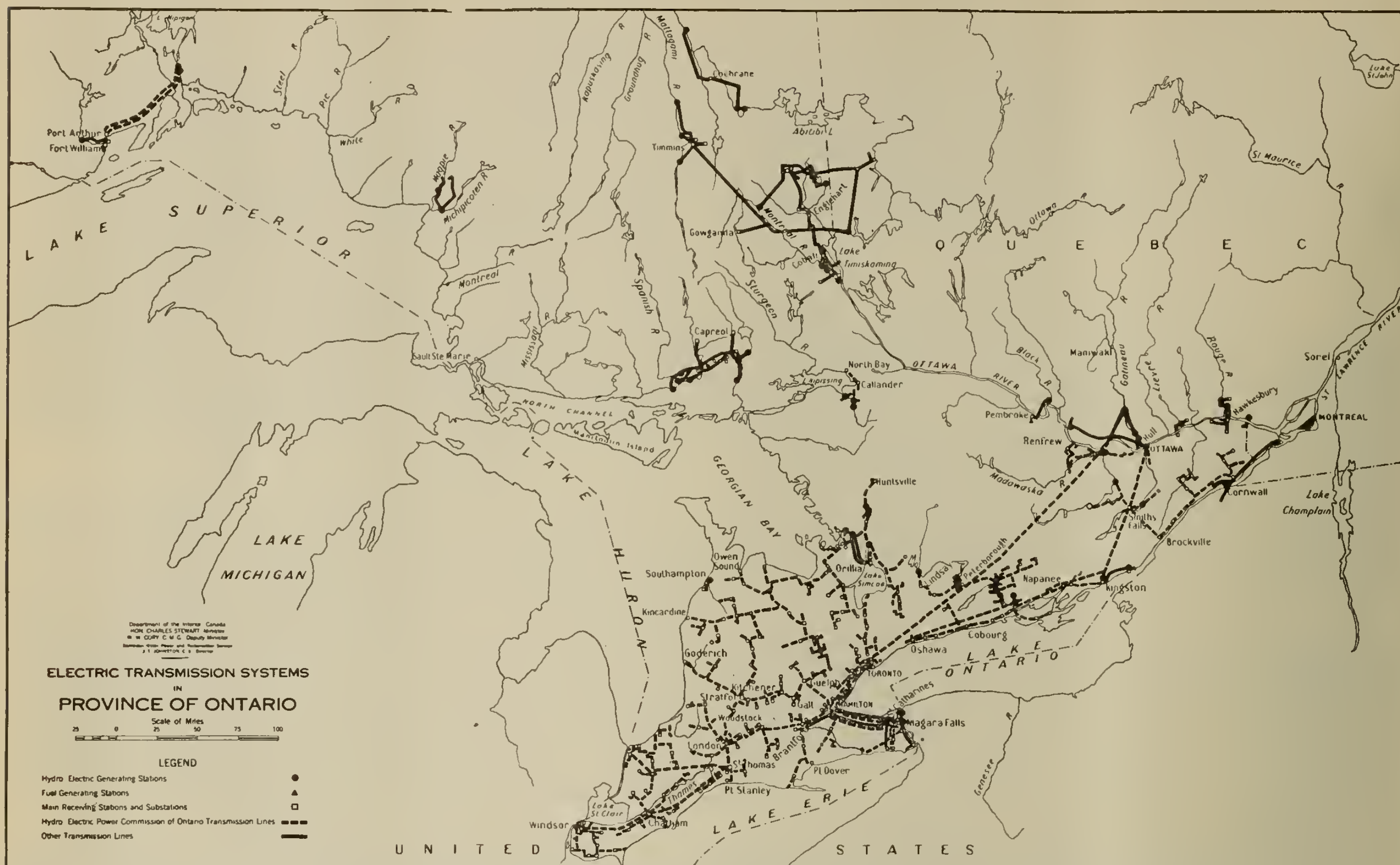

Figure No. 10.

stations. Recently the Aluminum Corporation of Canada established a plant for the production of aluminum at Alcoa. This industry at present secures power from the Isle Maligne development, though a subsidiary the Alcoa Power Company has commenced a hydro-electric development at Chute-a-Caron on the Saguenay river which, as already stated, will have an initial installation of four 65,000 h.p. units to be completed in 1931 and an ultimate capacity of about one million horse power.

Storage Developments

An outstanding feature of power development in the province of Quebec has been the construction by or under the control of the Quebec Streams Commission of storage dams to regulate and augment the flow of streams so as to greatly increase their available power. Such dams have been constructed on the St. Maurice, St. Francois, Ste. Anne-de-Beaupre, Metis and Gatineau rivers and on Lake Kenogami. The most recently completed storage project, that on the Upper Gatineau river, was commenced in 1926 with the construction of the Mercier dam and has just been brought to a successful conclusion by the completion of the Cabonga dam. It provides two reservoirs for the regulation of the Gatineau river, the Baskatong of 96,000,000,000 cubic feet and the Cabonga of 45,000,000,000 cubic feet. The Commission has an extensive storage project under way at the present time to regulate the flow of the Lievre river by a reservoir of 25,000,000,000 cubic feet at Cedars rapids while it has recently been announced that the Shawinigan Water and Power Company under the authority of the Commission will construct a reservoir on the Mattawin river which will warrant an addition of 100,000 h.p. to the company's plants at Grand'Mere, Shawinigan Falls and La Gabelle.

Maritime Provinces

The provinces of New Brunswick, Nova Scotia and Prince Edward Island, with a total area of about 51,000 square miles, are known collectively as the Maritime provinces and both geographically and geologically differ completely from Ontario and Quebec. The Laurentian plateau does not extend into these provinces, the climate is more moderate, the precipitation greater and the watersheds are smaller. The ample precipitation of from 40 to 55 inches annually, comparatively high altitudes approaching to the seashore and many natural reservoir sites, all contribute to the making of a number of attractive power sites. These sites when compared to those already discussed are relatively small but are nevertheless of considerable aggregate capacity and constitute a valuable economic natural resource.

Available Water Power Resources

The aggregate resources of these provinces is 82,400 h.p. under conditions of ordinary minimum flow and 302,900 h.p. for six months of the year, but with storage will justify a turbine installation considerably in excess of the larger figure, in fact the installed capacity is already 223,076 h.p.

Developed Water Power

The present installation in New Brunswick is 112,131 h.p., in Nova Scotia 108,406 h.p. and in Prince Edward Island 2,439 h.p. In New Brunswick there is one large development, that of the St. John River Power Company at Grand Falls on the St. John river where 60,000 h.p. is installed of an ultimate 80,000 h.p. capacity. Other substantial developments are 14,000 h.p. on the Nipisiguit river and 11,400 h.p., on the Aroostook river. The New Brunswick Electric Power Commission has now been in operation for about 10 years and distributes power in a number of districts. This power is produced in the Commission's own 11,100-h.p. station on the Musquash river, supplemented by power produced in privately owned stations. In Nova Scotia recent power development has been largely due to the Nova Scotia Power Commission which has developed a number of sites to supply power for both general distribution and for sale in bulk for industries. The number of the Commission's installations is now ten and the aggregate installation 60,905 h.p. or over 56 per cent of the total for the province. Water power development in Prince Edward Island is limited by the small extent of the power resources which consist of a number of mill-sites on small streams in the main only large enough to supply energy for a mill or small community. The most recent development was of 160 h.p. completed in 1927.

Utilization of Developed Water Power

Approximately 75 per cent of the developed power in New Brunswick is distributed by central electric stations, reference to figure No. 12 showing the considerable areas enjoying such service. Pulp and paper mills of which there are six operating on hydraulic power either developed as part of the mill project or purchased from central stations maintain an installation of 13,728 h.p. of which all but 1,900 h.p. is converted to electricity.

In Nova Scotia approximately the same conditions obtain as in New Brunswick. Almost 71 per cent of the power is installed in central electric stations and the pulp and paper mills of which there are eight operating and one under construction have an installation of 16,008 h.p. all directly connected to mill machines and also purchase considerable electric power from the central stations.

The Yukon and Northwest Territories

These territories have a total area of one and a half million square miles and aggregate power resources estimated at 294,000 h.p. under conditions of ordinary minimum flow and 731,000 h.p. for six months. These estimates are based, in the main, on the reports of members of the geological survey and other explorers and not upon actual measurements of flow and fall, although some reconnaissance measurements have been taken in the Yukon. The development of power is so far restricted to the Yukon and amounts to 13,199 h.p. used for the supply of Dawson and to supply power for gold dredging operations in that area. It is possible that the development of silver-lead properties in the Mayo district will require water power development, whilst a number of sites in the Great Slave lake areas are being spoken of to supply power for the working of recent mineral discoveries to the south of that lake. It is possible, therefore, that with the opening up of northern Canada there will be in time a considerable amount of water power development in the Northwest Territories.

III. Administration

Recent Water Power Legislation and Tendencies of Administrative Policy

Introduction

The third section of the paper on Canada's water power resources presented at the First World Power Conference in 1924 contained a description of the administrative policies and procedures adopted in the various parts of Canada for the control of water power development and a synopsis of the basic laws in force in each province. No important changes have been made in these policies and laws since 1924 and the great increase in development already described has taken place in accordance with administrative principles now well established which have proved sound and adequate to meet the conditions of an expanding and highly specialized industry.

The two main principles on which water power development is based throughout Canada may be described

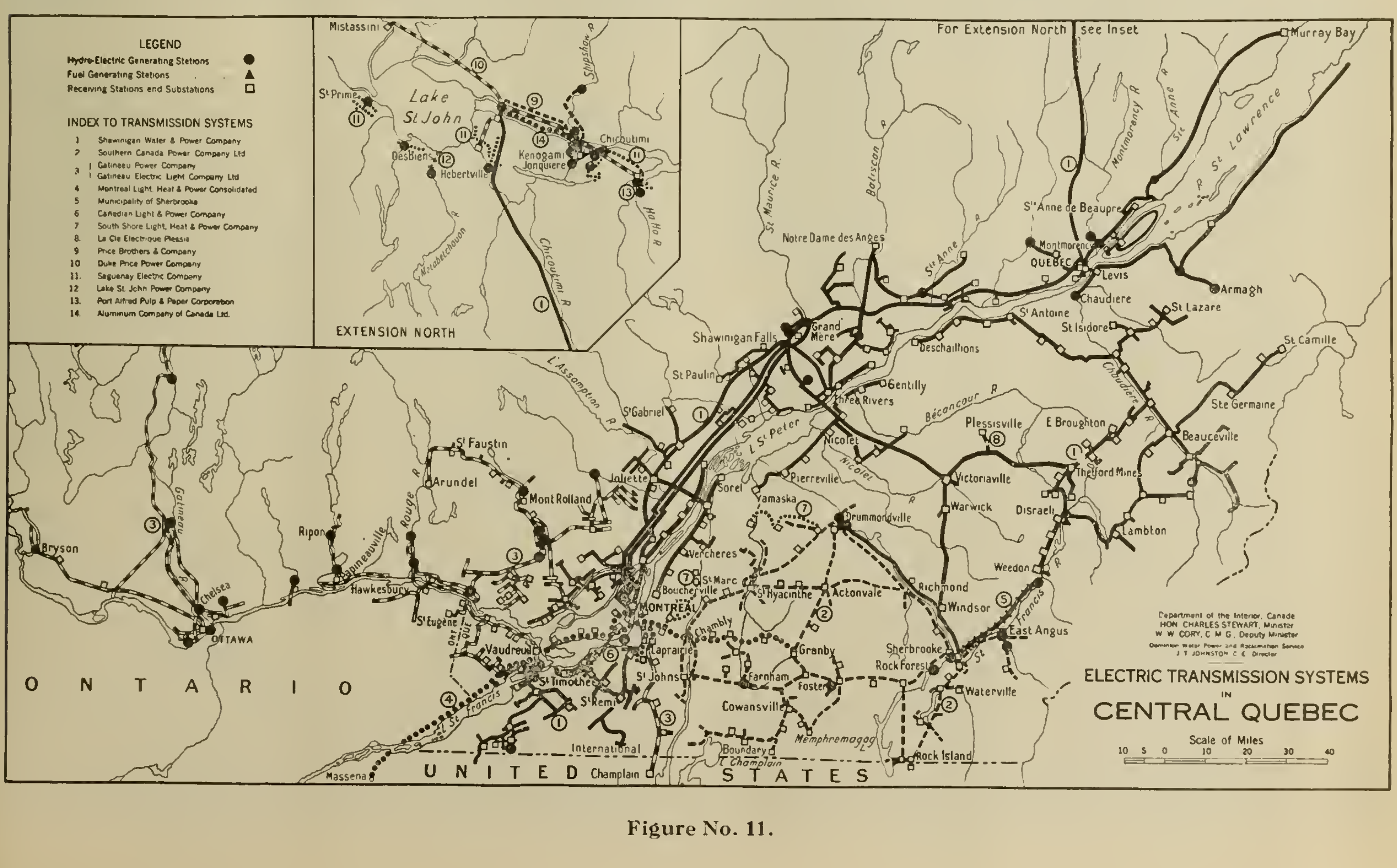

Figure No. 11.

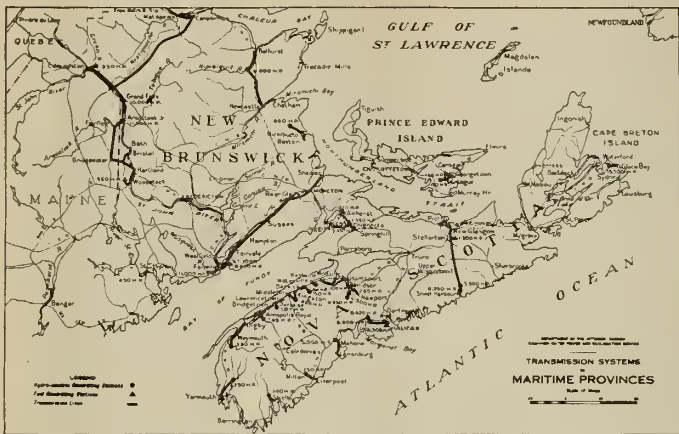

Figure No. 12.

as public ownership and operation under government agency and private ownership and operation under controlled conditions, or more specifically,—

(1) Development of power sites and transmission and sale of power at cost by a commission appointed by a provincial government, acting under legislative authority and financially supported by the credit of the province;

(2) Granting of power privileges to municipalities, companies or individuals by lease or license for a definite term, under government control of rates and service and subject to charges for the privilege granted

Power sites privately owned may also be developed upon complying with the Dominion and provincial laws in regard to works in water, but subject, in the cases of public utilities, to control of rates and service.

Public ownership with the supply of power at cost is general throughout the greater part of Ontario, and has been adopted on a smaller scale in New Brunswick, Nova Scotia, Manitoba and Saskatchewan. In Manitoba, the Power Commission operates an extensive system of transmission but buys nearly all the power which it distributes. In Saskatchewan, a Power Commission was appointed in 1929 under authority of an act of the Legislature passed early in that year and based on the similar acts already in force in Ontario and other provinces. The Commission has begun its operations by acquiring the municipal fuel-power plants in Saskatoon and some of the neighbouring towns; and by making suitable interconnections has thus begun to build up a power system.

Privately owned developments play an important part in supplying the power requirements of all the provinces and, in some cases, the outstanding or major part. Power companies operating sites leased from the Crown have built up great undertakings in Quebec, northern Ontario, Manitoba, Alberta and British Columbia which form the basis of the industrial and domestic well-being of these areas. The sale of blocks of power at economic rates from privately owned developments to the public ownership commissions constitutes an important factor in balancing power supplies with the demand in several important areas and jointly and beneficially meets the purposes and requirements of the two types of development.

Public ownership and municipal and private enterprise are thus to be found side by side throughout Canada either in the same or in neighbouring provinces and the two policies, so different in principle, are alike in the great results which they have achieved. The outstanding example in Canada of public ownership is the Hydro-Electric Power Commission of Ontario which has become the world's largest power producing and distributing agency. The group of power companies serving the metropolitan district of Montreal and adjacent areas and those supplying similar facilities in other provinces show the possibilities of private enterprise. The descriptions of these developments in the earlier part of this paper bear testimony to the great progress which has been made in hydro-electric practice under both administrative policies.

The reader is referred to the previous paper of 1924 for a general survey of water power legislation in Canada and of the policies which have been adopted to aid in the production of low-cost power, but it may be repeated, in order to make clear what follows, that under the plan of self-government which has been adopted for the Dominion of Canada, those provinces which in a general sense own their natural resources have, through their legislative assemblies, the exclusive right to determine the conditions under which the water powers within their territorial boundaries may be developed and used, while in those provinces wherein the natural resources are still vested in the Crown in the right of the Dominion, the water powers are administered by the Parliament of Canada.

The provinces which directly control their water power resources are Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia. In the others, Manitoba, Saskatchewan and Alberta, the water power resources are administered under Dominion legislation, as also in the parts of Canada lying outside the provinces, namely, the Yukon and Northwest Territories. In the railway belt of British Columbia, which is a strip of land twenty miles in width on either side of the main line of the Canadian Pacific Railway across the province, transferred by the province to the Dominion as an aid towards the construction of the railway, the water powers belong to the Dominion but their administration has been entrusted to the province, to be dealt with under the general water power laws of the province, for economic reasons.

Dominion Control of Navigable Waters

The absolute right of those provinces which own their natural resources to deal with the water powers within their boundaries is limited by the control of the Dominion over all works in navigable waters. "The Dominion Parliament, which has authority to legislate for the conservancy of navigation, has, beyond doubt, a right to declare what shall be deemed an interference with navigation, and to control all works erected in navigable waters." (Chief Justice Strong, 26 S. C. R. at 538.) In pursuance of this right the Dominion Parliament has enacted that,—

"No work (subject to certain minor exceptions) shall be built or placed in, upon, over, through or across any navigable water unless the site thereof has been approved by the Governor in Council, nor unless such work is built, placed and maintained in accordance with plans and regulations approved or made by the Governor in Council." (R. S. C. 1927 c. 140 s. 4.)

The nature and extent of the Dominion's control over navigable waters have been freely discussed in recent years and the subject is one which is full of difficulty and of much concern to the provinces. In order to define the respective rights of the Dominion and the provinces with regard to water powers in navigable rivers, especially those which are interprovincial and international in character, the Dominion Government, after consulting with the provincial governments, drew up a series of questions which were submitted for elucidation to the Supreme Court of Canada in October 1928. The questions, however, proved to be of too hypothetical a character, and the court declined to answer them in categorical terms. The decision of the court upon these questions leaves the whole subject much as it was before, but the general conclusion as expressed in this judgment is that a province has the right to control or use the waters in provincial rivers and to develop or authorize the development of water powers within the province, provided that in so doing navigation is not prejudiced and that the province complies with Dominion requirements as to navigation, and provided further that there is no valid conflicting legislation by the Dominion under an overriding power, such, for example, as the Dominion jurisdiction with respect to canals connecting a province with any other or others of the provinces or extending beyond the limits of the province. (See Re Water Powers Reference, Canada Law Reports, 1929.)

Exportation of Hydro-Electric Power

In 1907 the Parliament of Canada passed the Electricity and Fluid Exportation Act which prohibits the exportation from Canada of electrical power or energy together with petroleum, natural gas, water or other fluid except under license to be granted by the Governor in Council upon such conditions as he thinks proper. Under authority of this act, regulations were established by the Governor in Council on November 4, 1907, setting out the conditions for the granting of export licenses. The principal features of these licenses are that they must be renewed annually and are revocable at will by the Governor in Council if the licensee refuses or neglects to comply with any of the conditions from time to time imposed by the Governor in Council under the act.

Section 10 of the act of 1907 provides that the Governor in Council may impose export duties not exceeding ten dollars per annum per horse power upon power exported from Canada. In accordance with this provision, an export duty of three one-hundredths of one cent per kilowatt hour upon power exported from Canada became effective on April 1, 1925. This duty is payable monthly by the licensee and is in addition to the yearly license fee of from $25 to $50 per annum. During the fiscal year ending March 31, 1928, the duty paid on power exported amounted to $373,676.21.

Dominion Water Power Legislation

The Dominion Water Power Act remains unchanged since its passage in 1919. The regulations of 1921 under that act have been amended only by an Order in Council of September 10, 1928, which broadens the discretion of a regulating authority in determining the fair rate of return which a water power licensee may be permitted to earn and introduces the principle that current rates of wages must be paid to all those engaged in the construction, operation and maintenance of developments authorized by the act. The act and regulations, which were prepared with the greatest care, have proved eminently satisfactory as a means of encouraging water power development and protecting both public and private interests. Although the rights granted are for a definite term of years only, and the Crown reserves the right of recapture, more than $80,000,000 have already been invested by private and municipal enterprise in undertakings based upon these regulations.

The only recent legislation dealing with Dominion water powers is an act entitled An Act Respecting Water Power in the Provinces of Alberta, Saskatchewan and Manitoba, passed in 1929, which authorizes the Government of Canada to enter into agreements with the governments of the three provinces named, or any of them, for the transfer to the provincial governments of the administration of the ungranted water powers on Dominion lands in these provinces. The water powers are then to be administered under provincial laws in a manner similar to that in which the province of British Columbia administers the water powers in the railway belt of that province. Up to the present time no agreements have been made under this act, but Alberta early in 1929 passed legislation to provide for the administration of their water powers in the event of the transfer taking place.

Provincial Power Commission Acts

The provincial acts governing the operations of the power commissions in New Brunswick, Nova Scotia, Ontario and Manitoba remain substantially unchanged since 1924, although many amendments on minor points have been made as experience has shown to be desirable. Important additions have been made to the Ontario and Manitoba acts for assisting in the supply of power in rural districts. The Saskatchewan Power Commission Act of 1929, by means of which that province has now entered on the field of public ownership of power supplies, is very similar to the other corresponding provincial acts and provides adequate authority for the development, distribution and supply of power throughout the province by government agency. As a means of regulating the operations of privately owned supplies of power, public utility commissions have now been established in every province. The most recent act of this nature which provides for the establishment of a public utility commission in Prince Edward Island is described in the section below dealing with that province.

Water Power Legislation in British Columbia

The Water Act, 1924. The basic water power legislation in British Columbia, the Water Act, was consolidated in 1924 but the administrative system remains unchanged. In 1929, however, an important division was added by which the Board of Investigation became the Water Board and its duties were extended so as to make it a public utility commission with all necessary powers to enquire into and fix rates or tolls and conditions of service for all power companies in the province. There is a right of appeal from orders of the board to the courts. The act provides that every power company shall be entitled to earn a fair return on property used or reasonably held for use in service and that the Water Board in fixing rates must take this into consideration, but the act gives no indication of what constitutes a fair return. The regulations under the Water Act also remain unchanged.

Water Power Legislation in Ontario

In Ontario there has been no change in the regulations for leasing water powers on Crown lands, although the rental charged in new leases is usually one dollar per horsepower-year instead of fifty cents as formerly, the amount of the rental being at the discretion of the Minister of Lands and Forests.

The Water Powers Regulation Act which controls the use of rivers for power purposes also remains unchanged, but the Water Privileges Act and the Rivers and Streams Act, together with the Saw Logs Driving Act and the Timber Slide Companies Act, have been consolidated to form the Lakes and Rivers Improvement Act, R. S. O. 1927 c. 43.

Lakes and Rivers Improvement Act. The general purpose of the Lakes and Rivers Improvement Act is to specify the conditions under which lakes and rivers and their waters may be used for all purposes, to afford means for harmonizing conflicting interests making use of the waters of any particular stream and to regulate works in water. The provisions which particularly affect the owners or developers of water power sites are Parts I, II, and VII.

Part I provides for the approval by the Lieutenant-Governor in Council of dams or other structures for impounding water on all lakes and rivers to which the act applies. Dams already constructed may also be made subject to the act and the owner may be required to make repairs or improvements considered necessary for the protection of public or private interests. Officers may also be appointed to regulate the use of streams, including alterations in the flow and water levels. Part II corresponds to Part I of the Rivers and Streams Act and authorizes the Minister of Lands and Forests to determine without right of appeal the respective rights of users of any particular stream to which this part of the act is made to apply by proclamation. Part VII is the Water Privileges Act in revised form and enables the owner of a water privilege to obtain possession of the lands required for its effective utilization, including necessary transmission lines, subject to payment of compensation.

Power Commission Act. The operations of the Hydro-Electric Power Commission of Ontario, which have been described in Section II of this paper, are conducted in accordance with the Power Commission Act, consolidated in 1927 and now forming Chapter 57 of the Revised Statutes of Ontario 1927. No important changes have been made in the constitution or functions of the commission.

Water Power Legislation in Quebec

No change has been made in the policy by which the Quebec water powers are granted under the form of an emphyteutic lease, and the principal conditions of the standard form of lease are also unchanged. As regards legislation affecting private developments, this also remains practically unchanged, but while the substance of the legislation remains the same, the form of arrangement has been altered by the revision of the statutes adopted in 1925. In this revision the previous system of compiling the statutes as a whole in the form of a code has been abandoned and the statutes are now divided into separate chapters. For example, the reserve of three chains along the banks of non-navigable rivers and lakes, Crown granted since June 1, 1884, is now section 7 of the Quebec Fisheries Act.

The Water-Course Act. The legislation which most directly affects the owners or developers of water power sites in Quebec is the Water-Course Act which collects together in one act a number of the provisions previously scattered through different articles of the code. Of the seven parts into which this act is divided, Divisions I, II, III and VI relate to water power development. Division I affirms the right of the administrative authority to alienate or lease the beds and banks of navigable rivers and lakes, subject to certain conditions. Division II deals with the right of riparian owners to improve water-courses for power and other purposes. Division III authorizes the expropriation of lands required for the utilization of privately owned power sites and Division VI sets out the conditions governing the construction and maintenance of storage reservoirs.

Quebec Streams Commission. The legislation governing the operations of the Quebec Streams Commission, already described in Section II of this paper, was originally passed in 1911 and now forms Division VII of the Water-Course Act.

Prohibition of Exportation of Power. Water power development by private and municipal enterprise continues to be general in Quebec, but in recent years close attention has been given to the conservation of water power resources and their utilization in the best interests of the province. To this end, the exportation of power in which the Crown has an interest was prohibited by an act passed in 1926. The first two sections of this act as follows,—

(1) Every sale, lease or grant whatsoever of water powers, belonging to the province or in which it has rights of ownership or other rights, made on or after the 24th of March, 1926, shall contain a clause prohibiting the exportation, outside of Canada, of the electric power which may be developed in this province.

(2) Every contract, permit or grant authorizing, from and after the same date, the installation or passage of transmission lines, in or over the Crown domain, shall likewise contain a similar prohibitive clause.

The same prohibitions apply to existing contracts unless reported to the Minister of Lands and Forests within three months after the coming into force of the act and to renewals of such contracts. This act does not prohibit the export of power from Quebec to another province, and large contracts have been made in recent years for the export of power from Quebec to Ontario.

Water Power Legislation in New Brunswick

Since 1924, the chief interest in water power development in New Brunswick has centred in the operations of the New Brunswick Electric Power Commission and the development of Grand Falls by the St. John River Power Company.

The latter was incorporated by act of the provincial legislature in 1926 and authorized to develop power at Grand Falls and for that purpose to divert and regulate the flow of the St. John river, to develop storage in New Brunswick and beyond its borders and to transmit and distribute power anywhere in New Brunswick and beyond its borders. The power company, which is a subsidiary of International Power and Paper Company, Limited, acquired the rights and property of Grand Falls Company, previously incorporated with a provincial charter, and was also granted certain property and storage rights belonging to the province. In connection with the development of storage, the act provides that the owners of other power developments on the St. John river are to contribute to the cost, by payments to the power company for benefits derived from the company's storage "based on the ratio of the respective increases of dependable continuous power at each site created by such storage."

Water Power Legislation in Nova Scotia

The Nova Scotia Water Act, which vests in the Crown the right to the use of water and water-courses in the province, has not been amended since 1920 and is now Chapter 26 of the Revised Statutes of Nova Scotia, 1923. In 1926 the Chairman of the Nova Scotia Power Commission was appointed the Minister to have charge of the administration of the Water Act and the Regulations under it. These Regulations are still substantially in the form in which they were approved by the Minister of Public Works and Mines in 1922.

Water Power Legislation in Prince Edward Island

In 1929 Prince Edward Island fell in line with the other provinces of Canada by passing a Public Utilities Act providing for the appointment of a commission of three members by the Lieutenant-Governor in Council to deal with motor bus services, telephones, light, heat and power companies, and municipal undertakings of a like nature. The commission is given the usual powers to regulate effectively the rates charged and service rendered by public utilities and an appeal may be taken from any of its decisions to the provincial Court of Appeal. The annual expenses of the commission are to be borne by the several public utilities under its jurisdiction in proportion of their gross earnings.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA
FORCES HYDRAULIQUES DISPONIBLES ET AMÉNAGÉES AU CANADA

PROVINCE	Available 24-hour power at 80% efficiency: At ordinary min. flow h.p. (1)	Available 24-hour power at 80% efficiency: At ordinary 6 months flow h.p. (2)	Turbine Installation h.p. (3)
British Columbia	1,931,000	5,103,500	559,792
Alberta	390,000	1,049,500	70,532
Saskatchewan	542,000	1,082,000	35
Manitoba	3,309,000	5,344,500	311,925
Ontario	5,330,000	6,940,000	1,952,055
Quebec	8,459,000	13,064,000	2,595,430
New Brunswick	68,600	169,100	112,631
Nova Scotia	20,800	128,300	109,124
Prince Edward Island	3,000	5,300	2,439
Yukon and Northwest Territories	294,000	731,000	13,199
Canada	20,347,400	33,617,200	5,727,162

January 1, 1930

Recent Trends in Water Power Development in Canada

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

The activity in hydro-electric development in Canada, during the past five years, has been phenomenal. The demands of domestic, commercial and industrial load in the communities throughout the country have exerted a steady and increasing pressure in the fields of design and construction. At the end of 1923, turbine installations had a capacity of 3,200,000 horse power, and at the end of 1928, 5,350,000 horse power. Furthermore, new developments under construction at present will have an additional aggregate capacity in excess of 1,000,000 horse power.

Particular industries have, on their own initiative, been responsible for some of the outstanding developments in Canada today, and the co-ordination of the water power resources with those of the mines and forests has resulted in the establishment of communities in areas which, a few years ago, were known to few, other than prospectors and surveyors. These new industrial centres, which are growing on the frontiers of our provinces, are the future markets for power, creating a further stimulus to manufacture. This development brings sharply into relief the realization that cheap power, such as abounds in Canada's water power resources, is destined, more than any other single contributory factor, to lay the foundations of the country's future industrial growth.

In recording the immense increase in the utilization of hydro-electric power throughout the Dominion, reference should be made to the systematic investigations carried out by the Dominion Water Power and Reclamation Service of the Department of the Interior from coast to coast. Through the agencies of this organization there have been co-ordinated the stream measurement studies of all the provinces, with the result that the financier and the engineer interested in the development of hydro-electric energy are in a position to plan their undertakings upon dependable stream flow data secured by uniform methods and with standardized equipment.

The above named organization has supplemented its stream flow studies in the territory of western Canada, over which it has administrative jurisdiction, with detailed power and storage surveys of all the power rivers within the reach of early commercial exploitation. All these data are made available without cost to those interested in the development of the Dominion's water resources.

Water power development in Canada is governed, in general, more than ever before, by the consideration of economy. This has always played a prominent part in the design and construction of plants, in conformity with the conditions existing at the time of their inception; but the possibility, and, in some cases, the actuality of restriction in water supply, head and convenient and cheap power sites, have brought into prominence methods of design and details of construction which were foreign to the field of water power development a decade ago.

With the exploitation of the cheaper and more easily developed water powers, the increasing power demand has turned attention to the more remote, and more costly, sources of supply. While the regions in which the great majority of water powers abound have no known native fuel resources, the rapid advances that have been made in recent years, and the promise of further advances in the low cost production of electrical energy from coal, bring closer the day when steam plants will challenge the present supremacy of hydro-electric power, even in these districts. This has called into play a tremendous effort to offset, in whole or in part, the additional cost of these more expensive developments by devices to increase the efficiency of the component parts of the plants, to the end that as large a proportion as possible of the potential energy of the stream may be converted into usable power. The reduction of loss of head in hydraulic structures, and the increased average efficiency of water wheels over their range of loads is of paramount importance. To increase the output and reduce the cost of investment are the primary objectives in power plant design at present, and indications point to the increasing stress on these aspects, as time passes. Further, economy is at times exercised in the reduction of operating costs, where the installation of automatic or semi-automatic plants can justifiably be made. For isolated plants, the curtailment of cost and increase in net revenue are dependent entirely on refinements in design and construction, details of which are illustrated below in the examples cited.

Simplified layouts are becoming numerous, with the rejection of all but essentials; conservation of water is more carefully considered, and storage of impounded water, together with reduction of leakage or diversion, is being carried to a further degree than ever before.

The structures conveying the water to and from the turbine, which are subjected to the closest scrutiny with a view to efficient design, are the intake works, canal, tunnel or pipe line, distributors and draft tube.

In the case of the mechanical equipment, steady progress has been made in turbines, governors and their appurtenances. The relief valve is being dispensed with where pipe line conditions warrant its omission and the governor be allowed to reduce pressure rise by adequate adjustment. These, and similar modifications when possible, are effecting substantial savings in development costs.

Simplification of generator design and an increasing use of outdoor transformer and switching stations are becoming evident.

The salient features in which methods of design and construction have progressed are discussed below, and illustrated by examples drawn from a number of developments built recently, or at present under construction.

Intakes

Among the important changes in the design of intakes is the omission of the superstructure for the same. The provision of special devices to perform the usual duties of a crane in the handling of the racks and headgates, and the proper consideration of the particular conditions for each development have permitted satisfactory operation in latitudes having most severe winter climates. The use of self-contained rack structures supported in checks in the headworks walls is another feature offering considerable advantage by permitting the easy and quick removal of the same when necessary. The heating of racks by low voltage electric current has been of considerable assistance in plants where frazil offers difficulties in operation.

Headgates, with roller trains rigidly attached to the body of the gate, are now being used to overcome the difficulties in operation of gates having loose roller trains. Where operation under high heads is necessary, the gates

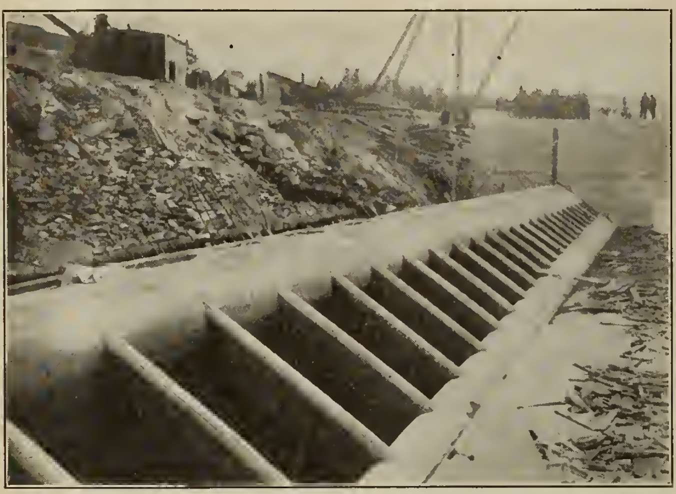

Figure No. 1.—Exterior of Intake Tube at Grand Falls Development. These Tubes, Two in Number, are 17½ feet in Diameter. The Vanes in the Intake Slot are set at Angles and Spaces Varied from End to End to Effect the Desired Distribution of the Draft throughout the Length of the Tube.

are now being built with a continuous roller train and fitted to rest on an inclined seat when in the closed position. New forms of sealing devices are also being introduced, and in this connection the use of a flexible brass sealing strip has proven very satisfactory.

The draft distributor proposed by Messrs. Johnson and Wahlman, for the Queenston development on the Niagara river, was described at the former conference. The feature of this design is that a uniform draft is secured through the full length of the distributor. This same type has been built in several installations since then, where reduction of intake loss and protection from floating debris or ice were imperative, and its use in the future will probably be more general. It offers particular advantage where the water supply is to be drawn from a shallow head pond, by materially reducing excavation necessary to secure the required depth as compared with the more conventional type. An intake of this type, which went into service recently, is that at the Grand Falls development on the St. John river in New Brunswick. This will be called upon to deliver 7,500 cubic feet per second to a tunnel 24½ feet in diameter.

Dams

In the development of water powers, it is to be expected that those sites offering the greatest natural head and requiring the least construction in the way of dams would be developed first. In consequence, an increasing number of plants are being constructed which involve the use of large dams to create the desired head. Such dams are usually higher and frequently of much greater length than those whose principal function is to maintain a head pond and to provide a proper seal for the intake to the water passages.

Several developments, in which dams of large proportions concentrate the river gradient, have been completed recently, or are at present under construction. Among these are the Ghost development on the Bow river in Alberta, the Seven Sisters development on the Winnipeg river in Manitoba, and the Alexander development on the Nipigon river in Ontario. As a result of the increased volume in such structures, there is presented a greater opportunity than heretofore for the economical use of the earth fill type of dam, although this type has been used in Canada for many years. Two examples are included in the above mentioned developments now under construction, namely, the Ghost and the Alexander plants.

At the present time there are two favoured methods being used in the construction of large earth fill structures, namely, the hydraulic fill and semi-hydraulic fill. The dam at the Ghost development is being constructed by the hydraulic fill method. In this case the material is handled by dredge pumps to pipes having outlets at suitable points for distributing material along the dam. As a result of the method of distribution employed, the finer material is carried to the centre of the structure to form an impervious core, and the coarser material is deposited in the outer section of the dam.

The dam which is being constructed for the Alexander development is of the semi-hydraulic fill type. In this instance the material is transported to, and deposited in, the sides of the dam by train and other mechanical means. By the use of hydraulic monitors, located on scows floating in a central pool, the finer material is segregated from the coarse, and is washed into the centre of the structure, forming a watertight core.

Both the above mentioned methods have proved satisfactory, and each has its advantages, depending on the conditions obtaining at the particular site.

In the case of masonry dams, no important changes have been made in the design or construction, except in the case of dams with steel gates, where more positive means are now being provided for the heating of the gate checks and of the gates themselves to prevent the freezing of the gate to the checks and the accumulation of ice on the face of the gate. Such provision makes it possible to operate the gates during the winter season, without danger of damage to the operating mechanism or without delays during times of emergency.

In the design of steel sluice gates, changes similar to those mentioned under headgates are being made to overcome the difficulties resulting from the breakages of roller train cables.

The use of fixed rollers on sluice gates of such large dimensions as are now used, required heavier operating

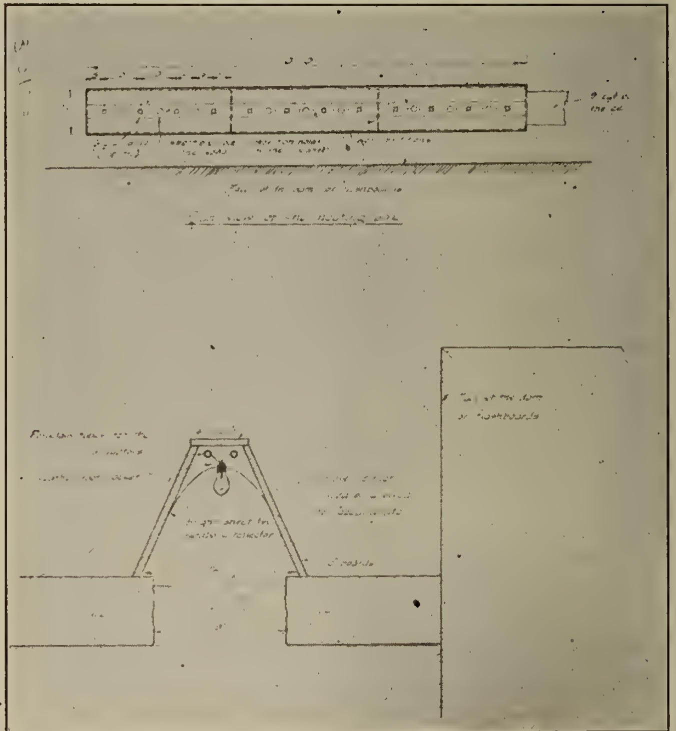

Figure No. 2.—To Relieve Ice Pressure on Dams, Reflectors of the Type Here Illustrated are used by the City of Winnipeg System to Maintain an Open Channel Close to the Face of the Dam.

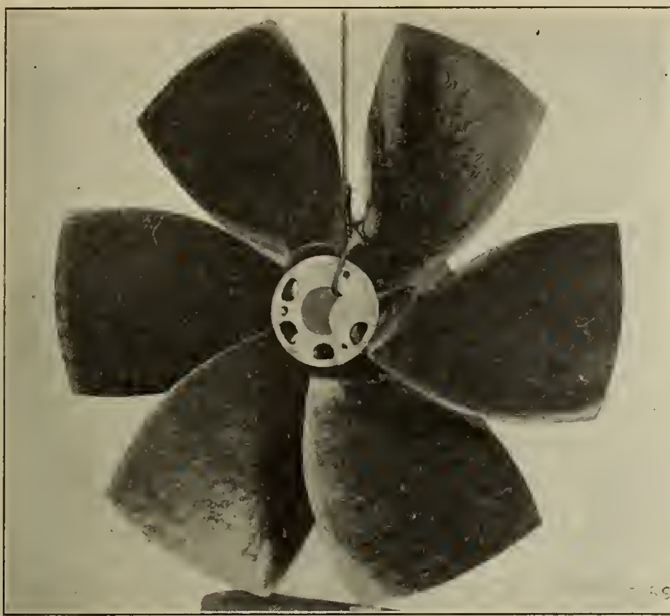

Figure No. 3.—Propeller Type Runner with Fixed Blades. The Turbine Runners at La Gabelle in Quebec and at Great Falls, Manitoba, are Identical with the One Illustrated. The Former have a Capacity of 30,000 Horse Power under a Head of 60 feet, and are 15′ 9½″ in Diameter, and the Latter have a Capacity of 28,000 Horse Power.

mechanism and heavier supporting structures for the same, without resulting increase in cost.

Where heavy ice forms on the head ponds of power plants, considerable attention has been given to securing protection against the ice action on the head walls, gates, dams and flashboards, particularly when the forebay is subject to much variation in level. Generally, the protection is secured by maintaining an open channel along the face of the structures by one of several methods, the most common of which are, cutting by hand or steam saw, by agitation of the water with compressed air, and by the use of heat reflectors mounted along the face of the structure.

Owing to the nature of the terrain over the greater part of Canada, very few examples of arch dams are to be found, but these are now making their appearance in the development of water powers in British Columbia, where the deep valleys of the Rocky mountains offer opportunities for the economical use of this type of structure.

Tunnels

In tunnel construction, considerable advance has been made in the case of large sections. Several well known examples exist where the cross-sections have greatly exceeded those used in former works. The Niagara Falls Power Company's pressure tunnel is mentioned, because of its great size, although situated in the United States on the Canadian border. It has a horseshoe section of cross-sectional area equivalent to a circle of 32 feet in diameter, with a concrete lining 18 to 24 inches in thickness.

The largest pressure tunnel in Canada is that of the Grand Falls plant in New Brunswick. The section is also of horseshoe shape, and equivalent to a circle of 24½ feet in diameter. It is lined with 18 inches of concrete.

The extension to the Shawinigan Falls plant, Quebec, includes a 20-foot diameter tunnel, lined with concrete.

In all of these, the greatest care was taken in design to obtain a channel of correct economic size, and, by construction methods, to have an alignment and a smooth surface finish that would reduce losses to a minimum.

Draft Tubes

Difference of opinion still exists regarding the respective merits of the various designs of draft tubes, with considerable favour going to the concentric type. While many of these have been constructed with satisfactory results, the increased cost of installation and the questionable advantage of this type in practical results, over its competitors, may result in a reversion to the cheaper, and withal efficient, elbow type of draft tube. Concentric draft tubes have been found to have a decided advantage, in many cases, in improving the part gate efficiency and in reduction of vibration and shock, due to variation of the draft-tube vacuum. There appears to be, however, a structural weakness in the high central cone used with certain types of concentric draft tubes, a number of cases having been reported where failure has taken place, probably due to repeated shock stresses. From the record of the performance of this central cone, it would appear advisable to have the cone built with a complete steel sheath filled with concrete. This steel cover acts both as reinforcement for the cone and also as the form work for the construction of the same. The limitation of the height of the cone to a point where the loosening of any part of the same would not permit its coming in contact with the runner, also appears as an advisable safeguard against serious damage as a result of any failure of this portion of the draft tube.

With runners having high specific speeds, pitting of the upper portion of the draft tube has been the experience in many instances. To assure quick and inexpensive repairs, renewable steel plates have been provided where the conditions were such that pitting was anticipated.

In low-head plants, the design of the draft tube becomes of greater importance, particularly with turbines of high specific speed, owing to the greater proportion of the total head represented by the draft head on the unit.

A recent development in connection with draft tubes is the use of ejectors, or underwater sluices, connecting directly from the intake to the draft tube chamber. These ejectors are controlled by submerged sluice-gates, which, when opened, permit of a heavy discharge into the draft chamber, thereby increasing the draft head and the capacity of the units. These are, of course, operated only during periods of high flow, when the tailwater is above normal level, and in conjunction with movable blade runners, they add materially to the output of the units at this time.

Water Wheels

Water wheels, for use in low head installations, are passing through a period of rapid development. The demand for increased efficiency in the use of water and for

Figure No. 4.—Runner for Back River Development. The Runner Illustrated is Rated at 8,800 Horse Power under a Head of 27 feet. Vanes may be adjusted Manually to Suit the Prolonged Reduction in Head, down to 18 feet, that is experienced in the Spring and Early Summer.

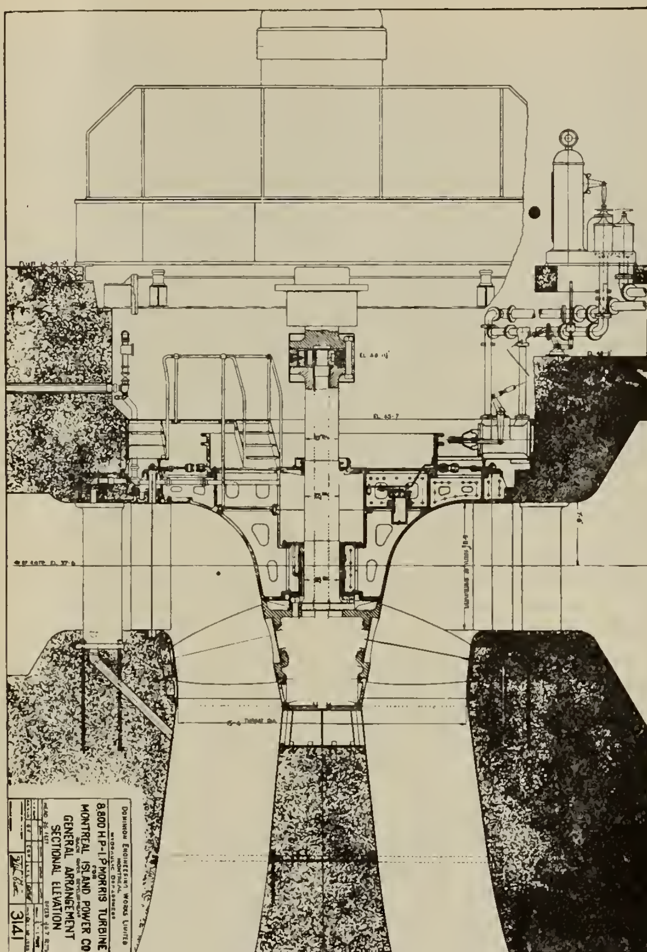

Figure No. 5.—Section Through One of the Back River Development Units. The Vanes are Adjustable, the Adjustment being effected at the Coupling Through the Hollow Shaft.

reduction in dimensions and number of units, has focussed the efforts of designers on the work of producing a high speed wheel to fulfil these requirements, with the result that the propeller wheel is rapidly dominating the low head field. This wheel has, until recently, been used in Canada with fixed vanes, but there are indications that movable vane type, or Kaplan turbine, may be employed more widely for such installations.

The earlier predictions regarding the limiting value of head under which propeller wheels could be justifiably selected, have been discounted. Actual installations of this type have been successfully made under heads up to 60 feet, with the probability of their use under higher heads. It is regarded in some quarters, with no little confidence, that successful use of the propeller wheel will shortly be made with heads in excess of 100 feet. Experiments are at the present time being conducted with this end in view.

A digression, to explain a condition common to many parts of the country that permits the efficient use of single unit plants with propeller type runners, may prove of interest at this point. There are large areas in various parts of the Dominion in which transmission networks, supplying hundreds of municipalities, draw energy from many different developments. By having centralized control of operation of a group of plants, it is possible to use all units at maximum efficiency, one or the other plant being shut down entirely, or run at maximum efficiency, as the load in the system varies from hour to hour. Propeller turbines, with fixed vanes, reach their maximum efficiency at or near full gate opening, and are usually inefficient at fractional gate openings. In large interconnected systems, it is possible to limit the operation of such turbines to loads at which they will be highly efficient. High maximum efficiency thus becomes of importance, and low part gate efficiency of less significance. In such cases, the advantage in part gate efficiency, possessed by the propeller turbine with governor controlled vanes, is discounted. The propeller turbine with fixed vanes is thus able, in large systems, to give efficient service, and, being less expensive and less complicated, has found frequent application.

These same conditions have prompted the use of plants in which the whole capacity of the site is developed in a single unit and, in general, in the use of as few units as the state of the art will permit. The consequent increase in unit capacity has enlarged the field of application of propeller and other high specific speed wheels.

In many low head plants there are periods, more or less protracted, during which the head available is reduced considerably below normal. The period of reduced head is usually coincident with a period of ample water supply. For these conditions, the fixed blade propeller unit is at a disadvantage and, in some cases, has been supplanted by turbines with manually adjustable vanes. An example of the installation of these turbines is found in the Back river development, about eight miles from Montreal. The Back river is one of the channels through which the Ottawa river reaches its outlet into the St. Lawrence. The average regulated flow is 20,000 cubic feet per second, for which condition the head is 26 to 27 feet. When the flow reaches a flood stage of 90,000 cubic feet per second, the head is reduced to 18 feet. There are six units installed at present, with an ultimate installation of ten. Three of the runners are 192 inches in diameter and have four vanes, and three are 185 inches in diameter with six vanes. The vanes are adjustable to suit the varying head and flow conditions, the adjustment being made manually and requiring that the unit be shut down. The adjustment will require only

Figure No. 6.—Francis Runner for West Kootenay Plant in British Columbia, Typical of Many Large Runners used Elsewhere Throughout the Country.

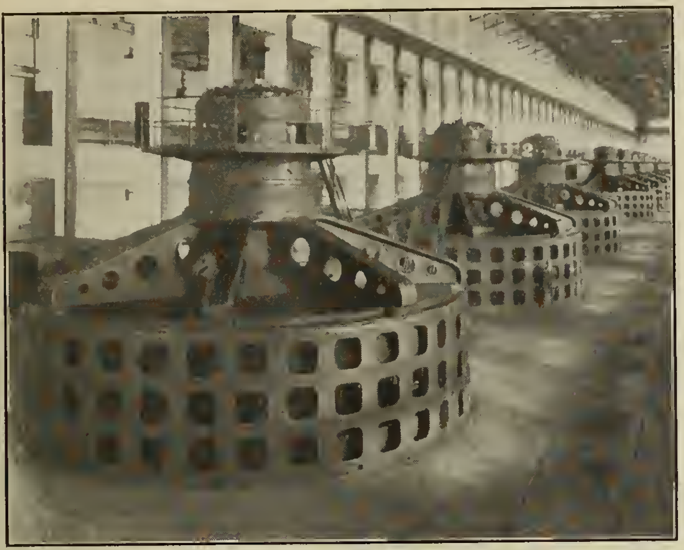

Figure No. 7.—Interior View of the Generator Room at Isle Maligne on the Saguenay River, Quebec. This Station contains Eleven Turbine Units Rated at 45,000 Horse Power under a Head of 110 feet. The Generators are rated at 30,000 Kv.-a.

a few minutes, and as the period of low head is of considerable duration, this is not a serious disadvantage, as compared with the resulting gain in power.

Among the typical Canadian installations in which propeller type runners of the fixed vane type are used, are those at La Gabelle in Quebec, and Great Falls and Seven Sisters in Manitoba. At La Gabelle the turbines are of 30,000 horse power capacity under a 60-foot head. At Great Falls, on the Winnipeg river, there are six 28,000 horse power units operating under a 56-foot head, and at Seven Sisters, on the same river, the installation now in progress will have runners with a capacity of 37,500 horse power under a head of 66 feet. In connection with the last, it is interesting to note that these units will operate at a speed of 138.5 r.p.m.

One installation of three Kaplan turbines is in progress in Nova Scotia at present, the first of this type to be used in Canada.

The quest for units of greater capacity and high speeds has produced runners (of the Francis type) having blades of decreased width or having a smaller number of blades. Both tendencies shorten the channel and guide the water less definitely and less positively. They also tend to increase the discharge. The combination of lack of guidance and the use of higher velocities result in a greater tendency towards pitting than is found with the original types of design. This shortening of the passages usually results in higher efficiency, offsetting the disadvantage of increased liability of pitting. Much attention has been given to means of overcoming this weakness, and, among others, reduction of the draft head and the coating of the runner with special alloys have been resorted to. While various degrees of success have attended these methods, it would appear that, if certain limiting relations of specific speed and head, and limiting values of draft head are exceeded, pitting may be expected. These facts have long been given consideration in connection with the fixing of speeds and setting for Francis turbines, but there appears to be a tendency to overlook the specific speed-head relation in dealing with propeller type units.

There are many plants where the periodic repair of pitted runners is considered as necessary maintenance. In many of these plants the saving in first cost, resulting from the higher speed, more than justifies the increased annual expenditure. Repair of pitted runners by electric welding is the universally adopted method. On plants having a number of units installed, it is a common practice to have a spare runner, in order that the time the unit is out of service is limited to that necessary to change the runners. In other plants, particularly with runners of large physical dimensions, the runners are welded in place at a considerable saving in time and expenditure.

Governors

Changes have taken place, and are in progress, in the flyball drive, governor control and governor pumping systems.

As between the arrangement of all the parts of the system in one housing containing actuator, servomotor and pumping system, and the arrangement of these parts separately from each other, the latter method has found greatest favour in Canadian practice.

The use of vertical units and development of automatic stations have focussed attention on the reliability of the driving power for the governor flyballs. Failure and slipping of governor belts have been experienced frequently, especially with vertical units. Electric motor drive for the flyballs has therefore been used to a great extent in new plants, and has replaced belt drives in a number of other cases. The motor drive assures reliability of service, gives finer speed control, and eliminates slippage and friction.

On certain governors the flyballs are of small size and require very little power to drive them. For these, ordinary instrument transformers connected to the generator leads, are sufficient. Numerous installations of this type are in service. For large flyballs, more driving power is required. In such cases, service transformers, or auxiliary generators, must be used. It is proposed to use auxiliary generators of small capacity, mounted on the main generator shaft, for

Figure No. 8.—Woodward Actuator Type Governor. This Type of Governor is used at the Cameron Falls Plant on the Nipigon River, and at the Paugan, Chelsea and Farmers Plants on the Gatineau River. In All of These Plants the Flyballs are Motor Driven.

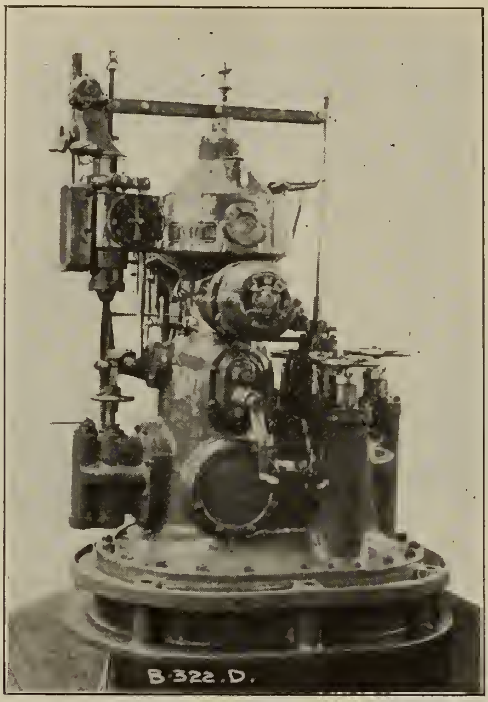

Figure No. 9. — Allis-Chalmers Governor with Motor-driven Flyballs.

new installations. No such arrangement is as yet in service in Canada, but a large development now under construction is to use this source of power for the governor drive.

Although electric flyball drives are generally considered more reliable than belt or gear drives, the practice is to equip the governors with sufficient safety devices to prevent overspeed, or other accidents, due to failure of power supply to the motor. As a further improvement, manufacturers are now equipping actuators with automatic load limiting devices, automatic synchronizing devices and locking devices for turbine gates and generator brakes.

Electric flyball drives are being used at the Back river development, the tenth unit in the Queenston development, at the Gatineau river plants, to name only a few, and generally on automatic plants.

As power stations with a number of large units came into use, there was departure from the practice of using oil as the governor fluid. Water, with sufficient potassium bichromate in solution to prevent rusting and to improve its lubricating quality, was substituted. At present, the largest power stations in Canada are operated with this governor fluid, and sufficient experience has been obtained to compare it with oil. It has been found to operate satisfactorily, if the system is kept clean. Otherwise, slimy matter tends to clog the more delicate parts of the governor mechanism. Constant care must be exercised to keep the correct percentage of bichromate in solution to prevent rusting.

Centrifugal pumping units of large capacity were found necessary in order to reduce heating of the governor fluid. Duplication of the pumping units was also necessary to assure continuous service. The centrifugal pump is at a disadvantage in the event of a drop in frequency, as the governor pressure is then reduced, crippling the whole system.

The unit system, however, still finds much favour, using small high speed pumps of the gear-rotary type, with oil as the transmitting medium. Flexibility and reliability are secured by interconnecting the pressure and return mains of the several unit systems.

Surge Tanks

While the surge tank has been necessary in many power plants, to afford relief for excess pressure due to sudden stoppage of flow in pipe lines, and to afford speedy acceleration of the water column on sudden demand, there are conditions developing in the field of power distribution that may permit its omission from some plants where formerly it might fairly have been considered indispensable.

In the case of isolated plants, the standpipe still offers the best means of furnishing extra flow in the event of sudden demand of load, but, in an interconnected system, the flywheel effect of all the rotating machinery exerts its influence on the speed regulation when load changes occur. In such cases the large available inertia is sufficient to maintain the system speed until the water column in the conduit is accelerated sufficiently.

The conditions arising from rejection of load on such a system are met by increasing the time of the governor stroke to such a degree that the pressure rise is kept within limits that may be provided for by reasonable structural design, the speed rise of the unit being controlled by the inertia of the connecting lines and the load of the whole system.

The above must not be read as meaning that the surge tank may be eliminated in all cases. As already pointed out, in isolated plants with long conduits and in large plants with long conduits, the surge tank is a very necessary part of the installation. The differential surge tank is generally preferred as having distinct advantages over the simple tank.

Bearings

Considerable interest has been aroused by the employment of rubber in the mechanical details of power plants, more particularly in the case of guide bearings and valve seats.

Marked success has attended the attempts to decrease leakage through large control valves by the use of rubber sealing rings. The experience with water lubricated, rubber guide bearings has been most encouraging; so much so, that they have beeen substituted for lignum vitae or oil

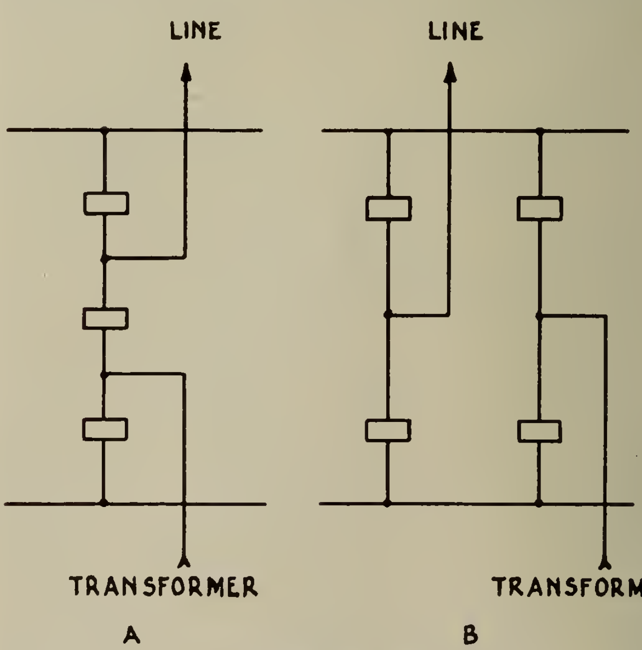

Figure No. 10.—The Arrangement of High Voltage Switching, illustrated in Figure (a), is referred to as the 1.5 Basis. As Compared with the Layout Illustrated by Figure (b), which it has Superseded in Some Instances, it effects a Saving of Some Moment. In a Station of 200,000 Horse Power Transformed at 220 Kv., with Four Banks of Transformers and Four Outgoing Lines, it effects a Saving of about $240,000 in Oil Switches Alone.

Figure No. 11.—Paugan Falls Development, Gatineau River. This Plant contains Eight Units, Rated at 34,000 Horse Power Each, at 125 r.p.m., under a Head of 132 feet. The Cooling Air for these Generators is Drawn Directly from the Power House, and Warm Air is Discharged from Generators through the Tailrace Wall. Part of the Power Generated here is Transmitted at 220 Kv. to Leaside, 230 Miles Distant.

bearings, with superior results. They appear to be particularly applicable with sediment-bearing water, where the lignum vitae bearings are subject to excessive wear, but particular attention must be paid to insure continuous water supply.

In the case of large butterfly valves, where it is necessary to reduce leakage to a minimum, such as would occur when a unit is used only to carry peak load, and will remain shut down for comparatively long periods, successful attempts have been made to secure a practically watertight valve by the introduction of a rubber seal. The valves used for this purpose are of standard butterfly type, with the sealing effect supplied by a hollow rubber ring, mounted in the periphery of the housing, and pressing against the outside of the wicket when closed. The pressure of the sealing ring against the disc is developed by water pressure within the sealing ring. Later designs have provided for the seal to be placed around the wicket itself, thus avoiding the collection of silt in the recess formerly necessary in the valve housing. Careful experiments were necessary to determine the best pressure and design of this sealing device, and the tests which took place found the leakage, in at least two installations of valves of approximately 20 feet in diameter, to be less than one-half second foot.

Attempts have been made to decrease leakage around guide vanes by the use of rubber, but do not seem to have met with sufficient success to induce its inclusion in design.

Automatic Plants

The successful operation of automatic plants has enabled the development of small water powers, where the cost of operation would formerly have been a deciding factor against their exploitation.

With simplicity of layout, economy of design, and reduction of operating costs, these plants are becoming more in evidence, and these small additional sources of power are making themselves felt, in the aggregate, particularly in those systems which do not contain any of the great power concentrations such as exist on the greater rivers of the country. The result is that electric power is available over much wider sections of the more sparsely settled country than would have been considered economically feasible a few years ago.

Control systems may be described as fully automatic, remote or supervisory, although these terms lack definiteness of application. In the fully automatic plant, starting and synchronizing, or stopping the unit, according to load demands, water level or water supply conditions, may be carried out by the equipment, without the intervention of an operator. With supervisory control, the operator at a remote station may take no active part in bringing a unit into service, but obtains signals advising him how each piece of equipment is functioning. Remote control permits the operator in the master station to start the unit, adjust speed, synchronize, adjust load, etc., in the automatic plant.

There are numerous automatic plants throughout the Dominion, among which might be mentioned those at Meyersburg and Hagues Reach, on the Trent river in Ontario, two fully automatic plants, the former having three units of 2,200 horse power each, and the latter three of 1,600 horse power each. A number of others in Ontario are designed for remote control.

The outstanding automatic plant in point of size is the Alouette generating station in British Columbia. This plant has a single vertical unit of 12,500 horse power under 125.5-foot head. The control equipment is fully automatic, the starting signal being given by the operator at Stave Falls ten miles distant. The starting signal being given, the main valve admitting water from the penstock to the turbine opens very slightly, and then pauses while water pressure is built up in the turbine, after which it continues its movement until fully open. The motor driven governor pump commences operation, as also does a motor driven lubricating oil pump, the latter continuing until a gear-driven pump operating from the main turbine shaft takes over its duty. In sequence, and as suitable conditions

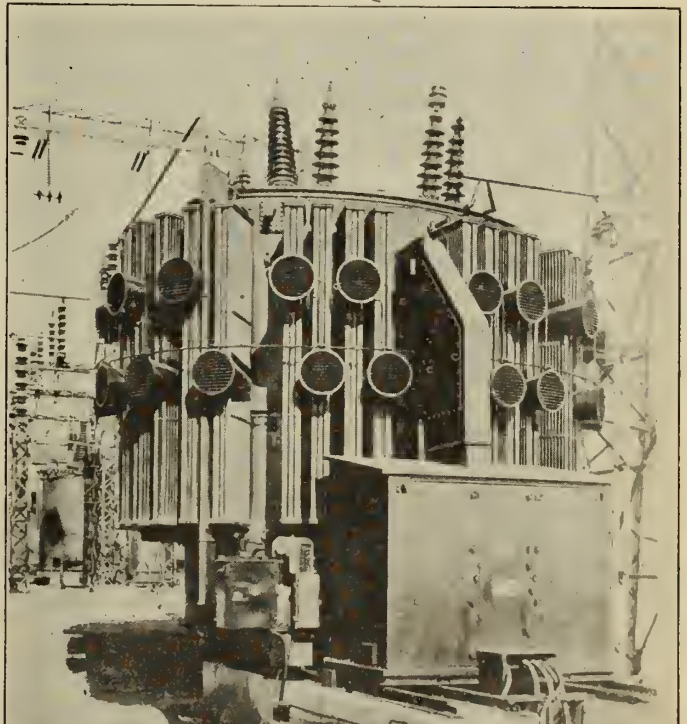

Figure No. 12.—Air-cooled Transformer equipped with Air Blowers. The Air-cooled Transformer is Frequently Preferred in Locations where Extremely Cold Weather is Experienced, as it Eliminates the Great Expense of Maintaining a Water Cooling System in Such Situations. By the Addition of Blowers, the Rating of the Transformer May Be Increased Materially.

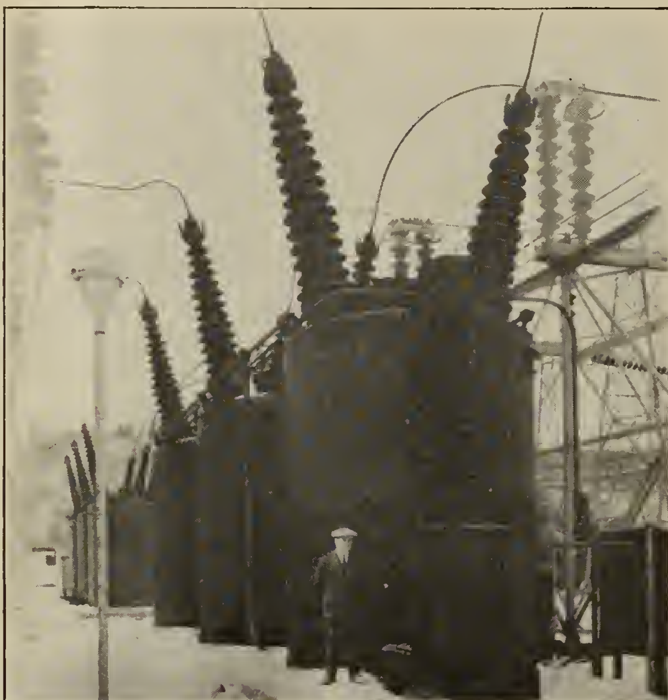

Figure No. 13.—Outdoor Installation of 220 Kv. Circuit Breakers at Leaside.

obtain, the turbine gates are opened, exciter voltage built up and applied to the alternator, the latter brought to synchronous speed, and the low tension breaker closed.

The element of time involved in the performance of these various functions depends on such conditions as head, amount of load, condition of the transmission system, etc. From the instant the starting signal is given, about seventy seconds elapse until the main valve is completely opened, synchronization requires 3½ minutes, and full load may be reached by the unit in 10 minutes.

In the first year of operation at Alouette there were fifteen emergency, and six automatic, shutdowns. Thirteen of the emergency shutdowns were due to governor driving belt trouble, all of which occured in the first four months of operation, and two were due to broken links on turbine gates. The automatic shutdowns were those caused by protective equipment coming into action. In no case was an emergency or automatic shutdown attributable to improper functioning of any of the automatic equipment.

Some of the earlier plants with supervisory control have given considerable trouble, and have not met the expectations of their designers. The experience in the Alouette plant, and in a number of others, indicates the tremendous advance in successful design and operation of automatic equipment. In general, a certain amount of attendance is necessary in plants. With this in mind, it is possible greatly to simplify the design of supervisory systems.

General Layout of Electrical Equipment

There are few avenues along which progress is possible in reduction of capital cost of electrical equipment of hydro-electric stations. Generator efficiencies leave no room for improvement, and adequate switching must be provided to meet the growth in interconnection. Extreme care is used in planning, to the end that operating labour and equipment will be reduced. There is a tendency to eliminate generator voltage equipment, except in cases where the transmission voltage is very high, when just sufficient low voltage equipment for synchronizing, or for local loads, is installed. When the transmission voltage is 110 kv. or less, a considerable amount of switching is done on the high voltage side of the transformers. An arrangement of high voltage oil switches, referred to as the "1.5 basis," is gaining favour. By the usual arrangement of transformers and lines, four switches are required per bay. On the 1.5 basis only three switches are required, effecting very considerable economy.

Economy in operation is effected by automatic plants in some cases, and in others by the use of a single operating floor, from which the operator may supervise the governors, oiling system, generators and turbines.

Switching equipment for 110 kv. and upward is generally placed outdoors. For lower transmission voltages, about one-half the installations are so arranged. Proposals to use outdoor generators have received some consideration on the score of reduction in capital cost, but, as the cost of the superstructure of the plant is such a small part of the total cost of development, and the saving by its omission is offset by the difficulty and high cost of repairs in bad weather, it has so far not been greatly favoured. Various schemes, however, are being studied to reduce building costs and, at the same time, meet this objection to outdoor generating station. In one case, a group of 25,000 kv.-a. vertical shaft outdoor type condensers is being installed, with arrangements for lowering the rotor so that repairs may be made on rotor or stator without dismantling the condenser or removing the weatherproof housing over the units.

Greater intensity of artificial illumination is now provided in generating stations than formerly, making working conditions in the plant immensely better. The decorative treatment is also given more attention, thereby improving the general appearance, assisting the lighting, and adding to the morale of the operating staff.

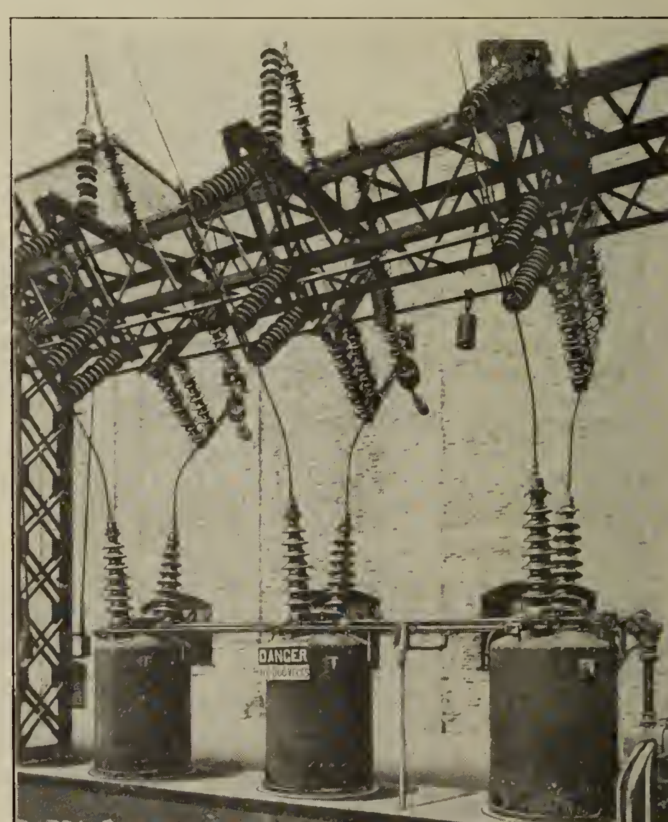

Figure No. 14.—Outdoor Installation of 110 Kv. Circuit Breakers. On Top of the Steel Structure is shown a Short Circuiting Air Break Switch to Permit the Oil Breaker to be inspected and Overhauled without an Interruption of Power.

Generators

Generator designs, in which structural steel replaces castings, are finding favour, because of lower cost, quicker delivery and reduction of head room required for handling rotating parts by crane. The umbrella type of generator is also growing in favour, principally because of reduction of head room required and ease of handling when dismantling for repairs. This last mentioned advantage is illustrated by design for a plant containing two 5,400 kv.-a. generators, in which a saving of 8 feet 6 inches in head room was effected. An order was placed recently for a 41,500 kv.-a. machine of the umbrella type. Generators self-enclosed for cooling are meeting approval, because of decreased dust accumulation and fire risk. Furthermore, the arrangement lends itself very readily to fire protection by the use of carbon dioxide. This method of fire protection has been used to some extent, but fire protection by means of water is frequently installed.

The use of hydrogen for cooling generators has not been seriously considered, due to the general low speed of this type of machine, but the increased output for a given generator, due to the use of this gas, combined with other advantages, may change the present viewpoint.

Generator lubricating systems are of the unit type in plants with few units, but where there are five or more units the tendency is to use a central system.

Transformers

In localities where very severe winter weather is experienced, self-cooled transformers are preferred, as the low cost of the water-cooled type is offset by the great expense of maintaining a water-cooled system. Furthermore, the rating of the self-cooled unit may be increased by the use of air blowers.

The choice between three-phase and single-phase transformers depends upon the system layout, but, in general, the single-phase unit is preferred. The shielded transformer for high voltage is receiving considerable attention.

Most large transformers are being ordered with tap changers, tap changing to be effected in some cases under load, and in others when not under load. The difficulty of transporting large transformers of this type is overcome by placing the assembled core in tanks on specially designed cars for shipment.

Switching

The minimum possible number of oil breakers are now used, and diagrams and connections simplified as far as possible, especially with voltages of 110 kv. and upward. Breakers having a rupturing capacity of 2,500,000 kv.-a. are now obtainable from reputable manufacturers.

Figure No. 15.

Practically all outdoor oil breakers are now equipped with bushing type current transformers for relay operation. Electric heaters are installed in the oil and in the operating mechanism housing to maintain good operating conditions during winter. Special circuit breaker oil is usually required with a cold test of —40° F. for use in outdoor breakers to assure satisfactory operation under the most severe climatic conditions.

Storage

Extensive storage and regulation schemes have been undertaken in various parts of Canada. On the Gatineau river, a tributary of the Ottawa, almost complete regulation of the upper reaches is effected by the Lake Bascatong storage basin. Four concrete dams and three small earth embankments were used to create this reservoir which impounds 93,000,000,000 cubic feet of water. There are at present, three large power developments on the river, and at the lowest of these the catchment area is 9,600 square miles; the catchment area of the reservoir is 6,200 square miles; regulation is thus fairly complete, and is being improved by the construction of another storage basin located at Cabonga.

Mention should be made here of the regulation works on the St. Maurice river, where the Gouin dam creates a storage basin with a capacity of 160,000,000,000 cubic feet. This, however, is not a recent development, and therefore, although of great magnitude, does not come within the scope of this paper.

In a number of instances, large lake expanses have been used as storage basins, notably on the Nipigon, English and Winnipeg rivers. On the first named, Lake Nipigon has an area of 1,500 square miles, and has been developed as a storage basin to benefit power sites on the Nipigon river, by which it is drained to Lake Superior. A range of 7 feet is used for storage here, but with the large lake area the impounded water amounts to 290,000,000,000 cubic feet. Lake of the Woods, also with an area of 1,500 square miles, and a storage range of 4 feet, has been used for some years to regulate the flow of the Winnipeg river. During the past year, a control dam has been built at the outlet of Lac Seul on the English river, which is an important tributary of the Winnipeg. Here it is possible to use a greater storage range than is usual on a natural water surface, as the country around the lake is undeveloped. The area of the lake is 420 square miles, and in a storage range of 12.5 feet it will impound 145,000,000,000 cubic feet, and provide a continuous outflow of 6,000 cubic feet per second, almost three times the low water flow under natural conditions.

To give scale to these storage developments, they may be compared with some of the other outstanding storage basins at present in use.

Storage Reservoir	Capacity of Basin (Cubic Feet)
Gatun (Panama)	183,000,000,000
Gouin (Quebec)	160,000,000,000
Assuan (Egypt)	78,000,000,000
American Falls (United States)	75,000,000,000
Lake Nipigon (Ontario)	290,000,000,000
Lac Seul (Ontario)	145,000,000,000

Aerial Surveys

The use of aerial surveys has been very rare in connection with water power development, but the last few years have seen some very important and interesting applications of this method.

The rapidity with which large areas can be photographed, and the remarkable truth of the resulting pictures, when studied through the medium of the stereoscope, place at the disposal of the investigator the means of quickly deciding the main features of a project, and localizing the field work to the bare necessities of the situation, with an assured saving of time and expense.

This would apply more particularly to those sites which are in regions which have not already been surveyed, and for which maps are not available, although, in certain cases where the country has been mapped, aerial surveys may still be justified.

Aerial surveys were used for the location of the transmission line delivering power from plants on the Gatineau river to Toronto, Ontario. This line was determined by means of aerial photography, and some idea of the importance of the time factor may be drawn from the fact that a flight for the purpose of photographing the proposed route, with fifty per cent overlap of the individual exposures, would occupy, with suitable weather conditions, an actual working period of about three hours, for the entire distance of 202 miles.

Applying the stereoscope to the photographic prints secured from the flight, permitted the rapid selection and final determination of the route in the office. The aerial survey was also a great time saver, since, by its use, many physical features were shown which did not appear on the available maps. Accurate information regarding topographic details was supplied, and the final field work in connection with the actual location and construction of the line was greatly facilitated.

Another specific example of the application of aerial survey methods is found in the delimitation of the area around Lac Seul that will be flooded at maximum lake level after completion of the storage dam at the lake outlet. Aerial photographs were taken of the shore of the lake, careful record being made of the time at which each photograph was taken. These photographs, along with data as to lake levels at the time of exposure, allowed the ground survey party to select those locations along the shore where the flood contour was any distance from the water's edge, and only at such places was the ground survey used to define the flood contour.

Conclusion

It is obvious that in a general paper of the length desired for such a conference as this, only a brief outline of the trend of such a widespread activity as power development can be given. The topographical features of Canada are so varied, and the uses of electric power so diverse that conditions encountered embrace almost every known circumstance. The foregoing description is an attempt to portray how the various requirements are being met. With such rapid and material progress as has been made in the immediate past, one hesitates to pass opinion as to the future. It would appear, however, that the coming years will see considerable development in pumping-storage schemes for peak load plants, and in the use of automatic devices for the starting up and synchronizing of large units.

The closer study of the allied problems of cavitation and pitting in turbine runners and draft tubes offers a field for much useful and beneficial research.

Consideration might also be given to the possibility of further simplifying plants having a considerable number of units. This may be done by equipping only a few of the units with governors, the other units being always run at full load, perhaps not even being equipped with wicket gates. The use of much simplified governors for large interconnected systems offers favourable possibilities also, in which case normal regulation of individual units, such as is needed, might be largely secured by frequency control.

Generation, Transmission and Distribution of Electricity in Canada

Current Practice in the Design and Operation of Electrical Generation, Transmission and Distribution Systems in Canada

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

Introduction

The paper will describe current practice in the design and operation of electrical generation, transmission and distribution systems in Canada.

The authors presented a general paper on this subject at the World Power Conference in London in 1924 and with that paper as a background the changes and developments since that date will be discussed.

In the period under review, 1924 to 1929, the development of electric power in Canada has been very rapid and the installed h.p. per 1,000 population for the whole of Canada is now over 580, while in the provinces of Quebec and British Columbia, the two provinces which definitely favour private ownership, the installed capacity is approximately one h.p. per capita.

The following table shows approximately the water power resources of the various provinces of Canada as estimated at the beginning of the year 1930.

Available and Developed Water Power in Canada
October 1st, 1929.

Province	Available 24-hour power at 80 per cent efficiency based on ordinary 6 months flow h.p.	Turbine Installation h.p.	Population June 1, 1929	Total Installation per 1,000 population
British Columbia	5,103,500	560,042	591,000	948
Alberta	1,049,500	70,532	646,000	109
Saskatchewan	1,082,000	35	866,700	...
Manitoba	5,344,500	311,925	663,200	470
Ontario	6,940,000	1,939,675	3,271,300	599
Quebec	13,064,000	2,572,418	2,690,400	956
New Brunswick	169,100	112,131	419,300	267
Nova Scotia	128,300	108,406	550,400	197
Prince Edward Island	5,300	2,439	86,100	28
Yukon and Northwest Territories	731,000	13,199	12,400	1,063
Canada	33,617,200	5,710,802	9,796,800	583

The figures in this table have been taken from the records of the Department of the Interior.

The construction of storage dams and reservoirs above the power developments has made it economical to develop many rivers beyond the capacity estimated under ordinary six months flow and conditions will tend to improve in this respect. The total of 33,617,200 h.p. is very conservative as an estimate of the total resources of Canada and when the numerous large and at present almost unknown rapids and falls are surveyed and the necessary storage reservoirs are constructed this total may well be doubled.

The installation for the whole of Canada averages 583 h.p. per 1,000 population, Quebec leads the other provinces with 956 h.p. per 1,000, British Columbia is second with 948, Ontario is third with 599 and Manitoba is fourth with 470 h.p. per 1,000. Nova Scotia has developed 85 per cent of the recorded power available while Quebec has developed only 20 per cent of h.p.

The installed turbine capacity in Canadian hydro-electric generating stations in November 1924 was 3,900,000 h.p. while in 1929 five years later it was 5,700,000 representing an average increase of 360,000 h.p. per year. This average rate of installation will probably be increased in the next five year period and plants now under construction or definitely projected will bring the total installation in 1934 above 7,500,000 h.p.

That steam plants play a relatively unimportant part in the supply of electricity throughout Canada in general may be seen from the fact that their combined capacity is less than 5 per cent of the capacity of the hydro-electric plants and they supply less than 1½ per cent of the kw.hrs. consumed in the country.

Capital Invested and Revenue per Horse Power

The total outstanding capital invested in water power development including transmission and distribution, from reports of the Department of Trade and Commerce is $1,172,600,000 which is an average of $219 per h.p. installed. This amount may be subdivided as follows:

Generation	69.5 per cent	.....	$152.00 per h.p.
Transmission	16.0 " "	.....	35.00 " "
Distribution	9.0 " "	.....	20.00 " "
General	5.5 " "	.....	12.00 " "

Generation includes investment in storage and regulating dams, power houses and sites including all equipment up to the step-up transformers.

Transmission includes investment in step-up transformer stations, transmission lines and receiving stations but does not include step-down transformers.

Distribution includes step-down transformers in receiving stations, distribution lines, substations, line transformers and meters.

General includes investments in office, buildings, stores, working capital, etc.

These figures which are obtained for the industry as a whole cannot be applied to particular properties. The figure of $152 per h.p. for power generation including all equipment up to the generator terminals is representative of medium capacity plants but many plants of large capacity favourably situated have been developed below $120 per h.p. for operation at from 60 to 70 per cent load factor. Such development costs must not be exceeded if power is to be sold in large blocks at figures equivalent to $12 to $15 per h.p. at the generator bus bar as has been done in many instances during the last five years.

It must also be remembered that probably less than 50 per cent of the developed h.p. is transmitted more than a very short distance and the figure of $35 per h.p. given above for transmission should be at least $70 per h.p. when applied to the power which is transmitted.

The percentage of the developed power which is distributed to small power users and for domestic purposes is probably less than 20 per cent of the whole and the cost per h.p. of distributed power should therefore be $100 instead of $20 as given above.

The same government department gives for 1927 the average revenue per h.p. of primary power as $24.93 for all Canada while in Quebec it is $19.26 and the revenue per kw.hr. generated as 0.72 cents for all Canada and 0.52 cents for Quebec, which has a large number of industries using large amounts of power at high load factor such as the paper mills and large chemical industries.

How far the developments of hydro-electric properties will continue and when steam-electric stations of large size will enter the field in Canada, depends on a great variety of conditions such as location of possible hydro-electric stations with respect to the load, cost of constructing the stations and the necessary transmission systems, quality of service demanded and finally on the capital cost of high efficiency steam-electric stations and on the cost of coal.

The steam electric station has already made its appearance in British Columbia where there is an abundant supply of coal and such stations will doubtless be constructed as stand-by and peak load stations in some of the large hydro-electric systems but probably not before Canada's present hydro-electric installation is doubled.

Analysis of the Cost of Power Generation and Transmission in a Typical Case

Assume that 250,000 kw. is to be delivered at 220,000 volts, 60 cycles, 90 per cent power factor at 250 miles from the generating station.

Two single circuit transmission lines will be required and synchronous condensers will be installed in the receiving station of sufficient capacity to raise the line power factor to unity.

Receiving Station

The receiving station will cost complete about $4,000,000 or $16 per kw.

The annual costs will be

Interest	6.0 per cent	$240,000
Depreciation	3.0 " "	120,000
Taxes and insurance	1.0 " "	40,000
Contingencies	1.0 " "	40,000
Operation and maintenance		80,000
Power losses, 5,000 kw.		100,000
Total annual cost		$620,000

This is equivalent to $2.48 per kw. per year or $1.86 per h.p. per year.

At 80 per cent load factor the cost is 0.352 mils per kw.hr. and at 60 per cent load factor is 0.472 mils per kw.hr.

Transmission Lines

Cost of two lines at $20,000 per circuit mile = $10,000,000 = $40 per kw.

Annual costs.

Interest	6.0 per cent	$600,000
Depreciation	2.0 " "	200,000
Taxes and insurance	0.5 " "	50,000
Contingencies	0.5 " "	50,000
Operation and maintenance $200 per circuit mile per year		100,000
Losses, 25,000 kw.		500,000
Total annual cost		$1,500,000

This is equivalent to $6 per kw. per year or $4.50 per h.p. per year and to 0.86 mils per kw.hr. at 80 per cent load factor or 1.14 mils per kw.hr. at 60 per cent load factor.

Step-Up Transformer Station

300,000 kv.-a. at $6.70 per kv.-a. = $2,000,000.

Annual costs.

Interest	6.0 per cent	$120,000
Depreciation	3.0 " "	60,000
Taxes and insurance	0.5 " "	10,000
Contingencies	0.5 " "	10,000
Operation and maintenance		40,000
Power losses, 3,000 kw.		60,000
Total annual cost		$300,000

Generating Station

280,000 kw. at $160 per kw. = $4,500,000.

Annual costs.

Interest	6.0 per cent	$2,700,000
Depreciation	1.0 " "	450,000
Taxes and insurance	0.5 " "	225,000
Contingencies	0.5 " "	225,000
Water rentals		400,000
Operation and maintenance		300,000
Total annual cost		$4,300,000

This is equivalent to $17.20 per kw. per year delivered to the load or $12.90 per h.p., 2.46 mils per kw.hr. at 80 per cent load factor and to 3.28 mils per kw.hr. at 60 per cent load factor.

	Generation	Step-up transformer station	Transmission 250 miles	Step-down transformer station	Total cost up to low voltage side of step-down transformers
Capital cost per kw. delivered to load	$160.00	$ 8.00	$ 40.00	$ 16.00	$224.00
Capital cost per h.p. delivered to load	120.00	6.00	30.00	12.00	168.00
Annual cost per kw. delivered to load	17.20	1.20	6.00	2.48	26.88
Annual cost per h.p. delivered to load	12.90	0.90	4.50	1.86	20.16
Cost per kw.hr. delivered to load at 80 per cent load factor	mils 2.46	mils 0.17	mils 0.86	mils 0.35	mils 3.84
Cost per kw.hr. delivered to load at 60 per cent load factor	3.28	0.27	1.14	0.47	5.12

The cost per kw.hr. delivered to the load may be subdivided 64.25 per cent generation, 4.35 per cent step-up transformers, 22.40 per cent transmission, 250 mils and 9.00 per cent step-down transformer station.

Generation of Power

The major additions to the generating stations in the various provinces of Canada since 1924 are briefly outlined below.

British Columbia

The British Columbia Power Corporation has a series of three developments on the water-way consisting of the upper and lower Alouette lakes, Stave lake and the Stave river. The first development of the system, the Stave Falls plant, has a capacity of 77,500 h.p. The Alouette plant was constructed at the Stave lake end of a tunnel discharging the waters of Alouette lake into Stave lake. It has a capacity of 12,500 h.p. in one unit and is designed for full automatic operation from the Stave Falls station. The Ruskin development below the Stave Falls plant is at present in the early construction stage. The first 42,500 h.p. unit is expected to be in operation in the autumn of 1930 and the second unit will be installed during the following year. The Stave Falls watershed will at that time be fully developed with a capacity of 175,000 h.p.

The West Kootenay Power and Light Company, controlled by the Consolidated Mining and Smelting Company of Canada, in 1926 completed the installation of a 60,000-h.p. plant at Lower Bonnington Falls on the Kootenay river. A 75,000-h.p. development at South Slocan on the same river was completed in 1929 and they have applied for the right to develop 80,000 h.p. on the Pend d'Oreille river.

Other power companies in British Columbia are making similar additions to their generating plants to cope with the increasing demand for power. During the last ten years the developed power has been increasing at a rate in excess of 30,000 h.p. per year.

Alberta

In Alberta a site is now being developed on the Bow river which will have an ultimate capacity of 36,000 h.p.

Saskatchewan

In Saskatchewan the population is concentrated in the prairie district where no water power sites of economic value exist and this has delayed the development of hydro-electric power in this province.

The Churchill River Power Company has started work on a development at Island Falls on the Churchill river to provide power for mining developments. The ultimate capacity of this plant will be 84,000 h.p. of which 42,000 h.p. will be installed in 1930.

Manitoba

The development of power in Manitoba is proceeding at a rapid rate.

The municipal plant of the City of Winnipeg at Point du Bois Falls on the Winnipeg river reached its ultimate capacity of 105,000 h.p. in 1926 and the city then purchased power from the Winnipeg Electric Company. The city has now started work on a development at Slave Falls on the Winnipeg river which will have an ultimate capacity of 100,000 h.p. in eight units.

The Winnipeg Electric Company through its subsidiary company the Manitoba Power Company has constructed at Great Falls on the Winnipeg river a plant of 168,000 h.p. capacity in 6 units of 28,000 h.p. each. This plant was completed in 1928 and work has already started on a plant at Seven Sisters Falls on the Winnipeg river, designed for six units of 37,500 h.p. each. It is expected that three of these units will be installed in 1930.

Ontario

The Hydro-Electric Power Commission of Ontario operates 25 hydro-electric stations with a combined turbine capacity of about 1,100,000 h.p. This load is growing rapidly but they are to a large extent meeting the growth by purchasing power from privately owned companies in the province of Quebec. The most important generating station owned by the Commission is the Queenston station on the Niagara river which has an installed turbine capacity of 502,000 h.p. in nine units. The turbines are vertical, single runner, Francis type, rated at 58,000 h.p. at 187½ r.p.m. The generators are 25 cycle, 12,000 volt, 54,000 kv.-a. and are at present the largest capacity machines in Canada. A tenth unit of 58,000 h.p. is now being installed.

The Commission in 1926 entered into a contract with the Gatineau Power Company to purchase 260,000 h.p. of 25 cycle power from the generating stations on the Gatineau river and later entered into a second contract with the same company for the supply of up to 100,000 h.p. at 60 cycles for the Eastern Ontario system.

In the fall of 1929 the Commission contracted to buy 250,000 h.p. of 25 cycle power from the Beauharnois Light, Heat & Power Company at Beauharnois, Quebec. This power will be transmitted over 300 miles into the Niagara system.

Of the developed power in Ontario about two thirds is controlled by the Commission and one third located mainly in the newer portions of the province is owned by private companies.

Quebec

In the province of Quebec new hydro-electric power developments are being made at a rate exceeding 250,000 h.p. per year and this rate will be increased during the next five years. The greater part of this power is required by industries in the province of Quebec but a very considerable amount will be delivered to the Hydro-electric Power Commission of Ontario to take care of the growth of their load.

The major additions to the generating stations in Quebec since 1924 are briefly described below.

The Duke-Price Power Company

First may be mentioned the great plant of the Duke-Price Power Company at Isle Maligne on the Saguenay river.

The Saguenay, one of the great tributaries of the St. Lawrence, flows out of Lake St. John by two channels, the Grand Discharge and the Little Discharge. These two channels unite at a point nine miles below the lake outlet and thirteen miles further down stream the river reaches tidewater at Chicoutimi.

Lake St. John is located about 100 miles north of the city of Quebec. Its normal water level is 310 feet above mean sea level and the drainage area of the lake is estimated to be 30,000 square miles. The Duke-Price Power Company by a grant of the provincial government is permitted to use the storage capacity of Lake St. John between ordinary low water and ordinary high water, a range of 17.5 feet giving a storage capacity of 187.1 billion cubic feet.

The power development at Isle Maligne has at present a capacity of 495,000 h.p. in eleven units of 45,000 h.p. each and a twelfth unit will later be installed bringing the capacity up to 540,000 h.p.

The head available ranges from 100 to 120 feet.

The turbines are 166½-inch, vertical shaft, single runner, Francis type units operating at 112.5 r.p.m.

The generators have a full load rating of 30,000 kv.-a. or 24,000 kw. at 80 per cent power factor, 13,200 volts, three phase, 60 cycle, 112.5 r.p.m. with a temperature rise not exceeding 55 deg. cent. but each generator will carry 35,000 kv.-a. continuously at normal voltage and 80 per cent power factor with a temperature rise not exceeding 70 deg. cent.

Between Isle Maligne and Chicoutimi the Saguenay has a fall of about 210 feet at Chute-a-Caron. The necessary rights to develop power in this section are held by the Alcoa Power Company a subsidiary of the Aluminum Company of America and construction work is well advanced on the site. The turbine capacity which can economically be installed is estimated to be 1,030,000 but it was found that the best economy in construction would be obtained by diverting part of the available water and building a temporary power plant developing 260,000 h.p. at a head of 150 feet in four units of 65,000 h.p. each. Construction of this plant will be completed in July 1930. The construction equipment and organization will then be used to carry out the final step which will give a combined capacity of 1,030,000 h.p. The first plant will be kept in operating condition and will be utilized when the river flow conditions warrant it.

The Shawinigan Water & Power Company

The St. Maurice river is the largest source of power in the province of Quebec at the present time, with a developed capacity of 650,000 turbine h.p. of which 580,000 h.p. is controlled by the Shawinigan Water & Power Company.

The St. Maurice river drains an area of approximately 16,200 square miles which consists entirely of forest cover and lakes. About 4,800 square miles of this area is above the storage reservoirs which have been constructed on the upper reaches of the river.

The main storage reservoir is the Gouin dam which has formed a lake about 300 square miles in area and stores all the spring run-off from an area of 3,650 square miles. The reservoir is capable of storing 180×10^9 cubic feet and through its construction the regulated flow of the St. Maurice river has been increased from 6,000 cubic feet per second to 16,000 cubic feet per second. Other storage reservoirs now under construction on tributaries to the St. Maurice will eventually increase the regulated flow at Shawinigan Falls to 19,000 cubic feet per second.

During 1928 and 1929 two 43,000 h.p. units were installed in the power house at Shawinigan Falls. The turbines are vertical units operating at 138.5 r.p.m. under an average head of 150 feet. The generators are three phase, 60 cycle, 11,000-volt machines of 40,000 kv.-a. capacity. An additional machine of 30,000 h.p. capacity will be installed in 1930 in each of the two remaining plants on the river.

The Shawinigan Water & Power Company has been granted the right to develop the rapids and falls on the upper part of the St. Maurice river and it is estimated that over 1,200,000 h.p. can be developed in this area. Work has already commenced on the first of these developments and a 220,000-volt transmission line is being constructed to carry the power into the Shawinigan network.

The Shawinigan Company has also purchased 100,000 h.p. from the Duke-Price Power Company at Isle Maligne for the supply of industries in the Quebec district.

The Gatineau Power Company

The Gatineau river enters the Ottawa river two miles below the city of Ottawa. Its drainage area is about 9,600 square miles. It is subject to great fluctuations in volume decreasing at times in the summer months to 2,500 cubic feet per second.

To improve the regulation of the river the Mercier storage dam was built about 100 miles above Ottawa. It has created a lake with an area of over 100 square miles capable of impounding 95×10^9 cubic feet of water for use during the low flow season. It is estimated that this reservoir in conjunction with other smaller reservoirs on the watershed will enable a regulated flow of 10,000 to 11,000 cubic feet per second to be obtained. The reservoir above the Mercier dam is the third largest artificial storage reservoir in the world.

The Gatineau Power Company a subsidiary of the International Paper Company has developed three sites on the Gatineau river in the province of Quebec.

The first at Farmers Rapids 4½ miles from the mouth of the river where a head of 66 feet is available.

Three vertical 162-inch, single-runner, Francis turbines 24,000 h.p. each are at present installed giving a capacity of 72,000 h.p. The ultimate capacity is 120,000 h.p. in five units.

Two of the generators are three phase, 60 cycle, 6,600 volt, 90 r.p.m. 25,000 kv.-a. and the third is 25 cycle, 6,600 volt, 90 r.p.m. 22,500 kv.-a.

The Chelsea station is 1½ miles above the Farmers station and operates under an average head of 96 feet.

Three vertical 162-inch single-runner, Francis turbines 34,000 h.p. each are at present installed giving a capacity of 102,000 h.p. The ultimate capacity is five units developing a total of 170,000 h.p.

Two of the generators are 60 cycle, 6,600 volt, 100 r.p.m. 36,000 kv.-a. and the third is 35 cycle, 6,600 volt, 100 r.p.m. 32,000 kv.-a.

The Paugan station is 26 miles above the Chelsea station. It operates under an average head of 130 feet. The power house is designed for eight 35,000 h.p. units of which six are installed. The plant may ultimately be extended to contain sixteen similar units. The present installed capacity is 204,000 h.p. and the ultimate capacity will be 544,000 h.p.

The turbines are vertical 140½ inch, single-runner, Francis type rated at 34,000 h.p. at 125 r.p.m.; the generators are 3 phase, 25 cycle, 6,600 volt, 125r. p.m. 28,500 kv.-a.

These three plants have a present installed capacity of 378,000 h.p. and an ultimate capacity of 834,000 h.p.

Of the power developed on the Gatineau river 260,000 h.p. at 25 cycles has been sold to the Hydro-Electric Power Commission of Ontario for their Niagara system and up to 100,000 h.p. at 60 cycles is reserved for the Commission to supply its contracts in the eastern part of Ontario.

The 25 cycle power is delivered at 220,000 volts at the interprovincial boundary and is transmitted to Toronto, a distance of 230 miles over the first 220 kv. lines to be constructed in Canada.

The Gatineau Power Company has also during the last year added a second 25,000 h.p. unit to the 60 cycle generating station at Bryson on the Ottawa river.

The Montreal Island Power Company

An interesting plant which is now rapidly approaching completion is that of the Montreal Island Power Company on Riviere des Prairies eight miles from the centre of Montreal. The operating head varies during the year from 18 to 26 feet and propeller type turbines are being installed with vanes that may moved by mechanical means. A shut down of about five minutes is required to adjust the blades. Two units rated at 9,000 to 10,000 h.p. are now in operation and four more will be installed to complete the initial stage of this development. The generators are 60 cycle, 12,000 volt, 10,000 kv.-a., 85.5 r.p.m. units designed to operate as low as 75 per cent power factor.

The James MacLaren Company

At High Falls on the Lievre river, a tributary of the Ottawa river, the James MacLaren Company is completing a 60 cycle power development with an initial capacity of 90,000 h.p. in three units and an ultimate capacity of 120,000 h.p. The head available is 180 feet.

The complete project includes a storage reservoir with a capacity of 25,000,000,000 cubic feet at Cedars Rapids and a 250-ton pulp and paper mill near the town of Buckingham.

The Beauharnois Light, Heat and Power Company

The Beauharnois Light Heat and Power Company have been granted the right to divert 40,000 cubic feet per second from Lake St. Francis on the St. Lawrence river and to return it lower down at Lake St. Louis. They will develop 500,000 h.p., half at 25 cycles to be delivered to the Hydro-electric Power Commission of Ontario and the remainder at 60 cycles, for the supply of industries in and around the city of Montreal.

Two million h.p. can be developed in this stretch of the St. Lawrence river.

The Maritime Provinces

In the Maritime provinces, New Brunswick, Nova Scotia and Prince Edward Island, while the total water power resources are limited, a number of important developments have been made.

The Grand Falls Development

The Grand Falls development on the St. John River in New Brunswick is the largest development in the Maritime provinces.

The station is designed for an ultimate capacity of 80,000 h.p., but at present three units only with a total capacity of 60,000 h.p. are installed. The operating head is 125 feet.

The generators are three phase, 60 cycle, 6,600 volt, 163.6 r.p.m. 17,500 kv.-a.

Mersey River System

Three developments have been made on the Mersey river in Nova Scotia and combined into one system of 20,000 h.p. to supply power to a paper mill.

At Upper Lake Falls the head varies from 42 feet to 22 feet depending on the level in the storage pond. Two 2,350 h.p. turbines are installed, they are of the propeller type and the blades are adjustable by hand for changes of head. The two generators are 3,000 kv.-a., 60 cycle, 6,600 volt, and the plant is arranged for automatic control from the main station.

At Lower Lake Falls a constant head of 49 feet is available and two 5,300 h.p. turbines and two 4,100 kv.-a, 60 cycle, 6,600 volt generators are installed, equipped for automatic operation.

At Big Falls, two 6,350 h.p., Francis type, turbines are installed and two 5,000 kv.-a., 60 cycle, 6,600 volt generators. The power from the three plants is brought to the bus bars in this station.

Design Tendencies

There has been no increase in the maximum size of hydro-electric generators during the last five years and the 54,000 kv.-a., 25 cycle units in the Queenston plant in Ontario are the largest capacity units in Canada. These will however soon be surpassed by the 65,000 kv.-a. 60 cycle units of the Alcoa Power Company at Chute-a-Caron on the Saguenay.

In the electrical design of generators considerations of stability have had an important effect on design. In the case of generators installed in power houses located at considerable distances from the load centres and where therefore long transmission lines are required, the generator reactance should be kept as low as economy will allow and the short-circuit ratio should be kept high or else the generator should be provided with quick response excitation. On the other hand when the power house is situated close to the load the reactance may be kept high and the short circuit ratio low resulting in a less expensive machine with lower fault currents.

There is a general tendency in the later developments towards a generator voltage of 13,000 volts instead of 6,600 volts.

Slight reductions in losses have been obtained by the use of better iron, transposition of armature windings and by improvements in the ventilating systems.

In synchronous condensers there has been a tendency towards higher speeds which has resulted in a reduction in both losses and costs.

The principal improvements in mechanical design have resulted from the general use of fabricated construction in both the stator and rotor. This development has made possible some reduction in weight and a great reduction in pattern costs and has removed very serious limitations to economic generator design and construction.

Transmission of Power

Transmission of electric power in Canada has not undergone any radical change during the last five years. In 1925 the highest transmission voltage in Canada was 132 kv., while to day one double circuit 165 kv. line has been in service for three years and one 220 kv. has been in service for over a year. Two other 220 kv. lines are under construction and many more will be built during the next three years.

Transmission at 220 kv. may now be considered standard practice where large blocks of power are to be transmitted over great distances of 150 to 300 miles. Loads up to 125,000 kw. per circuit can be handled efficiently at this voltage and it is doubtful if more than this amount of power should be carried normally over a single circuit.

When it is necessary to bring power over longer distances as, for instance, from the rivers flowing into James bay or Hudson bay where transmission distances may be as great as 500 miles, it is probable that 330 kv. will be used and no serious difficulty is anticipated.

Where distances of transmission over 300 miles are under consideration the principle of constant voltage transmission will probably be applied, that is, the voltage at both ends of the line will be maintained constant and of the same value. Synchronous condensers will be required not only in the receiving station but also at one or more points along the line to regulate the voltage.

The greatest distance to which power has been transmitted in Canada is 230 miles from Paugan Falls to Toronto to supply the 25 cycle system of the Hydro-Electric Power Commission of Ontario.

Within three years the Commission will have one or two 220 kv. lines over 300 miles in length carrying power from the new development of the Beauharnois Light Heat & Power Company on the St. Lawrence river to Toronto.

The transmission of power over long distances is somewhat easier at 25 cycles than at 60 cycles because of the lower line reactance and the smaller charging current but the cost of the line and the efficiency of transmission are not changed.

Although double circuit towers have been employed on many important transmission lines, there is a decided tendency to construct new lines with single-circuit towers with horizontal spacing of conductors to reduce the lightning hazard. This type of construction has been used on a number of important 60 kv. lines.

For tower foundations either the concrete block or the structural steel grillage type of footing may be used and both appear to be satisfactory.

Aluminum cable with steel reinforcing is used as the conductor material for almost all transmission lines in Canada. For 220 kv. lines a 795,000 circuit mil cable is used with an outside diameter of 1.093 in., while conductors up to 1,590,000 circuit mils have been installed to supply large electric steam generator loads delivered at generator voltage.

Two transmission lines of outstanding importance are briefly described below, the Quebec-Isle Maligne line and the Toronto-Paugan Falls line.

The Quebec-Isle Maligne Line

The Quebec-Isle Maligne transmission line of The Shawinigan Water & Power Company connects the industrial area around the city of Quebec with the great hydro-electric power reservoir of the Saguenay valley and the lake St. John district where over two million h.p. can be economically developed.

The line is 135 miles in length and crosses a country covered with virgin forest without inhabitants or roads. The maximum elevation reached was 2,900 feet.

The distance was not great enough to require 220 kv. and the importance of the service made it imperative to install two circuits.

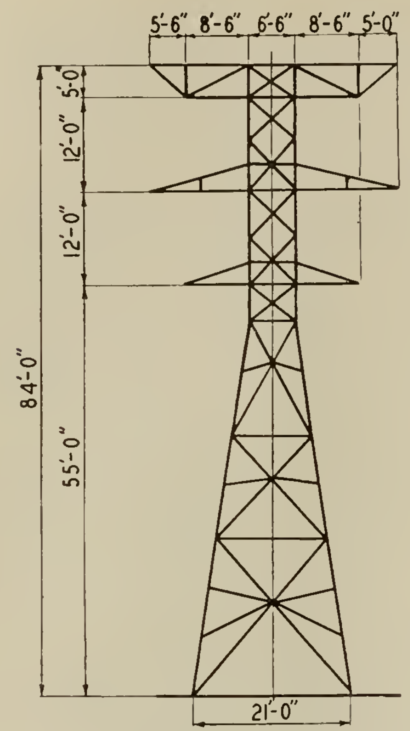

Figure No. 1—Standard Light Tower, Quebec-Isle Maligne 165-Kv. Line.

A delivery voltage of 165 kv. was adopted and a sending voltage of 180 kv. and provision was made in the transformers to vary these voltages by 10 per cent.

The line was required to carry 100,000 h.p. of 60 cycle power and it was necessary that one circuit should be capable of carrying the total load in case of failure of the other circuit.

A synchronous condenser designed to supply 30,000 kv.-a. either lead or lag has been installed in the terminal station at Quebec to control the voltage.

Figure No. 1 shows the tower dimensions and figure No. 2 the suspension insulator assembly for this line. Further details of the line are given in table No. 1.

The Toronto-Paugan Falls Line

The Toronto-Paugan Falls line of the Hydro-Electric Power Commission of Ontario is the first of a series of lines designed to carry up to one million h.p. of 25 cycle power from plants near the western borders of the province of Quebec into the industrial area surrounding the city of Toronto. It was designed to carry 125,000 h.p. on one circuit over a distance of 230 miles and was the first 220 kv. line to be constructed in Canada. The first of the two single circuit lines was put into service in 1928 and the second line is rapidly approaching completion. The conductor used was 795,000 circuit mils aluminum cable with steel reinforcing and the conductors were strung on a horizontal plane with a separation of 25.25 ft. Two ground wires were installed on each circuit.

The tower foundations are of the steel grillage type. Two 25,000 kv.-a. synchronous condensers have been installed in the Leaside receiving station at Toronto to regulate the voltage of these lines. In figure No. 3 is shown the outline drawing of the standard light tower and in figure No. 4 the suspension insulator assembly.

Some details of the line are shown in table No. 1.

Table No. 1—Comparative Characteristics of the 165 kv. Double Circuit and 220 kv. Single Circuit Lines

Item	Isle Maligne Line	Paugan Falls Line
Conductor..........	397,500 circ. mils A.C. S.R., 30 strands Al., 7 strands steel.	795,000 circ. mils A.C. S.R., 54 strands Al., 7 strands steel.
Spacing............	13 ft., 13 ft., 24 ft.	25.25 ft., 25.25 ft., 50.5 ft.
Average span.......	900 ft.	1,100 ft.
Weight of light tower	10,400 lbs. (Two circuit)	8,895 lbs. (Single Circuit)
Type and weight of footing...........	Concrete block, 2 cu.yd. = 8,100 lbs. per leg, 8 reinforcing bars. ½ in. by 5 ft.	Steel grillage 1,891 lbs.
Insulators..........	10 units suspension 4.75 in. per unit.	16 to 18 units suspension 5 in. per unit.
Types of towers.....	Light, semi-anchor, anchor, transposition	Light, light angle semi-anchor, anchor, transposition.

The Leaside Transformer Station at Toronto

The Leaside transformer station of the Hydro-Electric Power Commission of Ontario at Toronto was the first 220 kv. substation built in Canada. It receives power from the 220 kv., 25 cycle lines from the Paugan Falls station of the Gatineau Power Company and through two banks of three-winding transformers connects this system to the

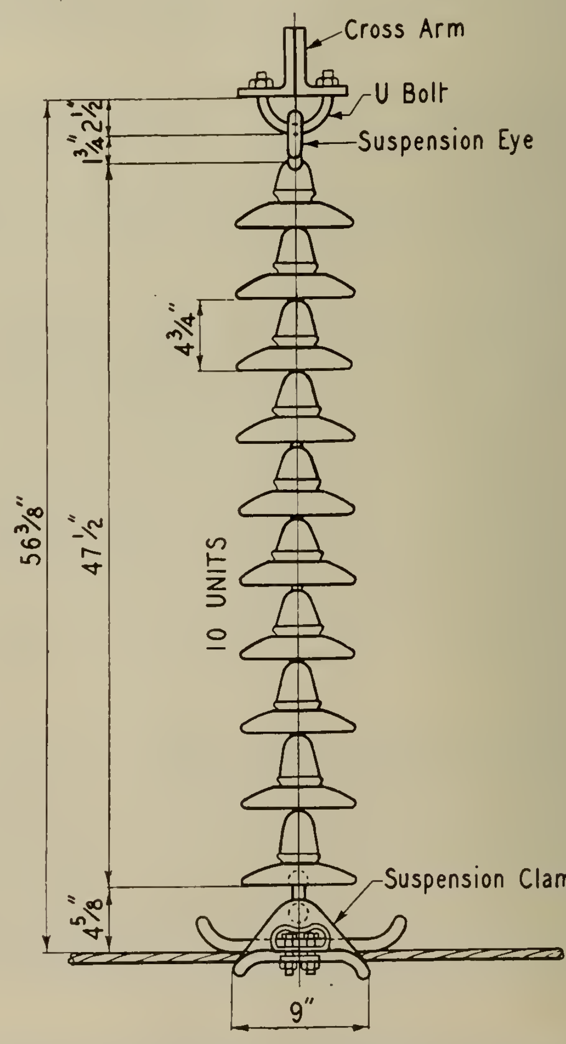

Figure No. 2—Suspension Insulator Assembly, Quebec-Isle Maligne 165-Kv. Line.

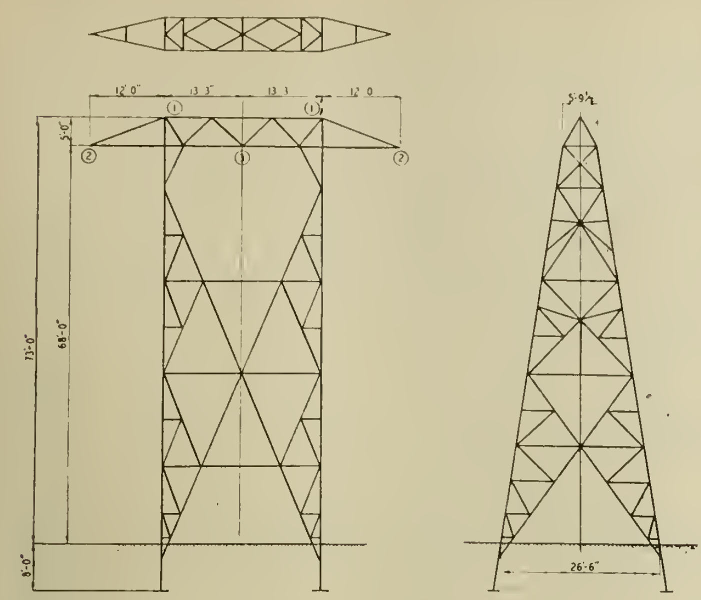

Figure No. 3.—Standard Light Tower, Toronto-Paugan Falls 220-Kv. Line.

110 kv. system fed from the Queenston generating station and to the 13.2 kv. local distributing system in Toronto.

The 220 kv. bus and switching equipment between the incoming lines and the transformers was laid out on a basis of 12 feet minimum clearance between phases and 7 feet 6 inches minimum clearance to ground.

The insulation for the disconnecting switches and on the bus supported by post insulators consists of six 14.5 inch high units. For the strain bus twenty 10-inch diameter standard 5-inch suspension discs are used and for the suspension bus 18 similar units are used. Hollow conductor copper cable with I-beam core is used for strain busses and for jumpers between busses. This conductor has the conductivity of 750,000 circuit mils copper cable and has an outside diameter of 1.249 in.

The 220 kv. oil circuit breakers have a current rating of 800 amp. and a rupturing capacity of 2,500,000 kv.-a. They are of the outdoor type with oil filled bushing.

Although low freezing oil is used in the breakers two 1,000-watt immersion heaters are placed in each tank to prevent the oil from thickening due to low temperature. A 500-watt heater is installed in the motor mechanism housing.

Two bushing type current transformers are mounted on each bushing for relay operation and for metering.

On test with the breaker not on load the complete opening stroke time was 0.7 second and the closing time 0.9 second. The time interval between the operation of the controller and the parting of the contacts was 0.15 second.

The 220 kv. disconnection switches are of the high pressure contact type and are rated 1,000-amp. The 220 kv. switches make the complete opening or closing operation in sixteen seconds.

Main Transformers

Two banks of transformers, each bank consisting of three 15,000 kv.-a. single phase, 25 cycle, 118,000/65,000/13,200-volt oil insulated water cooled, three-winding outdoor transformers and one spare have been installed. The banks are connected in star on the high voltage winding with the neutral point positively grounded. On the medium voltage winding they are connected in star and operated in parallel with the Commission's 110,000-volt system and the neutral is grounded through a resistance. The low voltage windings are connected in delta.

Each of the three windings has a continuous rating of 15,000 kv.-a.

The high voltage winding has a tap changer which can only be operated when the transformer is not energized. Taps are 215-kv., 205-kv., and 195-kv. No operating taps are provided on the medium voltage winding but the voltage of this winding can be changed under load by a special transformer which is connected in series to boost or buck the terminal voltage 7½ per cent in 2½ per cent taps. This special transformer is energized from the low voltage winding of the main transformers.

Synchronous Condensers

Two 25,000-kv.-a., 500 r.p.m. condensers are being installed one on each 45,000-kv.-a. bank of transformers. They are of the vertical outdoor type with the thrust bearing below the rotor and the exciters direct connected below the thrust bearing. They will be equipped with quick response excitation and automatic starting equipment with remote control. Carbon dioxide fire fighting equipment will be installed.

These machines are required to control the 13.2-volt bus voltage and in conjunction with the under-load tap changers on the 110-kv. systems windings of the transformers give flexibility to the distribution of the reactive kv.-a. between the 220- and 110-kv. systems besides increasing the efficiency of the system by making it possible to operate near unity power factor when desirable.

System Stability

By stability is meant the ability of rotating machines, such as generators, synchronous condensers and synchronous motors, to remain in synchronism under extreme changes in load whether caused by normal or abnormal system conditions.

This characteristic of stability has become a controlling factor in system design affecting as it does the design and

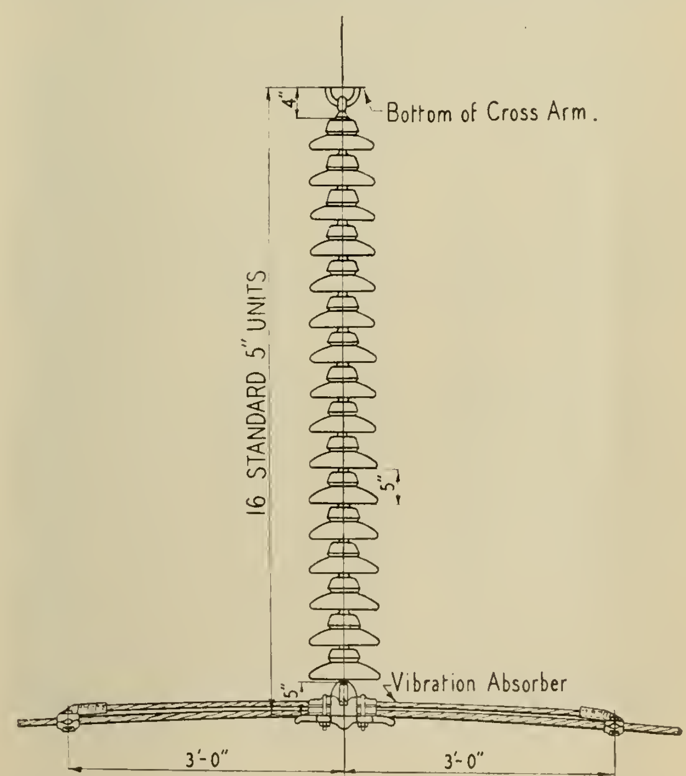

Figure No. 4.—Suspension Insulator Assembly, Toronto-Paugan Falls 220-Kv. Line.

application of all synchronous machinery on the system and also the choice of the operating voltage and the number and interconnection of circuits in the system.

This condition has been a gradual development brought about by the increasing importance of long distance transmission of power and the desire to obtain the maximum power capacity for a given investment in the transmission system.

The factors in generator design which particularly affect stability are transient reactance, synchronous impedance, short circuit ratio and the speed of exciter response. The moment of inertia of the generator rotor has sometimes an important influence on stability but the speed control exercised by the governors of the prime movers is too slow to affect the stability.

The per cent transient reactance of a generator is defined in the Standards of the A.I.E.E. as 100 times the ratio of the voltage produced by the combined armature and field leakage fluxes to the rated voltage, on the basis of rated armature current and with the axes of the armature and field magnetomotive forces coinciding.

The per cent synchronous impedance is 100 times the ratio of the field ampere turns required to produce rated armature current on sustained short circuit to the air gap ampere turns corresponding to rated voltage at no-load and at rated frequency.

The short circuit ratio is the ratio of the field ampere turns required to produce rated voltage at no-load and at rated frequency to the field ampere turns required to produce rated armature current at sustained short circuit.

Low transient reactance is desirable from the standpoint of system stability because it causes a small instantaneous drop in voltage and change in voltage phase when system short-circuits occur.

The per cent transient reactance of modern water wheel driven generators varies from 25 per cent to 50 per cent. As shown in the following table, it is usually about 50 per cent greater than the armature leakage reactance.

Modern Canadian Water Wheel Generators

Kv.-a.	R.p.m.	Cycles	Per cent syn. react.	Per cent trans. react.	S. C. ratio	WR^2 Lb.-Ft.^{2}
50,000	120	60	112	47	1.0	55,000,000
44,000	120	60	108	40	1.08	60,000,000
40,000	138.5	60	113.6	31.1	1.02	37,000,000
36,000	100	60	123	51	0.965	37,500,000
33,000	120	60	112	48	0.97	27,000,000
32,500	138.5	60	115.2	37.4	1.04	22,000,000
30,000	112.5	60	124	43	0.9	31,000,000
25,000	180	60	138	50	0.82	9,300,000
25,000	90	60	93.5	41	1.21	27,900,000
22,500	120	60	107	40	1.04	21,000,000
21,000	138.5	60	104.1	36	1.15	11,200,000
17,500	163.5	60	84.2	31.9	1.5	9,000,000
17,500	100	60	125	36.5	1.0	14,000,000
16,500	163.5	60	109.5	41.3	1.02	5,600,000
15,000	150	60	117	39	0.94	5,940,000
15,000	100	60	102.4	41.6	1.05	9,000,000
12,000	163.5	60	109.6	37.6	1.05	4,400,000
12,000	128.5	60	113.6	50	0.99	6,400,000
10,600	120	60	100	39	1.1	7,900,000
11,000	128.6	60	102	34	1.06	4,725,000
10,000	180	60	92	39	1.19	2,400,000
10,000	85.7	60	116	43.8	1.0	9,000,000
54,000	187.5	25	115.6	30.1	1.0	21,600,000
45,000	187.5	25	130.1	25.1	0.91	21,500,000
32,000	100	25	94	24	1.32	26,800,000
28,500	125	25	91	27	1.27	26,000,000
22,500	88.3	25	82.1	19.6	1.39	31,500,000
12,000	125	25	107.5	31	1.08	5,000,000

The lower values of transient reactance are difficult to obtain in 60 cycle generators and increase the cost of the machines.

A high short-circuit ratio is obtained by making the generator field strong in comparison with the armature, this results in less armature demagnetizing effect and in a smaller decrease of flux and voltage with increase of armature current. Such a condition tends to decrease the likelihood of system instability and for this reason the purchaser frequently specifies high short-circuit ratio.

However, the condition desired to promote stability is not a minimum reduction in flux, or flux interlinkages, but no reduction in flux and this can only be obtained by a quick response voltage regulator and excitation system and when these are supplied, the high short-circuit ratio becomes of less importance.

Short circuit ratios of modern Canadian generator range from 0.8 to 1.25. Where higher values are required the size and cost of the generators or synchronous condensers are increased.

When a single generator is to be used to charge a long transmission line a high short-circuit ratio is desirable to prevent excessive voltage rise. For this purpose machines with short-circuit ratios up to 2.0 have been designed.

The most effective method of improving the stability of generators and synchronous condensers is to accelerate the flux increase in the machine by improving the excitation and voltage regulating system. Rapid flux control has been assisted by improvements in the design of exciters, laminated stator frames are used to reduce the retarding effects of eddy currents during flux change; compensating windings are placed in the pole faces to neutralize armature reaction; the field windings are divided into a number of circuits to reduce self-inductive effects and the maximum voltage of the exciter may be increased up to about four times that required by the main field at normal load, giving a large forcing effect during system disturbances.

By making these improvements in design and providing a pilot exciter to excite the main exciter a sufficiently rapid voltage response can be secured in large low speed direct connected exciters and it is not necessary to provide the more expensive motor-driven exciters.

Where an exciter of ordinary design may be capable of increasing its armature voltage at the rate of 50 volts per second, low speed exciters for direct connection to large vertical generators have been built with a rate of voltage increase of 200 to 350 volts per second. This is a sufficiently rapid response for any except the most sensitive systems. High speed exciters for synchronous condensers can be built with a rate of control of 2,500-volts per second or over but such a rate is not required in the majority of installations.

The decrease of transient reactance and the speeding up of the exciter response, while they improve stability, both tend to increase the currents flowing when a fault occurs on the system and it is imperative that the faulty section be taken off the system with a minimum delay. The rupturing duty of circuit breakers is, therefore, increased and at the same time it is important that their operating time should be reduced.

The rating of oil circuit breakers has increased to 2,500,000 kv.-a. and this should be sufficient to protect any system where care has been taken to limit the possible power concentration. High voltage circuit breakers have up to the present time been rather slow in operation requiring with their control relays a total rupturing time of 0.4 to 0.6 seconds. It seems probable that this can be reduced to 0.2 or even 0.1 seconds but only at a considerable increase in cost.

For rapid and economical clearance of faulty lines it may be advisable to break the circuit on the low voltage side of the line transformers. The expensive high voltage oil circuit breakers may, in some cases, be entirely omitted and the transformers included as part of the line.

Lightning

Lightning presents a still unsolved problem for the transmission engineer. Extensive service experience, laboratory tests and calculations have given much valuable information as to the voltage and wave shape of induced lightning surges on transmission lines but the lightning proof line has not yet become a reality.

To protect lines from lightning the following measures are of value:

(1) Lines should where possible be kept away from locations where lightning is known to be especially prevalent.

(2) Overhead ground wires should be installed to reduce the induced lightning voltages. In addition to reducing the induced voltage the ground wire increases the attenuation of the wave as it travels along the line.

(3) Extra line insulation makes the line more nearly lightning-proof but transfers the danger of breakdown to terminal apparatus and only increases the need of lightning arresters to protect the terminal transformers.

(4) Grading rings may increase the insulator spark-over voltage for lightning waves of very steep wave front and will at the same time decrease the 60-cycle insulation value. This is not serious as the factor of safety is still high. Grading rings have not been installed on the 220 kv. lines in Canada as it was felt that their value had not been sufficiently demonstrated.

(5) The value of wood as an insulator against lightning voltage is being more and more appreciated and wood cross arms are being used in many cases even on steel structures. The insulation strength of wood poles wet or dry is 100 to 300 kv. per foot and 180 kv. is considered a good average value to assume.

Some engineers feel that too much money should not be spent in trying to eliminate entirely the lightning flash-over of a line but rather that instantaneous protection should be provided to clear the line, in case the power arc follows the lightning flash, before any permanent damage is done to the insulators. If the system consists of a number of parallel lines and is properly designed from the point of view of stability, the flashover and instantaneous clearance of one line will not result in loss of synchronism.

Lightning Arresters

A number of 220 kv. systems have been operated for a period without lightning arresters but the experience has not been satisfactory and it is now considered that for highly insulated lines lightning arresters are of sufficient value in protecting terminal apparatus to warrant the expense of their installation.

Only if the line insulation against lightning is reduced to a point where it is below the impulse voltage strength of the transformers is it safe to operate without lightning arresters.

The majority of switching surges are less than three times normal (normal being the crest value of the line to line voltage). Switching loads on and off produces relatively mild surges, but energizing or de-energizing unloaded lines produces a more serious shock. Six or seven times normal represents the order of the highest switching surge. This magnitude occurs with the de-energizing of an unloaded line.

Lightning voltages to which arresters may be subjected may be of any value up to the flashover value of the line insulation.

For 66-kv. lines with steel towers the r.m.s. 60-cycle dry flashover value averages 3.8 times the system voltage or 6.5 times the line to neutral voltage. But with wood poles and cross-arms in series the flashover limit is raised by an indefinite amount.

The lightning flashover with steel towers will be about 10 to 12 times normal with a fairly steep wave front but may be much higher with wood cross-arms.

Voltages to which lightning arresters may be subjected during operation should be studied very carefully. The highest voltages usually occur at light load or after load has been dropped suddenly and the generators are running at excessive speed.

Inductive Co-ordination of Power and Signal Systems

The problem of co-ordinating power transmission and distribution systems with neighbouring signal systems has become more complex as the power systems have increased in capacity and in extent.

Properly designed and co-ordinated transposition schemes will usually reduce the voltage induced in the signal system by the balanced components of current and voltage in the power system to such small values that they will not interfere with operation.

Induction from residual currents and voltages which are present in power systems under normal operating conditions is still serious in some cases. Transposition of the power conductors does not directly reduce such induction, but if the residual voltage is mainly due to differences in the capacities to ground of the various power conductors, transpositions in the power circuit will reduce the residual voltage. Transposing the signal circuit conductors results in equalizing the voltages induced in them by the power circuit residuals, and so eliminates the voltage between conductors, except insofar as impedance unbalances in the signal circuit may interfere with such equalization. Excessive residuals on the power circuit can usually be avoided without violating any principle of economic design.

Slot harmonics in generator voltage waves may be eliminated by sloping the slots relative to the axis of the machine either uniformly or in steps: or they may be reduced by using fractional values of slots per pole.

Harmonics due to the non-sinusoidal distribution of the excitation flux relative to the peripheral length of the pole pitch may be eliminated in salient pole machines by suitable shaping of the pole surfaces and in non-salient pole machines by the proper distiibution of the excitation winding.

Sixty cycle generators can now be made with a telephone interference factor (t.i.f.) as low as 11 in large size machines and from 15 to 25 in medium size machines without appreciable increase in cost. In 25-cycle generators the t.i.f. may be obtained as low as 3.5 in large size machines and from 5 to 10 in medium size machines.

Distortion of wave form may also be caused by transformers, particularly when operated with high flux densities which results in the production of harmonics in the magnetizing current waves. In a star-star connected bank of transformers the third harmonic magnetizing current and its multiples cannot flow and as a result third and higher harmonic residual voltages to ground are produced and result in interference. A delta connected tertiary winding or a change the star-delta connection will eliminate these residual voltages.

Arc furnaces introduce harmonics which are difficult to eliminate. Mercury arc rectifiers on electric traction circuits sometimes introduce residual currents and voltage of high frequency. A filter is in many cases necessary to reduce this effect.

When induction due to normal operating conditions had been studied and remedies developed, the abnormal or fault conditions remained and these present the real problem to day.

Abnormal conditions in the power system generally produce large residual currents and voltages and the inductions from these residuals may, in the case of a very severe exposure, amount to several thousand volts.

The electrostatic induction from abnormal residual voltages may be calculated by the method of images based on the hypothesis that the earth is a perfect conductor and may be replaced by a perfectly conducting plane at the surface of the earth.

When the method of images was applied to the calculation of induction from residual currents and the calculations were checked by tests it was immediately apparent that the surface of the earth could not be used as the equivalent conducting plane and many tests were made in different parts of the country to determine the proper location of such a plane. It was found that the proper depth for the equivalent plane varied widely with the nature of the ground and also with the distance between the two circuits. This method of calculating induction from residual currents has therefore been abandoned.

As a third approximation the earth is assumed to be a uniformly conducting body. The results calculated on this basis agree much more closely with the facts as determined by experiment but since the conductivity of the ground varies irregularly at different places and at different depths the most carefully calculated results cannot be taken as correct until their accuracy is demonstrated by test.

The ratio of maximum to minimum specific resistance of the earth met with in practice is about one hundred to one and the corresponding ratio of maximum induction to minimum induction varies with the distance between the circuits, being only about two to one for roadway separations but increasing rapidly as the separation increases. It is therefore very important to know the earth conductivity when calculating the induction to be expected in exposures especially with wide separation of circuits.

The abnormal conditions which give the greatest amount of trouble are (a) short-circuits; (b) grounds and (c) switching of loads or lines.

Short Circuits

Short circuit currents flowing in many modern systems are very large since the combined capacity of generators and synchronous motors connected to the system is large. It is to the advantage of the power company as well as of the signal company that short circuit currents should be limited, as the oil switches must be able to clear the worst short circuits without injury.

Three phase short circuits are not usually very troublesome as the currents and voltages in the three phases are more or less balanced. Single phase short circuits are however very serious as they are both electrostatically and electromagnetically unbalanced.

Grounds

When a system is connected star with grounded neutral, a ground on any phase constitutes a short circuit which is cleared by the overload protection but in the meantime the single phase short-circuit has caused a disturbance in the neighbouring signal system.

The magnitude of the fault currents can be reduced by inserting resistance or reactance in the neutral connection to ground. There has been however some difficulty in adopting this method as it has been found that the neutral impedance required to adequately limit the fault currents are, in the majority of cases, of such magnitude that the power transformers must be insulated for full line voltage and their cost is therefore increased.

There seems to be a growing tendency to standardize the star connection with neutral connected to ground through a medium resistance or reactance. The Peterson grounding coil has not as yet been applied in Canada.

When an isolated system is grounded at one point it can still operate but it is electrostatically unbalanced and will cause some electrostatic interference in neighbouring communication systems. If, however, a second ground on another phase occurs at some distance away, a fault current will flow out on the phase wire and back through ground. This will cause serious electromagnetic induction.

If a ground wire is installed it will carry part of the ground current and so will reduce the interference. High resistance steel ground wires will reduce the magnetic field created by the fault about 10 per cent. High conductivity ground wires may be expected to reduce the field by 35 to 40 per cent but to be effective they must extend over the whole distance affected by the fault and must be grounded through low resistance grounds.

The signal companies are in some cases asking the power companies to install high conductivity ground wires practically equivalent to the phase wires but this expenditure can only be justified in very exceptional cases.

Switching

Switching on and off of loads does not cause serious interference, but switching lines on and off may induce high voltages. Switching an unloaded line off is one of the most troublesome cases.

If under transient fault conditions the voltage induced along the two wires of a signal system in parallel does not exceed 400 or 500 volts no serious interference with the operation of the signal system should result unless the impedances to ground of the two sides of the system are unbalanced.

The exact limits of magnitude of induced voltages which can be effectually handled by acoustic shock preventing devices have not been definitely determined up to the present and they depend to a considerable extent on the impedance of the circuit through which the voltage operates. Currents up to 10 amp. have been discharged without causing severe acoustic shock.

Acoustic shock absorbing devices have been developed for the purpose of protecting telephone operators from such shocks but they cause appreciable losses in the circuits and are not applicable to substations and therefore cannot protect the public from these shocks.

The Common Neutral System

When the primary distribution system grows beyond the economic limits of the 2,000 volt delta network, it is the usual practice to change the voltage to 4,000 volt star retaining the same transformers as before. A fourth wire is installed to carry residual currents. This neutral wire may be connected to ground at the substation only or a number of grounds may be installed at different parts of the system. The primary distribution with multiple grounds gives a better voltage regulation for the power system but the residual current cannot be confined to the neutral wire and often more than 50 per cent of it will flow through the ground. This stray current gives trouble to the telephone companies particularly to the two-party lines which use the ground as part of the ringing circuit. However comparatively slight modifications of the telephone systems enable them to operate satisfactorily and it seems probable that the multiple grounded primary neutral should be accepted as standard. With underground systems no trouble is experienced.

When a secondary grounded network is provided including the water system it is common practice to connect the primary neutral system to the secondary ground network and this gives the common neutral system which appears to be the system which will be employed almost universally, but the power companies must take all precautions to maintain a good wave shape.

Hydro-Electric Industry of Canada

Some Economic Aspects

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

The phenomenal expansion of recent years has established the hydro-electric industry as one of the foremost activities in Canada. The rapid development of many new power sites and the widespread extension of transmission lines have created conditions which present certain economic aspects of particular interest.

It is first necessary to review briefly the situation with regard to all the available power resources throughout the Dominion in order to appreciate the predominance of water power as a source of energy.

Fuels as a source of power are found in abundance in the east in the bituminous coal deposits of Nova Scotia and in the west in Alberta and southeastern British Columbia and on Vancouver Island. Lignites are found in southern Saskatchewan, oil and natural gas in Alberta and to a limited extent in the southwestern peninsula of Ontario. In the central part of the Dominion, notably in the provinces of Ontario and Quebec, native fuels are almost entirely lacking but compensation is afforded by the widespread occurrence of ample water powers fortunately situated with regard to both the centres of population and to the other great natural resources of forests and minerals.

Fuels are used almost exclusively as a source of power for rail transportation in Canada, the exceptions being urban and suburban electric railways which in the main are operated by hydro-electricity purchased from central electric stations. Fuels are also used to a limited extent in general manufacturing and to a much more limited extent in the central electric station industry, the latter use being largely confined to Saskatchewan and parts of Alberta, Manitoba and the Maritime provinces. Due to its availability and the advantageous rates at which it is sold, hydro-electric power produces over 98 per cent of the electricity used by the public.

A comprehensive review of the water power resources of the Dominion and their development is being presented to the Conference by Mr. J. T. Johnston, M.E.I.C., Director, Dominion Water Power and Reclamation Service, Department of the Interior, so that it is only necessary to repeat here the estimates of total resources and present development in order to better understand the discussion which follows.

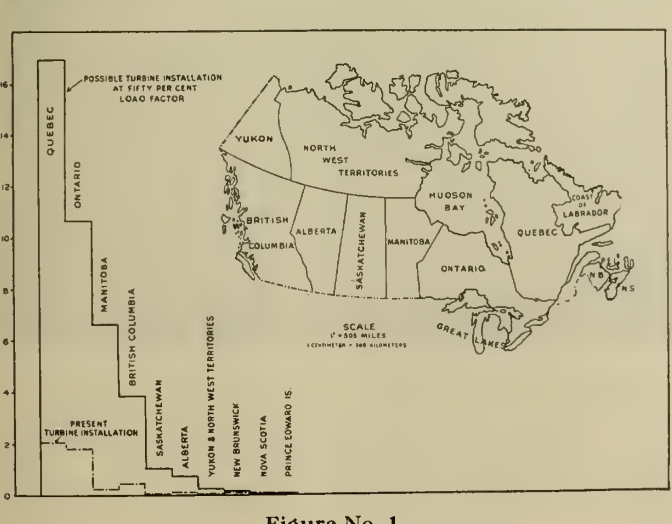

Figure No. 1.

Figure No. 1 presents graphically the possible turbine installation at approximately 50 per cent load factor and the total turbine installation at January 1st, 1930. This provides an interesting basis of comparison between developed and undeveloped water power in each of the provinces of the Dominion while table No. 1 lists for each province and for the Dominion as a whole, the total estimated water power resources and the total turbine installation in horse power at January 1st, 1930. The turbine installation is further divided to show the totals utilized by central electric stations and by other industries. These figures indicate that more than 84 per cent of Canada's total water power installation is in central electric stations and while definite figures are not available as to what part of the turbines in the "other industries" group is connected to electric generators, the best possible estimate leads to the conclusion that not less than 40 per cent is so connected.

Historical—Early Hydro-Electric Development and the First High Voltage Transmission

The utilization of water power for the generation of electricity started some forty years ago when certain

Table No. 1—Available and Developed Water Power in Canada
January 1, 1930.

Province	Available 24-hour power at 80 per cent efficiency		Turbine Installation		
	At ordinary minimum flow h.p.	At ordinary six months flow h.p.	Total h.p.	In central electric stations h.p.	In other industries h.p.
1	2	3	4	5	6
British Columbia	1,931,000	5,103,500	560,042	418,210	141,832
Alberta.........	390,000	1,049,500	70,532	70,320	212
Saskatchewan...	542,000	1,082,000	35	......	35
Manitoba.......	3,309,000	5,344,500	311,925	311,925	.....
Ontario.........	5,330,000	6,940,000	1,956,675	1,624,393	335,282
Quebec.........	8,459,000	13,064,000	2,572,418	2,216,150	356,268
New Brunswick.	68,600	169,100	112,131	83,910	28,221
Nova Scotia.....	20,800	128,300	108,406	70,979	31,427
Prince Edward Island........	3,000	5,300	2,439	376	2,063
Yukon and N.W. Territories....	294,000	731,000	13,199	......	13,199
Canada......	20,347,400	33,617,200	5,710,802	4,802,263	908,539

The figures in columns 2 and 3 represent 24 hr. power and are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration is definitely known or at least well established. Many rapids and falls are scattered on streams from coast to coast which are not yet recorded.

The figures of column 4 represent the actual water wheels installed throughout the Dominion and average 30 per cent greater than the corresponding available power as calculated in column 3. The figures quoted above therefore indicate that the *at present recorded water power resources* of the Dominion will permit of a turbine installation of about 43,000,000 h.p., i.e., the present turbine installation represents only *slightly more than 13 per cent* of the present recorded water power resources.

Columns 5 and 6 divide the total hydraulic installation into that used for the public distribution of electricity and that installed for industrial purposes.

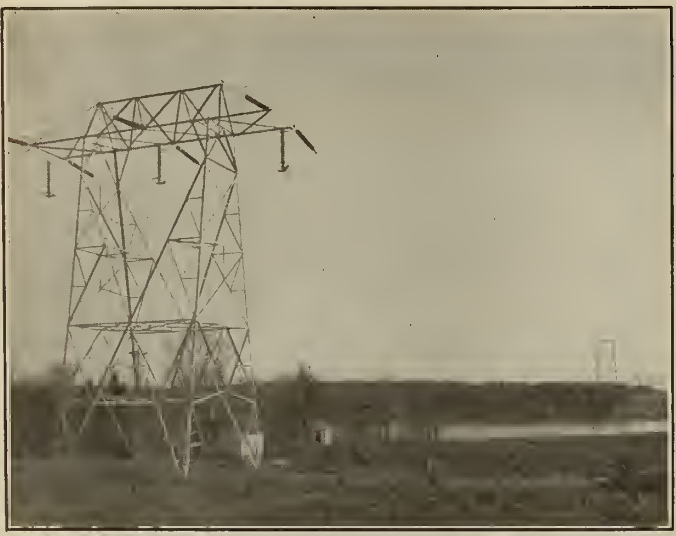

Figure No. 2.—Gatineau-Toronto Transmission Line Crossing the Ottawa River.

The first 220,000-volt line in the British Empire. A patrolman's house with telephone booth may be seen. A telephone line, built for operating purposes, parallels the power line 60 feet (18.3 m.) from the centre line of the towers except at the river crossing where it is carried on the steel towers below the power wires.

developments were established from which electricity was generated and distributed at generator voltage to immediately adjacent communities. The city of Ottawa is a case in point, hydro-electricity being produced for use within the city as early as 1890 from a plant at Chaudiere Falls on the Ottawa river. Such developments were the direct result of the then recent introduction of the incandescent electric lamp. The real impetus to hydro-electric development came, however, with the introduction of high voltage transmission which, in Canada, dates from 1895 when power was transmitted from a 1,200-h.p. plant on the Batiscan river to the city of Three Rivers, Quebec, over an 11,000-volt line, 17 miles in length. This was reputed to be the first high voltage transmission line in the British Empire.

The feasibility of remote utilization being thus established, similar developments rapidly followed at widespread points, Montreal receiving power from Lachine; Quebec City from Montmorency Falls; Hamilton, Ontario, from DeCew Falls; Victoria, British Columbia, from the Goldstream river and Nelson, British Columbia, from the Kootenay, all in 1898.

Advances in Transmission

Improvements in transforming equipment developed rapidly, leading to higher transmission voltages and correspondingly longer transmission lines. To supplement the supply of power to Montreal, an eighty-five mile, 50,000-volt transmission line was built from Shawinigan Falls in 1903, this being the longest and highest voltage transmission line in America at that time. It is interesting to note that by 1911, an additional double circuit line operating at 100,000 volts was provided to supplement this service. In 1906 power was first received in Toronto from Niagara Falls, 90 miles distant, at 60,000 volts, while in the same year Winnipeg river power was first transmitted to the city of Winnipeg over a 60,000-volt line 65 miles in length.

The next outstanding achievement in the transmission of hydro-electricity in Canada followed the creation of the Hydro-Electric Power Commission of Ontario which in 1910 commenced the transmission of power purchased at Niagara Falls to 12 municipalities in western Ontario at 110,000 volts. This system was gradually extended until by October 31, 1928, 833½ miles were operated by the Commission at that voltage.

While many improvements in conductors, insulators, switching and transforming equipment were developed, 110,000 volts remained the highest Canadian transmission voltage until 1927 when the Shawinigan Water and Power Company completed a 168,000-volt line 135 miles in length to transmit power from the great Saguenay river development of the Duke-Price Power Company to Quebec City. This achievement was followed in 1928 by the building of a 220,000-volt line from the Paugan station of the Gatineau Power Company to Toronto, a distance of 230 miles. A second line at the same voltage on the same right of way is scheduled to go into operation in August, 1930, to complete the delivery of 260,000 h.p. purchased by the Hydro-Electric Power Commission of Ontario. These lines are illustrated by figures Nos. 2 and 3.

The extension of transmission systems has led to widespread distribution of power and a gradual reduction in the number of the fuel power stations serving individual municipalities. The most outstanding instance has occurred in Ontario where over one hundred fuel stations serving as many municipalities have been replaced by hydro power distributed by the Hydro-Electric Power Commission. To a lesser extent similar replacement of fuel stations has occurred in the other provinces and is most marked at the present time in Alberta where the extension of the Calgary Power Company's distribution has brought hydro-electricity within the reach of a large number of communities formerly dependent on small steam or internal combustion plants. The widespread distribution of electricity has had a very marked effect upon living conditions in Canada. It is estimated that approximately 62 per cent of Canadian homes are wired for electricity, an outstanding proportion when due consideration is given to the fact that 45 per cent of the population dwell in rural areas.

In the domestic field not only are all the more common electrical appliances such as irons, washing machines, toasters, cooking ranges and small heaters in general use but newer devices including electric refrigerators, ironers, household water supply plants, dishwashers, and radio receiving sets are being constantly introduced and are meeting a growing demand. In the larger power field the electrification of the manufacturing industries is rapidly progressing, practically all operating either partially or wholly by electricity most of which is purchased from central electric stations.

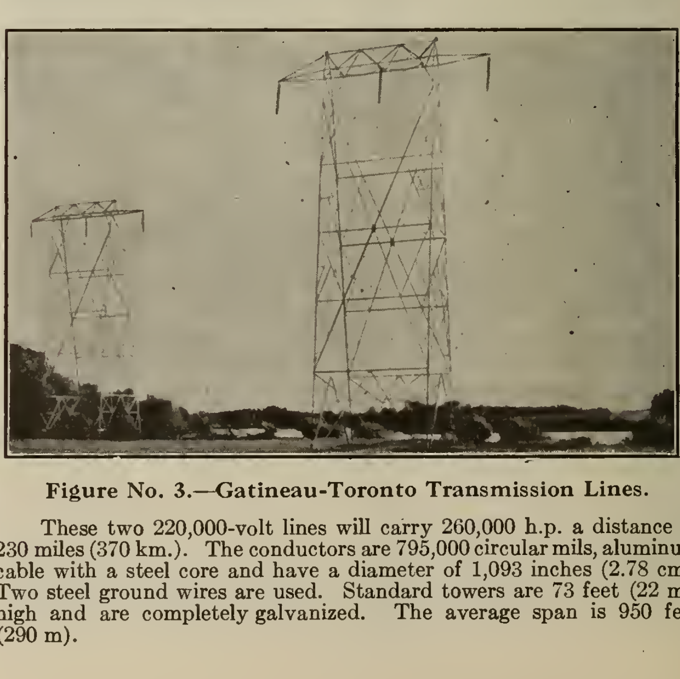

Figure No. 3.—Gatineau-Toronto Transmission Lines.

These two 220,000-volt lines will carry 260,000 h.p. a distance of 230 miles (370 km.). The conductors are 795,000 circular mils, aluminum cable with a steel core and have a diameter of 1,093 inches (2.78 cm). Two steel ground wires are used. Standard towers are 73 feet (22 m.) high and are completely galvanized. The average span is 950 feet (290 m).

Figure No. 4.—Aeroplane View of the Paugan Development of the Gatineau Power Company.

Showing the sluiceways on the right, the power house in the centre and 202,000-volt switching station on the left. In the river above the power house may be seen pulpwood logs being directed towards the log chute which is situated just left of the sluiceways. At the extreme left of the intake to the power house is the by-pass through which the river was diverted during the construction period. Six 34,000-h.p. generators are now installed in the power house which is designed for eight machines. The dam is built for six additional units, making an ultimate installation of fourteen.

Intensive study in connection with the design, installation and operation of central electric station equipment has resulted in such high operating efficiencies that not much room remains for improvement in these particular fields. Further economies in the industry are dependent upon such major processes as the interconnection of stations and systems giving the fullest utilization of stream flow, head and storage and providing a diversity of use producing highly efficient operation; the consolidation of controlling and operating companies with its accompanying opportunities for low cost financing and widely experienced executive and engineering management, and, the standardization of equipment of well considered and satisfactory design.

The Interconnection of Stations and Systems

As the demand for power increases, the problem of the complete utilization of stream flow becomes of increasing importance. One factor in solving this problem is the establishment of a series of interconnected installations on the same stream so designed as to correlate the heads and storage to produce the greatest output at the least capital expenditure.

The development of a number of plants on a stream under centralized control or of one large plant while possessing great economic advantages for the maximum production of power, involves such heavy capital expenditures that it becomes necessary to produce and market the fullest possible output with the least possible delay.

If a market for the power is not already available, it becomes necessary to create one even if this initial load does not provide an adequate return on the capital invested. This initial load may be and often is, provided by the establishment of some industry where steam for use in the manufacturing process may be generated in electric steam boilers until a more advantageous market can be found for the power while even after the development of a market at ordinary commercial rates, the low capital expenditure involved in an electric steam boiler installation warrants its retention for the use of any surplus or off-peak power.

Field for Electric Steam Boilers

It is well recognized that steam cannot be produced by electricity as ordinarily sold on the kilowatt hour basis, in direct competition with coal, except in cases where surplus power is available which can be contracted for at a low rate.

In estimating the possible revenue from the sale of electricity for the production of steam the relationship existing between the energy in a kilowatt hour and in a pound of steam must be considered. One kilowatt hour will produce in an electric boiler approximately three pounds of steam. One ton of coal will produce about 15,000 pounds of steam, i.e. 5,000 kw.h. of electricity will produce the same amount of steam as a ton of coal. The price of electricity for steam generation is, therefore, determined by the cost of coal.

While the revenue obtained from the sale of power for steam is generally insufficient to pay the fixed charges on the development, it is sufficient to permit many large installations being brought into operation when only a comparatively small proportion of their output can be sold at ordinary commercial rates.

Examples of Centralized Control

A recent notable instance of the development of a river under single control is afforded by the construction programme of the Gatineau Power Company on the Gatineau river in the province of Quebec.

Like most of the rivers draining the northern slope of the St. Lawrence valley, the Gatineau was subject to periods of very low flow, consequently power development on a large scale was uneconomic without extensive storage. No single development could be made to carry the high annual charges involved in adequate storage. To justify any development it was necessary to contemplate the construction of three plants and the storage of at least 100,000 million cubic feet of water.

These three plants were designed and constructed for a total installation of 562,000 h.p. with an initial installation of 378,000 h.p. which has since been increased to 436,000 h.p. One of the developments, the Paugan station, is so designed that a further 204,000 h.p. may be installed in an extension to the present power house if interconnection with other systems where navigation or other considerations preclude the storage of water, warrants low load factor operation on the Gatineau river.

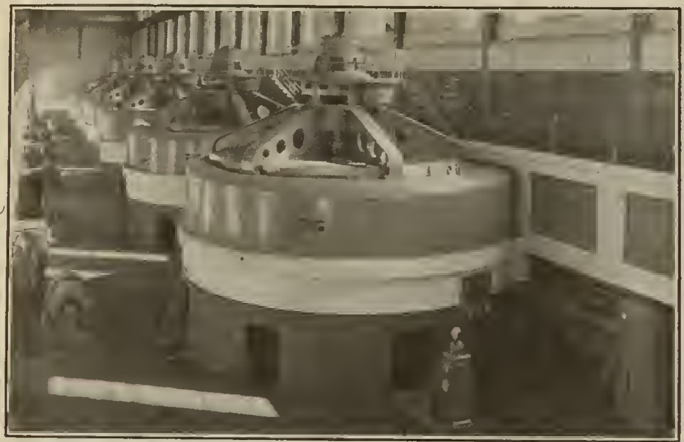

Figure No. 5.—Interior of the Generator Room, Paugan Station of the Gatineau Power Company.

The generator ventilating system is of the totally enclosed type and is controlled by the louvres at the right of these machines. The motor-generator sets at the left and the auxiliary generator which may be seen just below the railing around the direct connected exciters are part of the high speed excitation system used for maintaining the stability of the 220,000-volt system through which Paugan is tied in with Niagara 310 miles (500 km.) away.

The initial storage of 100,000 million cubic feet originally provided under the aegis of the Quebec Streams Commission in the Baskatong reservoir has been supplemented by the creation of the Cabonga reservoir where more than 45,000 million cubic feet of water are impounded.

The generation of the tremendous amount of power attendant upon such development necessitated the finding or creating of new markets for the output. These markets were provided by the building by an associated company of the world's second largest pulp and paper mill to which energy was sold not only to meet its heavy power demands but also for the generation of steam in electric boilers, and by the completion of contracts with the Hydro-Electric Power Commission of Ontario for the sale of some 360,000 h.p. of electrical energy to supplement the supply to the Niagara, Rideau, St .Lawrence and central Ontario systems.

The economic development of the Gatineau river on such a magnificent scale within a period of a few years is an event of outstanding importance in the field of hydro-electric undertakings. It was followed by the acquisition by the same company of three plants controlled by another organization on the Ottawa river, a stream of very limited regulation. These plants have been interconnected with those on the Gatineau river and are used to the maximum capacity of the water available (which on account of lack of regulation would have been wasted if not used) with a corresponding saving in water on the Gatineau river where regulation provides for the storing of water until load conditions warrants its use. The improvement in operating conditions in the Ottawa river plants is strikingly illustrated in figure No. 7 which shows representative weekly load curves for the three plants before and after interconnection with the Gatineau river stations.

The lower load curve on figure No. 7 is that for a typical week in October 1928 before interconnection was effected and the upper that for the corresponding week in October 1929, after interconnection. Not only were the operating conditions of the Ottawa river plants improved but it became possible to effect economies by the doubling of the equipment in one of them to achieve fuller utilization of the available water.

A somewhat similar instance of the development of a stream by a single company in order to take the fullest advantage of the flow and storage occurs on the St. Maurice river. The Shawinigan Water and Power Company has acquired practically complete control of this river by new construction, the acquisition of plants operated by other organizations and by the leasing of undeveloped sites to provide for future power demands.

The first undertaking by this company was the building of headworks at Shawinigan Falls to provide power for its own power house and those of two manufacturing companies. Delivery of electrical power commenced in 1902 and the installation steadily increased until 280,000 h.p. was in operation. The completion of the Gouin storage dam by the Quebec Streams Commission in 1917 increased the amount of power available at Shawinigan Falls in low water periods by 100,000 h.p. This dam is located at La Loutre about two hundred miles from the mouth of the river and impounds approximately 175,000 million cubic feet of water. Further storage is provided on the Manouan river, a tributary of the St. Maurice, where 17,000 million cubic feet of water are impounded. The Gouin and Manouan dams store sufficient water in their reservoirs to generate one thousand and ninety million kilowatt hours when utilized in the company's power houses at Shawinigan Falls, La Gabelle and Grand'Mere. The recent purchase of the latter brought the company's total installation on the St. Maurice to 576,000 h.p. The local storage ponds at these three plants are under such control due to the efficient regulation of the stream that a balance of the electrical loads of each is maintained with the result that the water is utilized to its fullest value in its passage to the St. Lawrence.

By the acquisition of the remaining undeveloped water powers on the St. Maurice the company has placed itself in a position to take the fullest economic advantage of the storage provided. The sites so acquired have an estimated capacity at commercial load factors of 600,000 h.p.

Many similar cases of interconnected developments occur throughout Canada. In British Columbia by the erection of a dam at the outlet of Alouette lake into the Alouette river the level of the lake was raised 45 feet and its water diverted through a tunnel into Stave lake. By the construction of a power plant at the mouth of the tunnel 12,500 h.p. is developed, the water being again used at the Stave Falls plant while a third development at Ruskin near the mouth will utilize the water of Stave lake for the second and that of Alouette lake for the third time. The increased flow in the Stave river due to the diversion

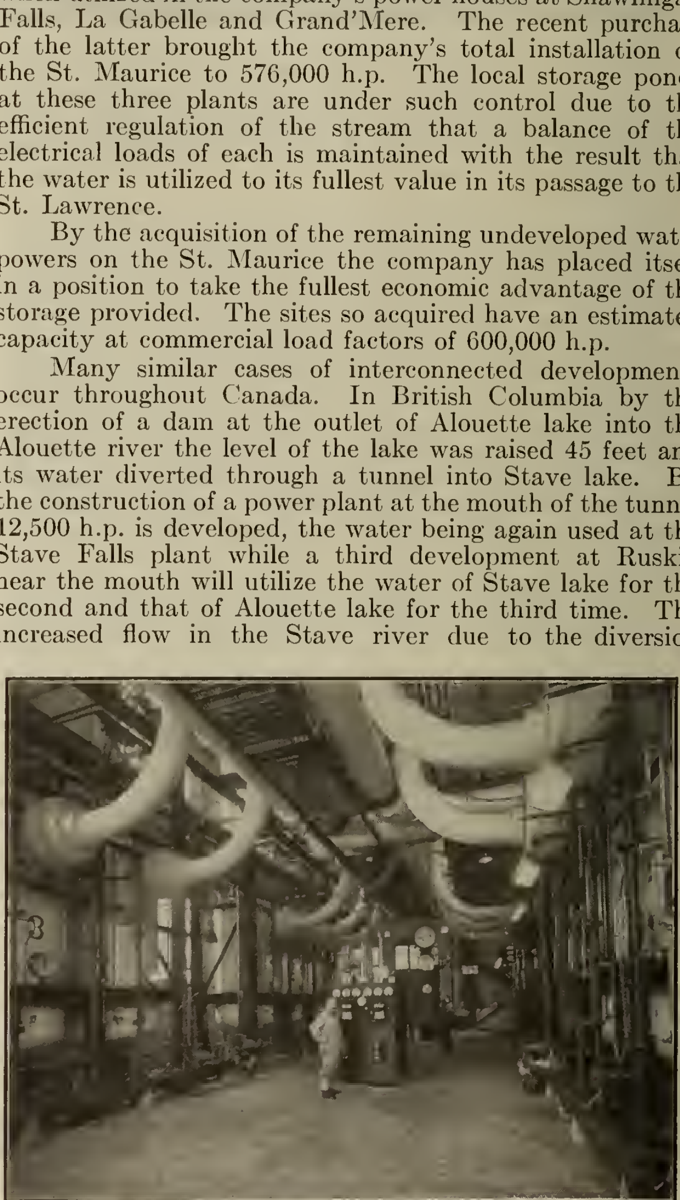

Figure No. 6.—Interior of Gatineau Pulp and Paper Mill Boiler Room.

This is the largest single installation of electric steam generators in the world. The four generators in this comparatively small room use 150,000 kw.

thereinto of the waters of Alouette lake provided power for the installation of an additional unit at Stave Falls and rendered economic the raising of the head at that plant with its attendant provision of additional storage. The net result of the scheme was that the installation of the Stave Falls plant was raised from 52,000 h.p. to 77,500 h.p., the new plant at Alouette dam produces 12,500 h.p. and additional water and more uniform flow is provided for the plant now under construction at Ruskin. The ultimate designed capacity of this plant is 170,000 h.p.

In Alberta the development of the Bow river is in the hands of the Calgary Power Company which operates two plants totalling 31,600 h.p. near Seebe, and a recently completed station at Ghost Falls where 36,000 h.p. is installed. The three stations are interconnected and the flow of the stream is regulated by the Minnewanka storage dam 30 miles upstream which impounds over one thousand, nine hundred million cubic feet of water in Minnewanka lake for use in each of the three plants in turn. The Ghost development, the furthest down stream, is a combined power and storage scheme and provides pondage for an additional three thousand, two hundred and ten million cubic feet of water.

In Ontario, the Hydro-Electric Power Commission wherever practicable has interconnected its plants. On the Nipigon river the Commission operates a 75,000 h.p. plant at Cameron Falls and is constructing another 54,000 h.p. at Alexander Landing while the remaining power sites on the river are also marked for development by the same organization.

As the amount of water available for the operation of the Niagara stations of the Commission is fixed by International Treaty, the three plants, Queenston of 502,000 h.p., Ontario Power of 208,200 h.p. and the Toronto power station 164,500 h.p. are interconnected and operated to obtain the maximum power. As water used at the Queenston generating station will develop more than double the power that it would develop if used at the other stations, this station is operated to carry the maximum load possible at all times. The efficient operation due to this apportionment of the available water is evidenced by the peak load figures of the plants for the year ended October 31, 1928, viz., 529,469 h.p. for the Queenston station, 182,574 h.p. for the Ontario power station and 141,019 h.p. for the Toronto power station.

The Commission's Georgian bay system is supplied with power by six interconnected stations of the Severn, Eugenia, Wasdells and Muskoka divisions and notwithstanding the fact that this system operates at 60 cycles and the Niagara system at 25 cycles the two are interconnected through frequency changing equipment at Mount Forest. The Commission's central Ontario and Trent systems include nine generating stations on the Trent canal waterways and these are all interconnected for efficiency in operation while the system is tied in to the St. Lawrence Rideau and Ottawa systems which also receive a substantial supply of power from the Gatineau Power Company's plants on the Ottawa and Gatineau rivers.

The Nova Scotia Power Commission operates three combined power and storage schemes. One of these, the St. Margarets bay system, includes three generating stations on the North East river. These stations have an aggregate installation of 15,820 h.p., are interconnected and utilize not only the waters of the North East river but also those of the Indian river which is diverted into the North East by damming. Four storage reservoirs have been created in connection with the system, Five Mile and Big Indian lakes reservoirs on the Indian river and Pockwack and Wrights lakes reservoirs on the North East river. These impound three thousand, five hundred and seventy-two million cubic feet of water.

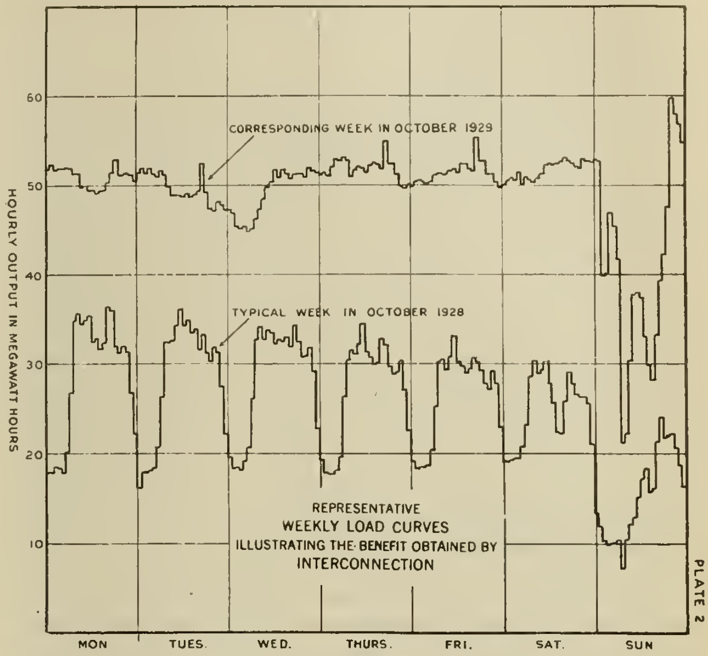

Figure No. 7.

The Sheet Harbour system has at present two interconnected generating stations on the East River Sheet Harbour of an aggregate capacity of 11,849 h.p. and a very extensive system of storage reservoirs throughout the drainage basin of the river which impound four thousand and sixty-two million cubic feet of water, equivalent to eight million, nine hundred and forty-two kilowatt hours when used in the two plants.

The third system, the Mersey, includes three generating plants totalling 31,050 h.p. on the Mersey river. These plants are interconnected and extensive storage is provided on the upper reaches of the river.

Many other instances of interconnection of Canadian generating stations leading to economies in the use of water could be quoted and considerable as are the advantages so derived they are perhaps secondary to those accruing from the interconnection of the transmission systems of related or independent organizations.

The Interconnection of Transmission Systems

The interconnection of transmission systems has many advantages in Canada where the widespread application of electricity to domestic, commercial and industrial utilization produces a diversity of load characteristics in different areas which permits of high load factor operation when the systems supplying these areas are interconnected.

In the cities, for example, the heaviest load usually occurs in the winter just before the factories cease operations for the day. The lighting load is then at its peak and the street car load is heavy. In small towns and villages the peak load occurs later in the evening. Construction and mining loads are usually high during the summer months and help to balance the winter lighting and heating peaks. Even in the field of purely domestic supply the existence of rates low enough to bring electric ranges, water heaters and the numerous other appliances available into every day use in large numbers of homes has done much to provide diversity in a load in which the average consumption was formerly very low and the period of maximum utilization short. The sum of these various loads in different areas ensures much higher load factor operation of interconnected systems than if the individual loads were carried by isolated systems. The selling of any off-peak or surplus power for the generation of steam, the smelting or casting of metals or for electro-chemical processes does much to increase the already high average load of such interconnected systems.

In the generation of hydraulic power the fullest use of the generating equipment at high load factor results in the lowest cost of the electrical energy so produced.

The saving effected in installation by the interconnection of systems is also very great in that it obviates necessity for large reserves of generating machinery. Isolated stations which must rely on their own resources to ensure continuity of service are practically compelled to install sufficient spare generating equipment to carry their peak loads with their largest units out of operation. The effect of interconnection in this respect is to pool the spare equipment, the amount required by the interconnected systems being very little greater than that which would have been necessary for the system with the largest individual load if interconnection had not obtained. Interconnection has helped to eliminate on practically all Canadian systems the necessity of maintaining auxiliary fuel power equipment.

Economies in the installation of new equipment are also effected by the installation of the larger, lower unit cost and more efficient equipment which is rendered possible by the stagering of construction operations by the different members of the interconnection. For example, if two interconnected loads are each growing at the rate of say 10,000 h.p. per year, it is possible for one organization to install a 20,000 h.p. unit to provide for the growth in the two systems to be followed later by the installation of a similar unit by the second constituent member.

Great economies in the utilization of water are also effected by the interconnection of systems generating power on watersheds of different regimen, the heavy flow from seasonal or abnormal weather conditions occurring at different times provides for the use of the maximum amount of water which cannot be stored, while conditions of abnormal low flow on some watersheds are frequently compensated for by satisfactory water conditions on others.

Most of the larger Canadian organizations generating electricity for public use have their transmission systems interconnected with at least one other system for the interchange of power. The most outstanding instance of this occurs in the province of Quebec where five organizations generating over 90 per cent of the total central station output of the province are so interconnected. These are the Gatineau Power Company which operates 6 plants aggregating well over half a million horse power on the Gatineau and Ottawa rivers in the Hull-Ottawa district and 12 smaller stations serving the district along the north shore of the Ottawa river between Hull and Montreal, the Montreal Light, Heat and Power Consolidated serving the city and district of Montreal from three stations totalling 229,500 h.p. on the St. Lawrence and one of 21,600 h.p. on the Richelieu river; the Shawinigan Water and Power Company and subsidiaries serving the districts along the north shore of the St. Lawrence from Montreal to Murray bay and between the St. Lawrence and the International and New Brunswick boundaries from sixteen stations with a total installation of 647,850 h.p.; the Southern Canada Power Company serving the district south of Montreal to the international boundary from five stations totalling 58,000 h.p. and the Duke-Price Power Company operating a 495,000 h.p. station at Isle Maligne on the Saguenay river.

In the province of Ontario the Hydro-Electric Power Commission has interconnections with a number of privately or municipally owned systems. The Niagara system receives power from the Canadian Niagara Power Company, from its own Georgian bay system, and from the Gatineau Power Company. The Georgian bay system in turn receives power as required from the Niagara system, from the municipality of Orillia's 6,360 h.p. plant on the Severn river which is operated in parallel with the six hydraulic plants of that system and from two steam power plants, one operated by the municipality of Owen Sound and the other by the Canadian Pacific Railway Company in Port McNicoll. The central Ontario and Trent systems secure power from the Gatineau Power Company while reciprocal arrangements for the exchange of power exists with the Peterborough Hydraulic Company, the Campbellford Water and Light Commission, the Canadian General Electric Company and the municipality of Fenelon Falls which organizations operate hydraulic plants with an aggregate installation of 12,770 h.p. The Rideau system receives power from the Gatineau Power Company and the Rideau Power Company while the St. Lawrence system also receives power from the Gatineau Power Company.

The Dominion Power and Transmission Company which operates a 45,000 h.p. hydro-electric generating station at DeCew Falls, near St. Catharines, and a 29,500 h.p. steam auxiliary plant in Hamilton is interconnected with the Canadian Niagara Power Company's 121,000 h.p. plant at Niagara Falls which as already stated is in turn connected with the Hydro-Electric Power Commission's generating stations at Niagara Falls.

In the province of Manitoba, the three large systems now in operation, that of the city of Winnipeg, 105,000 h.p., the Winnipeg Electric Company, 37,800 h.p., and the Manitoba Power Company, 168,000 h.p., are all interconnected for the exchange of power as required.

In New Brunswick a reciprocal arrangement for the exchange of power exists between the New Brunswick Electric Power Commission and the New Brunswick Power Company which operates a 6,600 h.p. fuel power plant in the city of Saint John.

In addition to the existing interconnections in the provinces of Quebec and Ontario, the Beauharnois Light, Heat and Power Company, recently formed, has started construction on the Beauharnois development, the first link in the much talked of St. Lawrence Waterways scheme. The initial development will be 500,000 horse power and power will be supplied to both the Hydro-Electric Power Commission in Ontario and the Montreal Light, Heat and Power Consolidated in Quebec thus providing a further interconnection between the power resources of the country's two leading provinces.

Commencing with the simple form of interconnection between the generating stations controlled by one organization, the practice has developed rapidly and will by force of circumstances be an increasingly important factor in the expansion of the hydro-electric industry. In interconnection between independent systems the making of contracts is one of the major problems. The numberless conditions of load division, segregation of losses, pooling of reserves and the allocation of fixed charges tend to make the necessary working agreements deeply involved but the advantages in operation are so outstanding that every year sees new interconnections effected.

There are necessarily economic limits to the interconnection of electrical systems and when no further improvement can be obtained in diversity, load factor and service and the cost of transmission due to distance becomes too great these limits have been reached.

The Consolidation of Operating and Controlling Organizations

Quantity production of electricity as of manufactured products leads to lowered unit costs and the consolidation of operating organizations has done much to provide more extended service at more advantageous rates. Consolidation has frequently resulted in taking electric utilities out of the hands of local capitalists of limited financial and

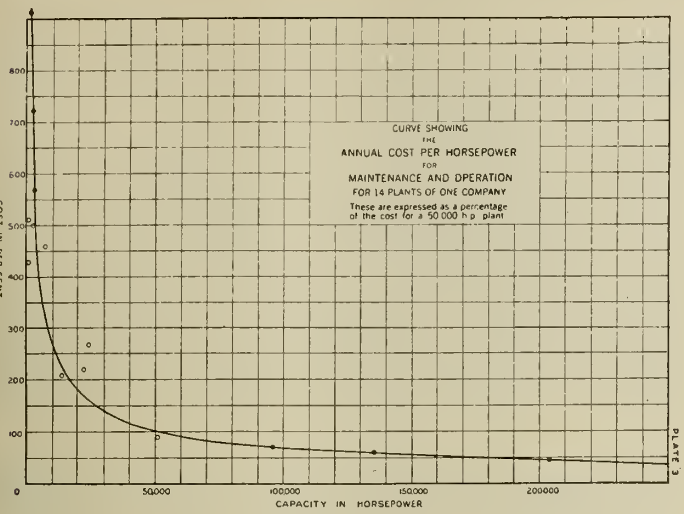

Figure No. 8.

managerial ability combining them with others where ample finances and expert executive and engineering management have led to their rapid development. In many cases plants developed to meet local needs but too small for economical operation have been dismantled and their markets supplied by the larger plants while plants capable of enlargement have been extended to capacity.

The economic advantages of replacing these small plants is very great as is illustrated in figure No. 8 which shows comparative costs for maintenance and operation of fourteen representative stations of different size expressed as a percentage of the cost for a 50,000-h.p. plant. As will be noted the disparity in costs in favour of the larger plants is very marked.

Practically all the larger systems in Canada are the result of a combined policy of the construction of new stations and the acquisition of existing ones with their appurtenant markets for power.

The Hydro-Electric Power Commission of Ontario, the world's largest distributor of electricity, which operates thirty generating stations has purchased eighteen of them of a totalled combined capacity of 450,309 h.p. These eighteen stations vary considerably in size the largest being the plant of the Ontario Power Company at Niagara Falls which at the time of its acquisition had an installation of 228,200 h.p. and the smallest that of the municipality of Gravenhurst at South Falls on the Muskoka river where 750 h.p. was installed. Only one of these (purchased during the past year) is operated as an independent unit.

The Shawinigan Water and Power Company has also done much to extend the sphere of its operations by the purchase of plants and distribution systems operated by other organizations. Beginning with the acquisition of the North Shore Power Company in 1907, numerous purchases have been made until the company now owns eight central electric station companies. The company also controls by stock ownership the Quebec Power Company and has substantial stock interests in other important central station organizations.

The Gatineau Power Company has also followed a policy of acquiring stations within its area of operation. The company was incorporated in 1925 to take over the developed and undeveloped water power sites acquired by the International Paper Company. The operation of the existing plant at Kipawa was at once assumed and the development of three sites on the Gatineau river commenced. During the period 1925 to 1928 the Company acquired sixteen central station Companies operating in the Ottawa and the Gatineau river valleys. The interconnections effected between the stations acquired by this company have had a most marked effect upon the distribution of electricity in the very extensive area served. Certain of the smaller stations which have proved unsatisfactory in service and operating costs have been closed or dismantled while operation by remote control from other stations will provide for more economical operation of others.

The Montreal Light, Heat and Power Consolidated which provides the electric power distribution in Montreal, Canada's largest city, had its beginning in 1902 and is now made up of ten consolidated companies.

The Southern Canada Power Company was incorporated in 1913 as a merger of several then existing companies and later acquired seven municipally owned and fourteen privately owned generating stations or distribution systems. Several of the generating stations acquired proving too inefficient and costly to operate were dismantled or replaced.

The principle of consolidation of operating companies as described above is general throughout Canada and numerous other instances of such consolidation might be cited. Another factor of more recent adoption in the Canadian central electric station field is the formation of holding companies; i.e., companies organized to acquire and hold the securities of operating companies and frequently to operate, manage and act as fiscal agents for the companies so controlled.

The holding companies afford to the operating companies under their control many economies and advantages by the centralization of expert executive and engineering personnel. The services of highly skilled engineers such as would scarcely be available to individual companies are retained and a breadth of experience and technical knowledge in design, management and operation is available to the constituent companies.

Among the more important Canadian holding companies may be included the Power Corporation of Canada which controls through stock ownership East Kootenay Power Company, Limited, and Canada Northern Power Corporation which in turn controls Northern Canada Power Company, Limited, Northern Quebec Power Company, Limited, Great Northern Power Corporation, Limited, and Northern Ontario Light and Power Company, Limited. In addition to its controlling interest in the foregoing companies, Power Corporation of Canada has a substantial interest in some twelve other prominent Canadian central station organizations.

The Canadian Hydro-Electric Corporation, Limited, was organized in 1927 to acquire and control Gatineau Power Company, Gatineau Electric Light Company, Limited, and Saint John River Power Company.

Many of the larger operating companies also function as holding companies for the smaller organizations which they own or control and much of the successful operation of these subsidiary companies is due to the financial, executive and engineering connection with the larger companies.

Standardization of Electrical Equipment

The economic advantages of standardization of electrical equipment are so great that in spite of the occasional criticisms of suppression of individuality and artistic instinct in design, it has become accepted in principle and is in general being adhered to in practice.

Standardization in Canada had its inception in 1917 with the issuance of Letters Patent to The Canadian Engineering Standards Association. The main object of this Association is to promote the establishment of industrial standards by providing an organization to receive requests for standardization, investigate their desirability and arrange for the formation of committees comprising representatives of both manufacturers and users to determine standards acceptable to all interests concerned.

The Association is not concerned with, nor does it take any active part in the preparation of the specifications but it reviews the findings of the committees to satisfy itself that the standards have been properly prepared, and finally it arranges for their publication and issue.

Other objects of the Association as enumerated in its charter include the co-ordination of the efforts of producers and consumers for the improvement and standardization of engineering products and the promotion of the general adoption of engineering standards and the revision and amendment of such standards when necessary.

The Association endeavours to follow as closely as possible the standards prepared by the British Engineering Standards Association with which it is closely allied but in many cases on account of established business interests it has been found advisable to follow other standards already generally adopted in Canada. In all cases the specifications prepared are drafted to meet the requirements of and to operate in the best interests of Canadian industry.

The budget of the Association is guaranteed by the National Research Council of Canada with the understanding that special efforts be made to obtain financial support from Canadian industry. The ready response to this suggestion gives tangible evidence of industry's appreciation of the economic value of the work undertaken.

One of the outstanding achievements of the Association has been the compilation of the Canadian Electrical Code which has been officially adopted in the provinces of British Columbia, Nova Scotia, Ontario, Quebec and Saskatchewan. This code has also been officially adopted in the Bahamas, British West Indies.

The standardization projects now under consideration include a revision of Part I of the Electrical Code; the preparation of Part II of the code which will indicate suitable standards for electrical apparatus and materials which must be complied with in order to obtain approval for their sale or use in Canada and also of Part III of the code which will deal with outside wiring rules covering minimum requirements which may prove acceptable to all provincial authorities. Standardization of distribution type transformers, power transformers, and of oil for transformers and oil switches is also under way.

Conclusion

In the foregoing summary of three of the main economic aspects of the Canadian central electric station industry it has only been possible to touch on the highlights of each.

The expansion which is taking place in Canada in general industry, the transition from agricultural to industrial supremacy and the rapid development of our natural resources of forest and mine all combine to create a demand for power under conditions constantly varying and each involving some special economic problem. Great as has been hydro-electric development in the past the future will witness even more rapid and far reaching progress and there is no reason to fear that the problems arising therefrom cannot be successfully solved.

Economic Aspects of Electrical Supply in the House and on the Farm

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

The economic results of the rate policies followed by the co-operative municipal undertaking administered by the Hydro-Electric Power Commission of Ontario, Canada, will, it is believed, be of special interest to delegates attending the World Power Conference, with respect to a number of outstanding features.

In the first place, as regards the magnitude of its operations in the supply of electrical energy, the Ontario undertaking occupies a preeminent place among the electrical organizations of the world; second, the careful records necessitated in carrying out the Commission's fundamental policy of service *at cost* afford a body of data respecting the economic results of its policies which is unusually comprehensive and informative; finally, the success which has been achieved over an extensive territory with respect to the provision of service to consumers at low unit costs, is, when judged by the standard of results in many other territories, to be characterized as almost phenomenal, and has been the subject of widespread comment.

Scope of Discussion

Five years ago — at the time of the First World Power Conference — a good deal of information was presented dealing descriptively with various aspects of Ontario's municipal electrical undertaking, and no attempt is made to recanvass ground thus already covered. In the present discussion, attention will be focussed upon certain economic aspects of the undertaking, and, to limit the consideration to reasonable dimensions, these economic results will be especially illustrated with reference to service to urban residential consumers, and to agriculturists.

In order to give the economic features of electrical service in Ontario their proper setting so that they may rightly be interpreted in their relationships to electrical service elsewhere, the general circumstances appertaining to the province and its people, and to their unique electrical undertaking, will first of all be indicated summarily, with special reference to progress made since 1924. The economic structure of the enterprise will be outlined, the principles followed in designing the tariffs will be referred to, and the domestic rates or tariffs(1) themselves will be described in a general and comprehensive way. The economic results attained by the application of these tariffs will then be cited, having regard to the two principal aspects — the results from the standpoint of the consumer, and the results from the standpoint of the utility.

The Province of Ontario

Of the total land area of Ontario — some 365,000 square miles(2) — much the greater part is underlain by the rocky formation of the Laurentian plateau, geologically known as the "pre-Cambrian shield." This northern territory possesses immense forest wealth, and has mineral resources of which the present developments — though of substantial magnitude — are believed to be only a beginning. It, however, supports directly a relatively small part of the province's population of 3,200,000. The

(1) The term "Rates" is used in Ontario and in this discussion with the significance of "tariff" and carries no idea of "taxes."

(2) The total area of the province is about 407,000 square miles and includes about 41,000 square miles of water area—chiefly Canada's portion of the Great Lakes.

southerly part of the province, comprising an area of about 40,000 square miles, is a fertile agricultural territory, and is also admirably adapted by reason of an advantageous climate, abundant natural resources, good transportation facilities, a central situation in the Dominion, and ample supplies of low-priced hydro-electric power, to continue to have a remarkable industrial and commercial development. About sixty per cent of the people of the province live in urban communities, and the other forty per cent are occupied with agriculture, including fruit-growing.

Industrial development has proceeded along modern lines; expanding use of power-driven machinery has continuously increased the productivity of the workers, and the relatively high wage levels thus made possible have permitted the masses of the people to attain an unusually high standard of living.

Central station power supply in Ontario is almost entirely based upon the water powers. The commercially available potential water powers are conservatively estimated to exceed 6,000,000 h.p., nearly 2,000,000 h.p. having now been installed in developed power sites. The climatic, geological and topographical characteristics of the province are such as to favour the economical development of water powers to a degree which exceeds that in many other territories.

It should be emphasized, however, that as regards ease and inherent cheapness of development, the water powers of Ontario are in no sense phenomenal, and the low costs of service to consumers which prevail in the province cannot be attributed solely, or even principally, to low costs of generation, *per se*. However, insofar as the province may have an advantage over some other territories as regards the cost of generation of power, this is partly offset by the costs of widespread transmission from the power sites to the centres of consumption. Even in the relatively closely settled southern Ontario, the density of population is not high, averaging, for example, about one-eighth that of England. The central electric stations of the province have provided more than 5,000 miles of high-tension transmission lines, many of which are of large capacity, as well as over 9,000 miles of distribution lines. Transmission distances range up to a maximum of about 450 miles. In some of the smaller and more remote municipalities, therefore, the delivered costs of bulk power are comparable with those of larger cities served by steam-electric plants, in other countries.

It is believed that the exceptional economic results obtained in Ontario municipalities under the operations of their Hydro-Electric Power Commission, which serves about 75 per cent of the population of the province, will be of interest and of value to the delegates to this conference even though many of their own undertakings may not be served by hydro-electric developments of low or moderate cost.

Extent of Operations and Recent Progress

As indicative of the scope of the Ontario Hydro-Electric enterprise and of progress made in recent years, the statistical data presented in table No. 1 will be of value.

Economic Structure of Ontario Undertaking

Although the undertaking of the Ontario Hydro-Electric Power Commission is a business enterprise which, in many respects, is similar to electrical undertakings elsewhere, yet important differences exist of which account must be taken in order correctly to appraise the economic results which are the subject of this discussion.

The "hydro" electrical undertaking of Ontario, serving over 75 per cent of the population of the province, is an organization of a large number of partner municipalities, co-ordinated into groups or systems for securing common action with respect to power supplies, through the medium of the Hydro-Electric Power Commission which under the Power Commission Act functions as their trustee.

Table No. 1—Extent of Operations and Four Years Progress

	1924	1928
Number of municipalities served		
Cities	25	26
Towns	82	86
Villages	102	110
Police Villages[3]	78	113
Townships[3]	131	257
Total	418	592
Miles of primary transmission lines constructed		
High-tension lines (12 to 220 kv.)	3,616	4,039
Low-tension lines[4]	548	583
Rural low-tension lines (4 and 8 kv.)	909	4,651
Total	5,073	9,273
Growth of load		
Total available capacity including power contracted for	h.p. 864,690	h.p. 1,443,780
December peak load distributed	780,789	1,070,742
Number of consumers served		
Domestic service	332,999	410,655
Commercial light service	57,272	68,435
Power service	10,744	12,097
Rural power districts	14,907	31,583
Total	415,922	522,770
Revenues		
Combined revenue of Commission and municipal electric utilities	$ 24,855,056.01	$ 36,388,391.98
Reserves		
Of Commission for sinking fund, renewals, contingencies and insurance	$ 13,440,810.50	$ 37,545,583.86
Of municipal electric utilities	24,267,977.17	38,802,723.82
Total reserves	$ 37,708,787.67	$ 76,348,307.68
Capital investments		
Investments of Commission	$178,900,000.00	$211,200,000.00
Assets of Municipalities in "Hydro" undertaking	72,700,000.00	98,300,000.00
Total capital investment	$251,600,000.00	$309,500,000.00

(3) Most of the townships and smaller police villages are served as parts of rural power districts.
(4) Exclusive of local distribution.

The undertaking, embracing all the operations from the provision of the power down to its final delivery to the ultimate consumer, involves two distinct phases of operations. The first is the providing of the electrical power — either by generation or purchase—and its transformation, transmission and delivery in *wholesale* quantities to individual municipal utilities, to large industrial consumers, and to rural power districts. This phase of the operation is performed by the Hydro-Electric Power Commission of Ontario as trustee for the municipalities acting *collectively* in groups or "systems." The second is the *retail* distribution of the electrical energy to domestic, commercial and industrial consumers within the limits of the areas served by the various municipal utilities and rural power districts. This phase of the operations is performed by the municipalities acting *individually* in one of two ways. In the case of the cities, towns and larger municipalities it is performed by municipal utility commissions which, however, operate under the general supervision of the Hydro-Electric Power Commission. In the case of rural power districts the Commission itself — on behalf of the corporations of the individual municipalities — operates the rural power district, and distributes electrical energy to the customers of the corporations in any such rural power district.

The rates at which power is supplied by the Commission to the various municipalities vary with the amounts of power used, the distances from the sources of supply, and other factors. The entire capital cost of the various power developments and transmission systems is allocated to the connected municipalities and adjusted according to the relative use made of the lines and equipment. The entire annual direct expenses such as operation, maintenance, interest and administration, together with reserves for sinking fund, depreciation, contingencies and obsolescence, are paid out of revenue collected from the municipal "hydro" utilities and other consumers through the medium of power bills rendered by the Commission. Power bills to municipal utilities are rendered at an interim estimated rate each month during the year, and credit or debit adjustment is made at the end of the year when the Commission's books are closed and the actual cost determined.

The balance of the revenue of the municipal utilities is retained by them and is used to defray the expenses incurred in distributing to the ultimate consumers the electrical energy provided by the Commission. These include operating, maintenance and administration expenses, interest on the capital investment, sinking fund or principal payments on debentures, and depreciation charges. Concurrently, therefore, with the creation of funds to liquidate their debt to the Commission and provide reserves for renewals, contingencies and obsolescence on the generating, transforming and transmitting systems, the municipalities make similar financial provisions with respect to their local "hydro" utilities.

From the foregoing it will be seen that in the charges for electrical service, the consumers in the municipalities are paying year by year, not only all the costs of providing the service and keeping the physical plant in an up-to-date and efficient condition, but in addition, are providing sums which are used to retire the capital outlays. Thus the municipalities are progressively becoming the owners of a fully paid-up plant. With respect to the local distribution systems, many municipal "hydro" utilities have already reached the point where their quick assets, such as securities and investments, bank and cash balances, and accounts receivable, exceed their total liabilities.

From the above description it will be understood how the principle of service *at cost* is carried out with respect to the wholesale service given to the municipal utilities. We now come to a more detailed consideration of the means by which the same principle of service *at cost* is, under the Commission's direction, carried out in connection with the local individual consumers.

Basic to the design of rate schedules is a knowledge of the costs incurred in providing service and the Commission, as part of its service to the co-operating municipalities, has designed a uniform accounting system and requires that detailed cost records be kept for each municipal "hydro" utility. It also exercises a continuous supervision over the rates charged to consumers, and their relation to the economic status of the local utility.

It has long been conceded that the scientific methods of ratemaking outlined by Dr. John Hopkinson and his successors are correct in principle, in that they seek to make a rate for charging for electrical energy which shall cause each consumer to pay for his service at the rate of its cost to the vendor plus a definite percentage for profit. Such rates have been applied — although to a relatively limited extent — in many parts of the world.

In the case of Ontario's undertaking the principle of service "at cost" embodied in the legislation governing the Commission made it necessary to design and apply rate schedules which, for each class of service, most nearly interpreted in a practicable way the principle of service *at cost* to all consumers.

Now, before coming to a consideration of the economic effect of rate schedules or tariffs designed to give service at cost, it will be profitable to discuss, briefly, the principal factors which have influenced the design of the Commission's rate schedules, and to describe the rate schedules themselves. It will be of assistance to an understanding of this discussion if it is kept continuously in mind that what is being sold by an electrical utility, is not kilowatt-hours *per se* but *electrical service.* The cost of providing electrical service may be divided broadly into (a) customer costs, such as meter-reading, billing and collecting, etc.; (b) demand costs, i.e., costs incurred so that the undertaking is in a position to serve the customer at any time with the service he requires up to the limit of his maximum demand; (c) energy costs.

Now, in the case of electrical service based upon water-power development, the demand cost is the most important element. In the matter of equitable rate determination and application, however, energy consumption — an easily measured quantity — is valuable as an indirect aid to measurement of effective demand, owing to the fact that as the individual load factor is raised the probable diversity between consumers is reduced; and also owing to the fact that in the case of certain classifications and groups of consumers there is a general constancy of relation between energy consumption and station demand.

In the classification of costs for the purpose of designing an equitable rate structure it is not contended that all the costs incurred in supplying service can definitely be allocated to one or other of these three divisions, but it is evident that an equitable rate schedule must take account both of the demand and the consumption, and the readiness to serve.

It will be appreciated that theoretical principles and considerations are of value more particularly as representing an ideal to be striven for, and as a general guide in shaping the main elements of the tariffs. The final test of the validity of principles followed in rate design is, of course, the results obtained in practice.

On account of several factors, including the great elasticity or variation possible in consumption, the large numerical preponderance of consumers and the universal interest which attaches to electrical service in the home, the class of domestic or residential service is especially suited to illustrate the economic results achieved and the conclusions to be derived from the experiences of Ontario in the application of rate schedules designed to apply the principle of service "at cost."

Rate Schedules or Tariffs for Domestic Service

In Ontario, domestic rates apply to electrical service in residences, for all household purposes, including lighting, cooking and the operation of all domestic appliances.

When the Commission started operation in 1910, the recognized domestic use of electricity was for lighting only, and the floor area was considered as indicative of the demand. A service charge was therefore established based on the floor area of the house, which was combined with a consumption or kilowatt-hour rate much lower than generally obtained elsewhere. The development of electrical household appliances was encouraged by the moderate consumption rate, and with the accumulation of cost data secured by the Commission it became evident that to maintain service at cost still lower rates must be given for additional consumption. Consequently, a second or follow-on energy rate, of one-half of the first energy rate, was estab-

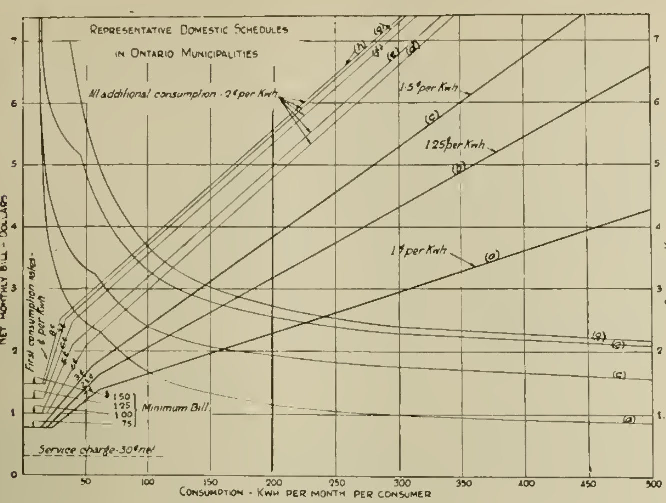

Figure No. 1.

lished for domestic service, and this was applied to all consumption over a certain amount each month, dependent upon the floor area. This form of rate naturally encouraged a greater use of household appliances, and electrical cooking gradually became popular.

Conditions respecting domestic consumption and use in many municipalities have been rapidly changing, and in recognition of this fact a new and somewhat simpler form of rate schedule was devised which has now been very generally adopted for use by the municipal utilities. Under present-day conditions in Ontario, domestic consumers may be grouped into three main types whose average characteristics are known and do not vary greatly in any one municipality. These types are (1) consumers using electrical service for lighting only, (2) consumers using lighting and appliances, not including electric ranges, and (3) consumers using lighting, appliances and electric ranges. Now, a general domestic rate schedule based upon cost must secure from each type of consumer an adequate but not excessive revenue, and the form of domestic rate schedules used in Ontario has been designed with this object.

The present standard schedules therefore consist of (1) a fixed uniform service charge of 33 cents gross per month and an additional amount of 33 cents gross is charged for three-wire or range service, or to consumers having more than 2,000 watts permanently installed, (2) a first consumption rate applicable to energy consumed up to a certain number of kilowatt-hours per month, and (3) a follow-up or secondary rate applicable to all additional energy used. Minimum charges and prompt payment discounts — as in the earlier form of rate — are also employed.

Broadly, the *service charge* may be considered as covering certain costs common to all users of this class, such as meter reading, billing, and a part of the demand costs appertaining to the local distribution system. The consumption or kilowatt-hour rates cover the cost of bulk power delivered to the municipal utility, and any costs of distribution not obtained by the service charge. The first kilowatt-hour rate and the rate for all additional energy are so adjusted as to ensure that in each municipality domestic consumers of each of the three prevailing types — lighting; lighting and appliances; lighting, appliances and ranges — will, as far as practicable, contribute revenues commensurate with the cost as ascertained from known characteristics of these types.

The standard domestic rate schedules may, therefore, representatively be given as in table No. 2 and are graphically shown in figure No. 1. The first three schedules, *a*, *b* and *c*, may be considered as typical of the rates in

Table No. 2.

	Service charge gross	First consumption charge per kw.hr.	No. of kw.hrs. to which it applies	All additional per kw.hr.	Discount prompt payment	Usual minimum bill
	cents	cents		cents	%	\$ c \$ c
a	33	2	60	1	10	0.75 —
b	33	2.5	60	1.25	10	0.75 or 1.00
c	33	3	55	1.5	10	0.75 or 1.00
d	33	4	50	2	10	1.00 or 1.25
e	33	5	45	2	10	1.00 or 1.25
f	33	6	40	2	10	1.25 or 1.50
g	33	7	35	2	10	1.50 or 2.00
h	33	8	30	2	10	1.50 or 2.00

Ontario municipalities. Less than 5 per cent of domestic energy consumption is sold at higher rates than these.

In order to meet special conditions in certain municipalities, variations may be made in any one or more of these factors — except the 10 per cent prompt payment discount which is everywhere employed. The scheme has proved to be a well-graded and flexible one, and has already been adopted for general use in the municipalities served by the Commission.

Table No. 3 representatively shows, for various consumptions, the net monthly bills which are rendered to domestic consumers in Ontario municipalities under the standard rate schedules described above. The first three lines *a*, *b* and *c* may be considered as truly typical of charges to Ontario consumers, as less than five per cent of domestic electrical energy is sold at rates higher than these.

The general circumstances appertaining to the province and to the Commission's undertaking having been reviewed, the basic principles followed in designing rate schedules having been discussed and the domestic rates themselves having been described, it is now in order to deal with actual economic results that have been achieved through the application of the Commission's tariff policies to domestic service under the circumstances existing in Ontario. In this connection two aspects present themselves for consideration — the economic results from the standpoint of the consumer and the economic results from the standpoint of the utility. It will be shown that the policies followed have enabled the consumers to take advantage of the comforts and economies attending the

Table No. 3.—Net Monthly Bills to Consumers—Standard Domestic Schedules

	First charge		All additional per kw.hr.	Monthly consumption in kw.hrs.					
	per kw.hr.	No. of kw.hrs.		25	40	60	160	300	500
	Cents		Cents		\$ c	\$ c	\$ c	\$ c	\$ c
a	2	60	1	75 (min.)	1.02	1.38	2.28	3.54	5.34
b	2.5	60	1.25	86 or min.[5]	1.20	1.65	2.77	4.35	6.60
c	3	55	1.5	97 or min.[5]	1.38	1.85	3.20	5.09	7.79
d	4	50	2	1.20 or min.[5]	1.74	2.29	4.08	6.60	10.20
e	5	45	2	1.42	2.10	2.59	4.39	6.91	10.51
f	6	40	2	1.65	2.46	2.82	4.62	7.14	10.74
g	7	35	2	1.87	2.57	2.95	4.75	7.27	10.87
h	8	30	2	2.10	2.64	3.00	4.80	7.32	10.92

[5] The minimum charge varies in different municipalities. It would become the charge where it exceeded the figure shown.

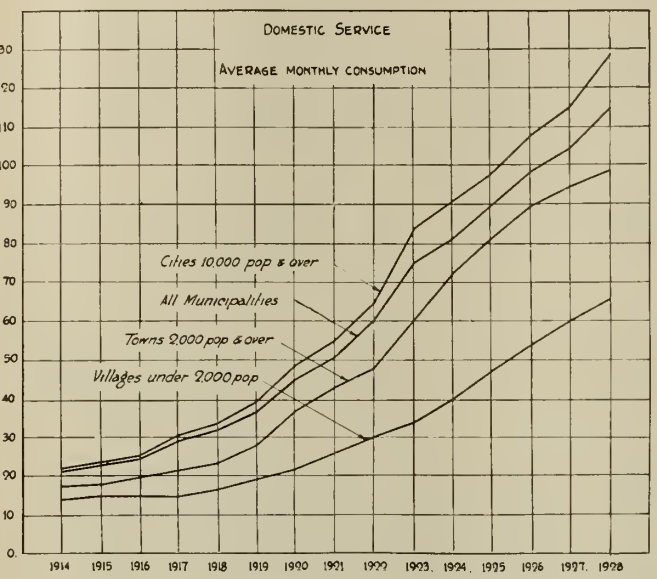

Figure No. 2.—Average Monthly Consumption per Consumer—All Municipalities, showing Growth.

liberal use of electrical energy, to an unusual extent, and that the average unit costs of electrical energy to the consumer have been reduced to a very low point. It will also be shown that this desirable result has been accomplished without impairing the ability of the utilities to earn from domestic service adequate net returns on the capital employed, and without departing from the principles of sound finance.

Economic Effect of Ontario Domestic Rates from the Consumer's Standpoint

From the foregoing summary description of the rate schedules used in Ontario municipalities for domestic service, it will be observed that by incorporating a low follow-on rate they take the form commonly known as "inducement rates." It should be emphasized, however, that while they are inducement rates in form and also in effect, they are not inducement rates in the sense that their primary purpose is to promote consumption, or that they contemplate the assumption of initial losses which will later be recovered through enhanced profits. The primary object in mind in designing the rate schedules is to apportion charges to all consumers as nearly as is practicable according to the costs of the utilities to provide the service. The inducement form of the rates is simply a result of this object — a result, however, which has been of great economic benefit to the consumers of the Ontario undertaking. Rates of the inducement form have enabled Ontario domestic consumers to utilize labour-saving and comfort-giving electrical appliances to a much greater extent than would otherwise have been possible. The increase in average domestic consumption has been exceptionally rapid, and has been a major factor in making possible the provision of electrical service to Ontario domestic consumers at average costs to the consumer, per kilowatt-hour, which are probably lower than in any other comparable territory.

Statistics relating to the consumption of electrical energy in Ontario municipalities served by the Hydro-Electric Power Commission are compiled and published in the Commission's annual reports. There are presented herewith diagrams and curves giving derived statistics relating to certain phases of "hydro" electrical service.

Before presenting these diagrams, however, a word of caution is necessary. Certain of the diagrams present data respecting the "average cost per kilowatt-hour" to the consumer, and are derived from statistics of revenues and kilowatt-hour sales of the utilities, by simple division. Such average costs and revenues per kilowatt-hour have frequently been assumed to be a reliable criterion of the relative rates or prices for electrical service in one municipality or territory as compared with another. Such an assumption involves a serious statistical fallacy and is productive of very misleading results. Particularly is this the case when revenues and consumptions of all classes of service are indiscriminately lumped together in order to deduce a so-called "average cost or rate per kilowatt-hour" for all services; a lower average for one utility than for another is more likely to be due to a preponderance of sales under the industrial and other low-cost classifications than it is to be due to a lower general scale of tariffs.

Even where the utilities compared have similar forms of tariff and where one classification only is considered, the average cost or revenue per kilowatt-hour is no criterion of comparative rates to consumers. It will be observed, for example, from figure No. 4, that in the last twelve years since 1916 there has been a reduction in the average cost or revenue per kilowatt-hour for domestic service in hydro municipalities of approximately 50 per cent. It would be quite incorrect, however, to assume that domestic tariffs have been reduced on the average by 50 per cent in the period. By 1916 the rates in most of the cities and towns had become well-established on a low cost basis with low follow-on rate, and since that time domestic schedules of rates in force have for the majority of customers remained notably free from important upward or downward revision. In general, the charge to the majority of consumers for a specified monthly consumption was not materially different in 1928 from what it was in 1916. The lower average cost to the consumer in 1928 is principally due to the higher average consumption per consumer — see figures No. 2 and No. 3 — and to the form of the tariffs.

Unless this feature of the data presented is fully appreciated, they will fail to convey a useful understanding of the economic results of the Commission's tariff policies. The Commission's tariffs for domestic service are low, but they are not by any means as low in relation to domestic tariffs elsewhere, as would be indicated by indiscriminate comparison of revenues per kilowatt-hour for domestic service.

If it is desired to appraise the Commission's tariffs for domestic service in Ontario in relation to those used else-

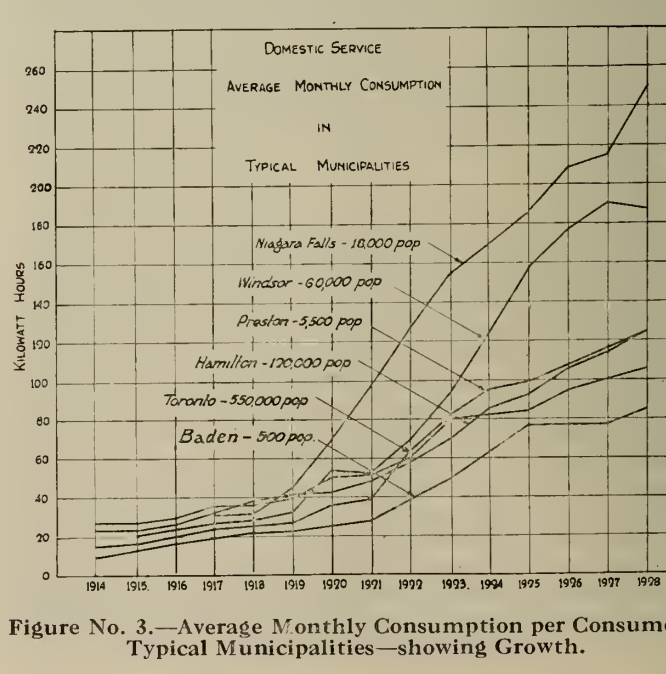

Figure No. 3.—Average Monthly Consumption per Consumer in Typical Municipalities—showing Growth.

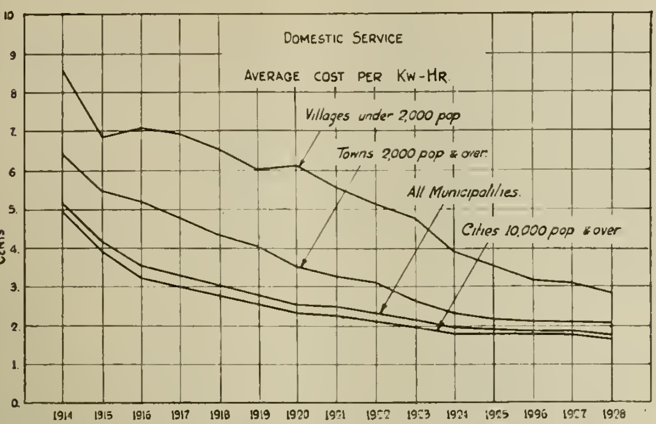

Figure No. 4.—Average Net Cost to the Consumer per Kilowatt-hour Inclusive of all Charges—All Municipalities, showing Decrease.

where, valid conclusions can only be reached by comparing the cost of a month's service to a typical consumer, or series of consumers, taking service under identical conditions as regards energy consumed and other relevant circumstances in the two territories.

Figures Nos. 2 to 6 indicate the rapid growth in consumption, decline in unit cost and other trends respecting domestic service as it has developed under tariffs designed to give service at cost.

The data basic to these diagrams have been published in the annual reports of the Commission. The totals of the principal items are presented in table No. 4.

The curves are shown from 1914 to 1928, but for the present study special attention should be directed to the portion from 1916 on, for the following reasons: The period prior to 1916 was one of exceptionally rapid growth with respect to the number of municipalities of larger size in which "hydro" service was being inaugurated; subsequent to 1916 there has been a steady increase in the number of municipalities served, but those added in recent years have been of smaller size individually. Prior to 1916 was also a period of adjustment of rates among many of the larger municipalities. Substantial reductions in rates were being made affecting a large proportion of the consumers. This is reflected in the decided drop between 1914 and 1916 in the average monthly bill for all municipalities, notwithstanding a substantial increase in average consumption. In the case of a municipal utility newly-established, there are usually substantial reductions in rates during the first few years of service, but in a short time the rate becomes fairly well stabilized and future adjustments of rates, if any, are small. Except in some of the smaller communities this point is reached with a rate schedule equivalent to or approximating the rate schedules *a*, *b*, or *c*, referred to above, depending upon the usual factors of distance, size of load, etc. Data for municipalities whose domestic tariffs had not reached comparative stabilization by 1916 or shortly after exert in the aggregate little influence upon the statistical results of the system as a whole, which are shown in figures Nos. 2, 4 and 5.

Considering, therefore, the portions of the diagrams for the years 1916 to 1928, it is seen that the effect of the Commission's tariff policies and of its sales efforts in merchandizing appliances, has been to induce a steady and consistent growth in average monthly consumption from about 25 kilowatt-hours to 115 kilowatt-hours or a 366 per cent increase. The average monthly bill has increased from $0.84 to $1.97 or 135 per cent. The average cost per kilowatt-hour has dropped from 3.5 cents in 1916 to 1.71 cents in 1928; and this has occurred notwithstanding the fact that the cost of wholesale power — owing to advancing costs of generation and transmission, etc. consequent upon economic adjustments due to the Great War — has increased.

Figure No. 3 relating to certain individual municipalities has been included in order to assist appraisal of the degree to which on the one hand the inclusion from time to time of new municipalities with initially higher rates, and on the other hand the reduction of tariffs in certain of the newer and smaller municipalities after the initial period of operation, have affected the statistical results for the system as a whole. In the case of Niagara Falls and Toronto there have been no changes in domestic rates from 1916 to 1928, and in the case of the other municipalities, such changes as have been made have been in the nature of minor adjustments. The results in these municipalities give, therefore, an indication of the effect of the tariff policies that is comparatively free from complicating factors and serve to confirm the general results from the curves derived by including statistics from all municipalities.

Dealing with the period from 1914 to 1928 and summarizing the results presented in table No. 4 for all municipalities, it is seen that the number of municipalities has increased from 49 to 268, the revenue from $730,168 to $9,411,812, or 13 times, the consumption from 14,359,000 to 551,010,000 kilowatt-hours, or 38 times, the number of consumers from 64,866 to 408,071, or 6.3 times, the average monthly consumption from 21 to 115 kilowatt-hours or 5½ times, the average monthly bill from $1.06 to $1.97, or less than twice, and that the average cost per kilowatt-hour has decreased from 5.08 cents — which it may be noted was even in 1914 a lower figure than was common elsewhere — to 1.71 cents in 1928 or to about one-third.

The last diagram presented, figure No. 6, shows the average cost of electrical service in municipalities served by the Hydro-Electric Power Commission of Ontario. And although for purposes of simplicity we are considering the economic results chiefly as illustrated by the domestic consumer, there have been included in this diagram statistics relating to the commercial lighting service and to the power service. It will be seen that the favourable economic effects of the policy of providing service *at cost* are by no means confined to domestic service but that similarly low-cost service is given both to commercial lighting consumers and to power consumers. With respect to power service supplied by the municipal utilities, the statistics for which are incorporated in the diagram, it should be pointed out that the average load per consumer is about 30 h.p. The Commission serves certain large power consumers direct on behalf of the various systems of municipalities.

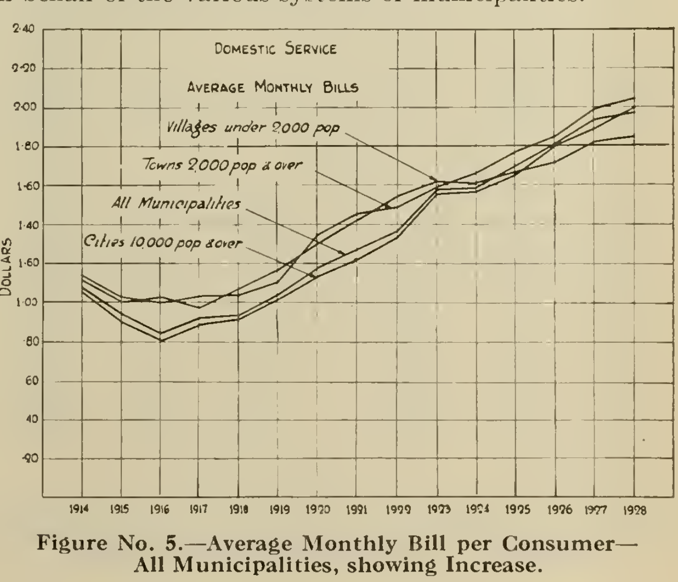

Figure No. 5.—Average Monthly Bill per Consumer—All Municipalities, showing Increase.

Table No. 4—All Municipalities Totalled Domestic Service

Year	No. of municipalities	Annual revenue	Kilowatt-hours consumed	Number of consumers	Average cost per kw.hr.	Average monthly bill	Average monthy consumption kw.hr.
1914	49	$ 730,168.00	14,359,100	64,866	5.08c	$1.06	21.0
1917	123	1,340,855.00	41,930,200	131,313	3.20	0.91	28.6
1920	166	2,514,658.00	98,211,000	193,892	2.56	1.15	44.6
1923	206	4,955,420.00	242,926,600	286,852	2.04	1.54	75.7
1926	243	7,353,394.00	404,722,959	349,882	1.81	1.79	98.4
1927	267	8,497,190.79	469,851,690	387,573	1.80	1.87	103.5
1928	268	9,411,812.48	551,010,035	408,071	1.71	1.97	115.5

Use of Domestic Electrical Appliances by Ontario Citizens

The form of tariff or rate schedule which is necessitated by the principle of service at cost, by incorporating a low follow-on rate promotes a liberal use of the service for electrical appliances and at the present time the major factor in domestic consumption in most Ontario municipalities is the energy consumed for domestic cooking, water heating and labour-saving devices.

During the past five or six years statistics have been collected in most of the municipalities served by the Commission, respecting the number of appliances in use by domestic consumers. The results of the surveys made each year show that there has been a steady growth in the number of appliances in use and also in the percentage saturation of the possible number which might be used.

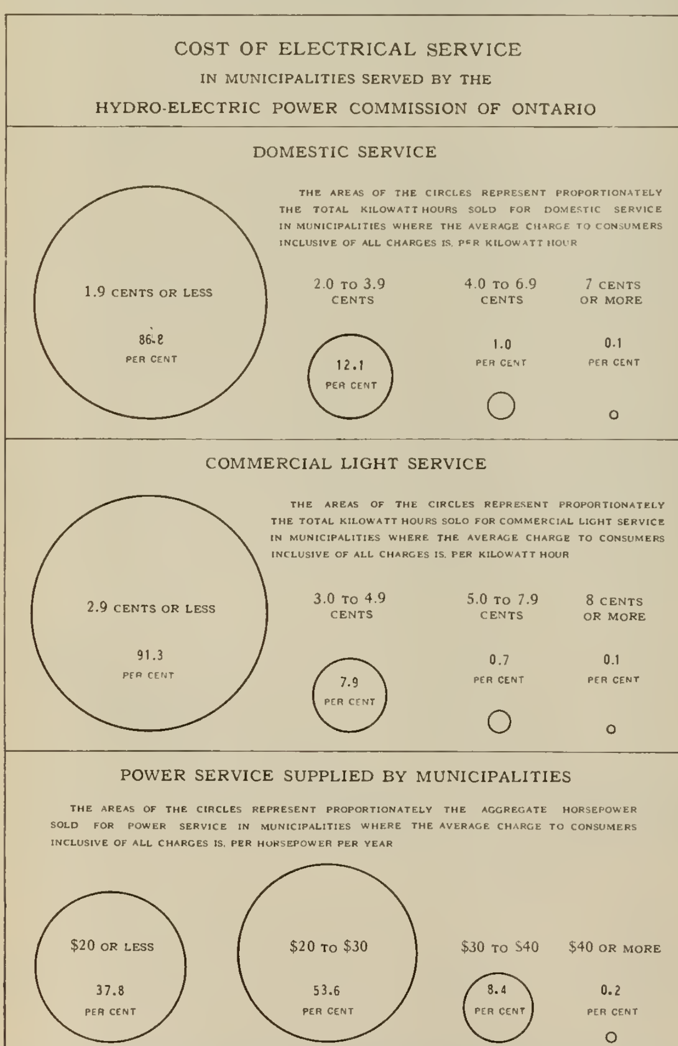

Figure No. 6.—Cost of Electrical Service in Hydro Municipalities —Domestic, Commercial Light, Power Service.

Table No. 5 presents in summary form this information for the years indicated up to January 1st, 1929.

Financial Results of Ontario Tariff Policy

It is pertinent at this point to consider the economic results under the Commission's tariff policies, from the standpoint of the relation of net earnings of the utility to capital investment. Such a consideration will, it is believed, show that the Commission's tariff policies have been quite as successful from the standpoint of the utility as from that of the consumer.

Since domestic service has been selected as the classification which most strikingly illustrates the principles and results under discussion, the economic results for the other classifications of service need not be treated in detail. It suffices to emphasize that the same general tariff policies and methods of cost accounting are pursued for all classifications, except for a minor modification with respect to power supplied by the utilities to the municipal corporations themselves for such purposes as street lighting and waterworks pumping. Tariffs in general are conservatively designed to yield a moderate surplus over all costs; municipal power is supplied strictly at cost.

Now, if it were to be attempted to present consolidated revenues, costs and earnings of capital for the domestic service in all municipalities, or even in a series of representative municipalities, such a presentation would become unduly involved. Where consumers of various classifications of a utility utilize in common important parts of the plant, segregation of costs becomes necessary, and before an intelligent appreciation of such data could be conveyed, a detailed discussion of the methods of assigning and segregating costs would be required, — a discussion which could not adequately here be presented. Moreover, the point at issue — whether the extremely low costs to domestic consumers in Ontario municipalities have been attained without violating the requirement of adequate net earnings on the capital employed — can be settled simply and conclusively without reference to a multiplicity of detailed data.

Results Under Lowest Tariffs

Obviously, if it can be shown that, in the municipality where the lowest domestic tariffs are employed, the resulting revenues are sufficient to produce adequate net earnings on the capital employed, which cannot wholly be attributed to any source other than domestic service, then it will follow *a fortiori* that in the other municipalities, using higher tariffs, even more favourable results are possible of attainment by the utilities. The city in Ontario where the charges for domestic service are lower than in any other municipality is Ottawa, and the circumstance that, in this residential city, the business of the municipal electrical utility is predominently a lighting service, makes it possible to show directly from the audited financial results of the utility, that domestic service and commercial service, at what would be regarded in many quarters as phenomenally low unit costs to the consumer, are nevertheless by themselves productive of a substantial surplus of revenues over all costs.

Owing to unusually favourable costs of bulk power, domestic tariffs in Ottawa are lower even than rate "*a*" of the standard system. A typical domestic lighting and cooking consumer, using say 400 kilowatt-hours per month, pays a monthly charge of $2.94. The domestic consumers in Ottawa use electrical appliances very extensively, and the average monthly consumption is 231 kilowatt-hours per consumer, a condition which results in average cost per kilowatt-hour to domestic consumers of but 0.87 cents.

The pertinent financial results of the Ottawa "hydro" utility for the year 1928 are presented below, in summary form:

Capital invested in distribution system		
Plant, original cost	$1,989,288.40	
Less depreciation reserve	670,670.91	
		$1,318,617.49
Working capital (all other assets except sinking funds, $446,736.36) [5]		242,387.59
Total depreciated capital investment		$1,561,005.08
Funded debt outstanding		953,374.17
Equity of municipal corporation		[5]$ 607,630.91
Revenues of the utility		
Domestic service	$ 278,094.78	
Commercial service	133,523.10	
Total, domestic and commercial	411,617.88	
Street lighting and municipal power (at cost)	94,949.84	
Industrial power and miscellaneous	63,415.87	
Total revenues of the utility		$ 569,983.59
Expenses of the utility		
Cost of bulk power	$ 211,309.52	
Operation and maintenance of distribution system	181,787.82	
Total operating expense		$ 393,097.34
Net earnings before depreciation		$ 176,886.25
Per cent on total capital investment	11.3%	
Depreciation		51,291.00
Net earnings after depreciation		$ 125,595.25
Per cent on total capital investment	8.0%	
Bond interest paid		43,463.44
Total surplus		$ 82,131.81
Per cent on municipal equity	13.5%	
Surplus applied to retire capital	$ 19,673.51	
Free, operating surplus	62,458.30	
	$ 82,131.81	

[5] The Ottawa municipal utility has invested sinking funds in the amount of $446,736.36 which will be used to acquire additional equity in the local system as the bond issues mature.

The surplus earnings reflect the conservative policy which is followed, in order to ensure that the financial status of the undertaking will always be of unquestionable soundness. These earnings, according to the practice in the Ontario undertaking, will be used to lower costs of service in the future, by paying off indebtedness, by extending plant and by investment in trustee securities, or will be returned to the consumers in cash.

A feature of the results in Ottawa which influenced its selection for purpose of illustration — aside from the fact that the costs to consumers are lower there than elsewhere — was the predominence of the lighting services over all other classifications. In the case of Ottawa, reference to the financial statement shows that the bulk of the free operating surplus of $62,000 must have come from the lighting services, including the service to domestic consumers. Services rendered the municipal corporation are by law required to be on a strict cost basis, and the revenues from this source — $95,000 — can thus have contributed no part of the surplus. Industrial power and miscellaneous revenues aggregate but $63,000, and could thus under no circumstances have provided more than a modest proportion of the total of $62,000 surplus. In other words, the utility could have given away the industrial power service it sold — which yielded a revenue of $55,253 — and still have had a surplus from supplying domestic and commercial consumers at the low rates charged.

It is true that the Ottawa utility enjoys a more than usually favourable position in some respects — notably in that the Commission has been able to furnish the local utility with bulk supplies of power at a rate that is lower than is found elsewhere in the province. It will be appropriate, therefore, to cite the results in one other utility, a comparatively small community situated remote from the source of power supply, in order to afford an indication of the economic results of the Commission's tariff policies under circumstances which more closely approximate those generally encountered in territories outside of Ontario.

Results Under Unfavourable Conditions

Selection of a municipality for purpose of illustration has in this case, as in that of Ottawa, been made with a view to simplicity of analysis, and the town chosen is therefore one where service is predominently residential. The town of Sandwich, in the extreme west of southern Ontario, is

Table No. 5—Tabulation Showing the Number of the Larger Electrical Appliances Reported to be in Use Among Hydro Domestic Consumers in Ontario at the End of 1928 and the Number Calculated to be in Use Deduced from Figures Reported[6] Also the Totals Estimated for 1924 and 1926 for Comparison

	Estimated number in use Dec. 31, 1924, by 344,250 consumers	Percentage saturation	Estimated installed capacity kw.	Estimated number in use Dec. 31, 1926, by 376,882 consumers	Percentage saturation	Estimated installed capacity kw.	Estimated number in use Dec. 31, 1928, by 414,139 consumers	Percentage saturation	Estimated installed capacity kw.
Electric ranges	47,505	13.8	285,030	70,883	18.8	425,298	95,906	23.1	575,436
" Hot plates	18,883	5.5	37,766	25,291	6.6	50,582	38,699	9.3	77,398
" Washers	55,342	15.8	11,068	78,063	20.7	15,612	107,370	25.9	21,474
" Cleaners	64,205	18.6	12,841	75,120	19.9	15,024	90,275	21.8	18,055
" Water heaters	16,605	4.8	25,000	26,069	6.9	39,100	37,028	9.0	55,542
" Grates	15,075	4.4	30,150	16,812	4.4	33,624	17,620	4.3	35,240
" Air heaters	103,000	30.0	82,400	106,125	28.0	84,820	149,900	36.2	119,920
" Ironers	1,590	0.4	4,770	2,255	0.6	6,765	3,045	0.8	9,135
" Irons	307,800	89.2	203,148	311,377	82.9	205,508	370,820	89.9	244,741
" Refrigerators	657	0.2	130	2,667	0.7	533	16,338	3.9	32,676
" Toasters	152,200	44.1	83,710	160,077	42.5	88,042	194,637	47.0	107,050
" Grills	46,800	13.8	30,888	42,000	11.2	27,720	45,262	10.9	29,872
Totals			806,901 kw. 1,081,640 h.p.			992,628 kw. 1,330,600 h.p.			1,326,739 kw. 1,778,470 h.p.

[6] In some instances estimates or actual figures showing the number of appliances in use were not supplied by the smaller municipalities. Estimates for these missing figures were supplied by averaging the figures which were received from other municipalities.

of moderately small size, with population of 9,400; it is remote from the source of power supply, with transmission distance of 245 miles, and has electric revenues that are predominently derived from domestic service.

Even under these unfavourable circumstances, the Commission's tariff policies have enabled the 2,700 domestic consumers of the Sandwich utility in the fifth year of operation to utilize an annual consumption of 5,700,000 kilowatt-hours, at a total cost to them of $105,000. The average monthly consumption per consumer is thus 180 kilowatt-hours, and the average cost to the domestic consumer is but 1.83 cents per kilowatt-hour. Cost of service to other classifications is similarly low, commercial consumers paying an average of 2.1 cents per kilowatt-hour, and the few industrial consumers the town has paying on the average but $31.25 per horse power per year. Notwithstanding these low costs to the consumers, the utility is in a flourishing financial condition, as will be observed from the financial statement for 1928 which follows:

Municipal Electrical Utility, Town of Sandwich, Ont.

Capital invested in distribution system		
Plant, original cost	$ 251,851.42	
Less depreciation reserve	20,626.42	
		$ 231,225.00
Other assets (except equity in Commission's plant, $52,795.16)		43,659.61
Total depreciated investment		$ 274,884.61
Funded debt outstanding		126,758.74
Equity of municipal corporation		$ 148,125.87
Revenues of the utility		
Domestic service	$ 104 647.25	
Commercial light service	20,069.40	
Total domestic and commercial	$ 124,716.65	
Street lighting (at cost)	8,318.15	
Industrial power and miscellaneous	28,346.75	
Total revenues of the utility		$ 161,381.55
Expenses of the utility		
Cost of bulk power	$ 99,128.08	
Operation and maintenance of distribution system (all classes of service)	16,362.78	
Total operating expense		$ 115,490.86
Net earnings before depreciation		45,890.69
Depreciation		4,220.00
Net earnings after depreciation		$ 41,670.69
Interest payable on bonds outstanding		6,700.88
Total surplus		$ 34,969.81
(Applied to retire capital $ 4,865.12)		
(Free operating surplus 30,104.69)		

From the above data, taken from the audited financial statements of the Sandwich "hydro" utility, it will be observed that the net earnings on the total capital for the year were at the rate of 16.7 per cent before depreciation, and 15.2 per cent after depreciation. The net annual surplus earnings, after payment of interest, were at the rate of 23.7 per cent on the municipality's equity in the undertaking.

The figures speak for themselves. The conclusion cannot be escaped that the tariff policy of the Commission has been eminently successful from the standpoint of the utility, even in small communities handicapped by the costs of long-distance transmission. They establish the fact that service can be given to domestic consumers at average charges per kilowatt-hour of less than two cents, and yet produce net earnings on capital at a rate which would constitute a very attractive return to the owners of the utility even were it privately owned.

There is nothing exceptional about the two financial statements selected for purpose of illustration except the features noted, of preponderating domestic service in both cases, of extremely low consumer's unit costs in Ottawa, and of adverse circumstances in Sandwich. In these two municipalities, results for the year 1928 are entirely consistent with those for previous years.

Taking the municipalities of the system all together, the revenues of the local utilities aggregated in 1928 some $26,000,000 and yielded, above all operating and depreciation costs, interest payments of $2,100,000, surplus applicable to capital retirement, $1,600,000, and additional free surplus of $2,000,000. The investment in plant was $70,000,000, less depreciation reserve of $11,000,000 and additional assets, except sinking funds and equity in the Commission's plant, totalled some $9,000,000. The net earnings of the local capital, after depreciation, were thus approximately 8 per cent, taking all the utilities together, and the net surplus earnings were 14 per cent on the municipal corporations' equities.

Load Characteristics of Domestic Appliances

In view of the already extensive use of electrical appliances in Ontario municipalities, and the rapidity with which, under the stimulus of the inducement form of rate, their use is being extended, the load characteristics to which these appliances give rise have been a subject of special study by the Commission. The surveys made and other relevant data available indicate that, in general, the load characteristics of these appliances are not such as to give rise to high costs.

In Ontario municipalities, the use of electrical service for lighting may be said to be practically universal. The use of electrical appliances of small capacity and intermittent or irregular use — such as flat irons, vacuum cleaners, electric toasters, and washing machines — is also very general among Ontario domestic consumers. The favourable load characteristics of these appliances are so well known that they do not call for extensive discussion at this time. The use of electrical cooking ranges, however, is a feature with respect to which the extensive experience of the Commission will be of interest, and in this connection, the load characteristics of other electrical appliances of large capacity and energy consumption, such as water heaters, ironing machines, air heaters, etc., will also be discussed.

With respect to the influence of load characteristics on costs of supply, it is to be noted that, since lighting and the use of smaller appliances by a domestic consumer usually precedes, and nearly always accompanies, the use of the larger appliances, the utility, from the economic standpoint, is concerned principally with the *additional* costs, consumption and demands appertaining to electrical service used for cooking and lighting and small appliances, over those appertaining to the use of the service for lighting and small appliances only.

Under Ontario conditions, it is found in general that the costs of bulk power to municipal utilities materially exceed the costs for distribution within the municipality, and consequently the factor of principal importance from the economic standpoint, is the extent to which the installation of ranges increases the peak load of the municipality. A factor of hardly less importance is the influence of the electric range upon the load factor of the municipality. Factors of secondary — but not of negligible — importance, are the individual demands of range consumers. Individual demands exert practically no influence upon such costs as meter reading, billing and collecting and office overhead, nor do increased individual demands on the part of the domestic consumers tend appreciably to increase the costs appertaining to such important items of distribution plant as poles, hardware, etc. Large increase in individual demands does, however, increase total costs with respect to such items as copper for distribution conductors, and distribution transformers and substations.

That very large diversity exists among Ontario domestic consumers' demands is indicated by the smallness of the resulting station demand in relation to the sum of the individual demands of the consumers. The diversity is particularly good in the moderately large cities where the distances from employment, hours of work and other factors bring about a large variation in time of day when the electric cooking appliances are used. In certain smaller and highly industrialized municipalities, however, a tendency is found for nearly all of the inhabitants to cook the heavy meal of the day at approximately the same hour, with the result that, in such municipalities, the diversity is somewhat less favourable, and costs attributable to electric ranges are relatively higher than is found in general throughout the province. The experience of the Commission, however, has demonstrated that even under the least favourable circumstances, the costs occasioned by the use of electric ranges are decidedly moderate, and service can be given to consumers at rates low enough to be attractive to the consumer without loss to the utility or disadvantage to consumers of other classifications.

Results with High Electric Range Saturation

As illustrative of load conditions obtaining in a city of some 60,000 population where — notwithstanding a transmission distance of 240 miles and tariffs, in consequence, somewhat higher than those in more advantageously situated Ontario municipalities — the electric range saturation among domestic consumers is the remarkably high figure of approximately 78 per cent, the following results may be cited. The average monthly peak load of the municipality, incurred in serving consumers of all classes, was 17,550 kw. The industrial consumers had aggregate demands, averaged over the year, of 6,530 kw.; the 2,200 commercial consumers had aggregate demands of approximately 6,200 kw; the 3,300 residential consumers not using the service for cooking had aggregate demands estimated at 3,300 kw., and there were served, in addition, approximately 11,500 domestic consumers using electric ranges in conjunction with lighting and other appliances.

Having regard to the diversity, one with another, of consumers within a group, and also equitable apportionment of diversity of one group with the others, as deduced from load records and other data, it is estimated that, of the maximum coincident station load for all groups — 17,550 kw. — between 9,500 kw. and 10,500 kw. is assignable to the 11,500 domestic range consumers, and between 7,000 kw. and 8,000 kw. is assignable to the domestic consumers without ranges, the commercial lighting consumers, the power consumers and the municipal street lighting service. The assignable station demand per range consumer is thus, on the average in this municipality, between .83 kw. and .91 kw.

The annual consumption of electrical energy by domestic consumers in this municipality is approximately 32,000,000 kilowatt-hours measured at the consumers' meters, from which, making allowance for distribution losses, it appears that the municipal station load arising from domestic service, with 78 per cent range saturation, and a slightly restricted energy consumption due to tariff somewhat higher than usual in large Ontario cities, has an average monthly load factor in excess of 40 per cent. The average *daily* load factor would of course be materially higher than this figure.

Results With Relatively Unfavourable Diversity

As representative of load characteristics in a municipality where diversity is relatively unfavourable, the results of a special study made in a municipality with some 6,000 domestic consumers may be cited. In this municipality, a sharp peak had been observed to occur between the hours of eleven-thirty and twelve o'clock, which, although the range saturation was but 33 per cent, was obviously attributable to unusually poor diversity of use of electric ranges. Special study was made of characteristics of individual consumers' loads, and the domestic service was definitely segregated from other classifications of service during the period covered by the survey. The cost of bulk power in this municipality was less, per horsepower, than that in the larger municipality cited above, and the domestic tariff was also lower; in consequence, the average domestic consumption, per range consumer and per lighting consumer, was materially higher than in the larger city.

Typical daily load curves for domestic service in this city, over a period of six months, showed an average maximum demand of approximately 3,800 kw. arising from 2,000 consumers having ranges and 4,000 consumers without ranges. The portion of the domestic peak load assignable to range consumers was approximately 2,700 kw., or 1.35 kw. per consumer, and that to lighting consumers, 1,100 kw., or 0.28 kw. per consumer. The analysis in this city having been directed more particularly to the ascertaining of the characteristics of the domestic load by itself, these figures do not, as in the case of the larger city, include apportionment of diversity existing between the various classifications of service, and are thus somewhat higher than the resulting assignable station demands. Even when appropriate allowance is made for this difference in the basis of the two sets of data, however, the results indicate clearly that diversity among the range consumers in the smaller, industrialized municipality, though good, was materially less than in the first city.

Respecting load factor in the smaller city, the actual typical daily load factor of the domestic load — again without allowance for diversity between classes — was high, the higher average consumption per consumer having offset the poorer diversity. For the month of December, the measured typical daily system load factor was nearly 50 per cent for domestic load by itself, and, if based upon assignable contribution to the aggregate municipal station load, would be a still higher figure.

Thus, even under relatively poor conditions of diversity, the Commission's extensive experience — of which the above data cited are representative — indicates that the load characteristics of domestic appliances are essentially good, and are such as to justify from the economic standpoint the provision of a supply of electrical energy to cooking consumers at low tariffs.

With respect to the load characteristics of the individual consumer, it should be noted that the electrical cookers in general use in Ontario are of the high-capacity type, with insulated oven, but without any special provision for heat accumulation, and no special measures have been taken to encourage limitation of individual peak demands. For consumers using ranges, lights and small appliances, the average installed capacity is about 11,000 watts per consumer, and the average monthly ten-minute integrated peak of the individual consumer is approximately 5,500 watts. Among domestic consumers using the service for lighting and small appliances, but not for cooking, the installed capacity averages about 2,200 watts, and the individual monthly peak demand averages 1,000 watts. As has been noted, however, the high individual peaks of range customers, and the resulting low individual load factors are of comparatively minor import to the utility from the economic standpoint.

In the course of the detailed survey to which reference has been made above, data were also secured respecting the load characteristics of the heavy appliances other than electrical cooking ranges, which are used to a considerable extent by domestic consumers in Ontario municipalities.

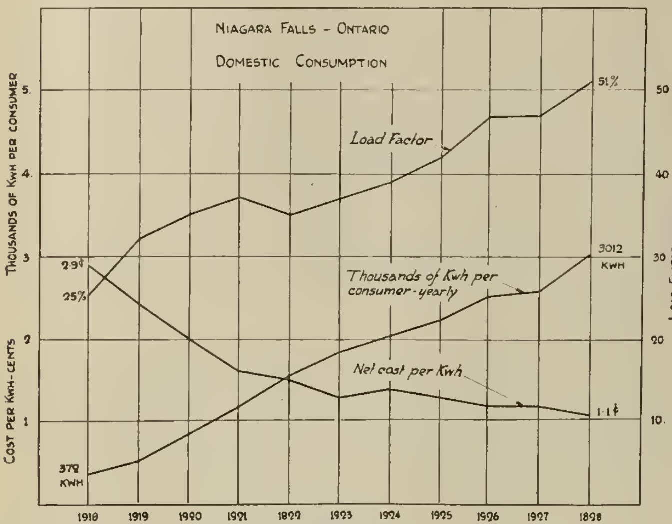

Figure No. 7

Among a group of consumers using both electric ranges and other appliances of large capacity and energy consumption, it was found that the average installed capacity was some 16,000 watts per consumer, about 5,000 watts more than the average installation for range consumers not using such heavy appliances. The average of individual demands, however, was but 5,700 watts, as compared with 5,500 watts, and the average annual consumption showed an increase of 1,860 kilowatt-hours. The large increase in energy consumption with trifling increase in individual demands, is evidence of the very favourable load characteristics of such appliances as regards diversity and improvement of load factor. Inspection of the load curves of the municipalities indicates that air heaters have less desirable diversity characteristics than the other heavy-duty appliances.

Influence on Load Factor of Rapid Growth in Consumption

Figure No. 7, relating to a third city — Niagara Falls, Ontario — shows the domestic consumption for the years 1918 and 1928 inclusive, in kilowatt-hours used per consumer per annum. It will be noted that for 1918 the average was 372 kilowatt-hours whereas for 1928 an average of 3,012 kilowatt-hours was consumed. The curve also shows the effect on the net cost per kilowatt-hour, which varied from 2.9 cents in 1918 to 1.1 cents in 1928. With this curve is also shown the average load factor for domestic purposes during that period. It is interesting here to note that the load factor during this period has increased from 25 per cent to 51 per cent — an increase in load factor which, undoubtedly, is largely responsible for the drop in the net cost per kilowatt-hour.

There has been remarkable development during this ten-year period in the use of electrical appliances. For instance, in domestic service in 1918 the use of electricity was almost wholly confined to lighting. With the beginning of 1919 and following through to 1922, the first major use of the electric range took place, until it was found that in 1921 the daily peak established by ranges equalled the lighting peak created in the evening. This gave the highest possible load factor with respect to the two peaks established. In 1922, the cooking load became greater than the evening lighting load, with a consequent reduction in the load factor. This was compensated for in 1923 by the gradual increase in the use of other appliances, a growth which has been steadily felt during the following years. A fact of interest is also observable about the years 1925 and 1926 when a large number of flat-rate water heaters were installed by domestic consumers. These flat-rate water heaters tended very materially to increase the load factor to the present, which now approximates an average of 51 per cent throughout the year. It is interesting also to note that during this period there has not been any change in the rate structure[7] for the city of Niagara Falls, and that the results have been brought about entirely through the increased use of appliance loads other than for lighting. Although the information is not fully available, yet it appears probable that this load factor will be still higher for the year 1929.

The results just presented clearly demonstrate what may be expected from a proper application of 'inducement' rates to domestic uses in conjunction, of course, with the development of the art.

The results under review were brought about under the most unsettled conditions the industry has probably had, namely, the period following the Great War, when prices, labour charges, etc., went through great changes and when, under normal conditions, a marked advance in the net cost of electric service might have been expected. During this period, the cost of power to the municipality under discussion had been substantially advanced. The cost of distribution material also was considerably higher, but in spite of all such features, the improvement in load factor, and greater use of energy per consumer, have manifestly resulted in a gradual drop in the cost per kilowatt-hour to the consumer.

Thus, in conclusion, it may be remarked that the economic results that have attended the application of the form of tariffs used by the Commission — results that have been shown, in an earlier section of this discussion, to be decidedly favourable from the standpoints of both consumer and utility — are in large measure due to the very advantageous load characteristics which appertain to the use of domestic appliances by the consumers of the Ontario undertaking, even under the less favourable conditions as regards diversity.

Rural Electrical Service

The data that have been presented for domestic service are representative of, and adequately illustrate, the economic results of the Commission's policies as they concern the operations of the Commission in their major aspect of supply to urban consumers. Rural electrical service, though of comparatively minor importance as regards the quantity of power supplied, is nevertheless of special interest because of the intensive efforts that have been directed in recent years and in many parts of the world, upon the problems of solving the difficulties inherent in rural distribution, and also because of the very great economic benefit which accrues to the rural consumer and to the general welfare of the citizens, from the provision of adequate supplies of electrical energy for agricultural consumers at low cost. The results of the Commission's methods and policies in this field will therefore be briefly indicated.

Electrical Service in Rural Districts of Ontario

A number of the outstanding features of rural electrical service in the province of Ontario were described at some length in the paper presented five years ago before the First World Power Conference. This earlier paper[8] was published in the proceedings of the conference, and is thus available for reference. In the present discussion it is

(7) The domestic rates in Niagara Falls throughout the years 1918 to 1929 have been as follows:

Monthly service charge......	3 cents per 100 square feet of floor area.
Energy charges..............	2 cents per kw.hr. for first 3 kw.hr. per 100 square feet.
	1 cent per kw.hr. for all additional energy per month.
Discount for prompt payment	10 per cent on whole bill.

proposed to direct attention specifically to some of the economic aspects of rural supply, and to indicate the results that have been attained through the application of the Commission's methods and policies, notwithstanding the general difficulties inherent in rural electrification, and the special difficulties encountered, even in the 40,000 square miles of "old Ontario," by reason of the relative sparseness of population and absence of the need for irrigation and of other large power demands.

The last five years have been a period of rapid expansion in rural electrical supply in Ontario. The number of rural power districts in operation has increased from 52 to 131. The number of miles of rural distribution line in service has increased from 600 miles to 3,800 miles. The number of consumers served in the rural power districts has increased from 4,200 to 30,000. The bulk power supplied to rural power districts has increased from 2,000 h.p. to 17,000 h.p.

(8) In the former paper a description was given of the Commission's pioneer work in the evolution of practical methods whereby handicaps to rural electrical service in Ontario were successfully overcome; and the legislation under which rural operations were promoted by efficient organization into rural power districts was presented in detail. The special design features whereby the Commission had been able to effect satisfactory overhead and underground rural distribution at low capital costs were described, and average costs per mile were given. The uniform classifications applicable to consumers of the various types found in agricultural areas were set forth, and the basis of estimating the respective costs and designing rate schedules in accordance therewith was discussed. The demand rating, average monthly consumption, and the service charge required to cover distribution costs at that time were stated for each class of service, and the annual consumption charges and total costs of service appertaining to consumers in typical rural power districts were enumerated. The results that had been attained up to 1923 were reported, with respect to the number of consumers, the mileage of distribution lines, and the capital expenditure. The uses made of the service by farm consumers were enumerated, and the energy consumptions appertaining to various types of farm equipment and to various agricultural operations were stated. The favourable influence of rural electrical supply upon the economic status of the agricultural population of Ontario, and its importance with respect to the economic life of the Province in general were discussed, and the powerful stimulus that had been afforded to rural industries was noted.

Since 1923 the modifications of practice found of value in reducing costs of distribution under present conditions have for the most part been of a relatively minor character. Increased loads and wider separation of feed points have rendered a primary voltage of 8,000/4,600 volts more economical than the former standard of 4,000/2,300 volts. The higher voltage is now standard for new construction, and 500 miles of line have been constructed for this potential. For service to small loads at outlying points, it has been found of advantage to extend the phase wires only of the 4,000/2,300 volt grounded circuit, using a 4,000 volt transformer connected across the phases. This procedure extends the possible distance of service, having regard to load and voltage drop, to three times that permissible when using 2,300 volts.

The former standard primary distribution line, which had a pole spacing of 160 feet and employed hard drawn copper conductors, has been found less economical than the present standard line, which has pole spacings of 200 feet and 250 feet — depending on the nature of the territory — and uses steel-reinforced stranded aluminum conductors, with minimum size of No. 4 B. and S. gauge. Copper is still used, however, for secondary conductors. Underground cable construction, which, in the period immediately following the War, had been the means of effecting economies in certain circumstances, has now, as the result of price changes, become less economical than overhead construction in nearly all circumstances.

Capital costs of overhead rural primary distribution lines, constructed according to present standards, using 200 foot spacing and aluminum stranded conductor, steel-reinforced, are approximately four per cent lower than the figure reported in 1924. A mile of single-phase line, installed complete, now costs, including supervision and overhead charges, $1,020, and the corresponding cost for a mile of three-phase line is $1,257. The cost per mile for single-phase No. 6 paper-insulated lead-covered underground cable laid in earth, however, has increased as the result of price changes, and is now approximately $1,266.

The classifications under which rural electrical service is supplied have been found in general to be satisfactory, and minor changes only have been made. In the case of hamlet service, no restriction is now made with respect to number of lighting outlets or use of small appliances, and service is given to shops under this classification. Former classes 1-A and 1-B are thus combined in the present class 1-B. Sub-classifications have been provided in the case of heavy farm service and special farm service, distinguishing between users of single-phase and three-phase power. The class demand ratings are unchanged.

The "grant-in-aid" which the government of the province had made toward the initial capital cost of primary rural distribution lines, as part of its general policy of aiding agriculture was, in 1924, extended to cover 50 per cent of secondary equipment, such as transformers and meters.

Economic Results from Consumer's Standpoint

Respecting the economic results of rural electrical service from the standpoint of the consumers, possibly the best evidence of the benefits derived is the rapidity with which the number of consumers taking advantage of the service has increased. Agriculturists, as a class, exhibit a tendency to form their conclusions respecting the economic benefits of electrical service on the farm from personal observation of the results derived by their neighbours. In the 52 rural power districts that had come into operation up to 1923, the favourable experience of the 4,169 consumers served at that time had by 1928 induced no fewer than 15,741 of the immediate neighbours of these farmers to take advantage of the service, and in addition had encouraged 10,059 rural residents in other parts of the province to take service from 79 rural power districts that had not been served up to 1923.

The average annual consumption and cost to all users in rural power districts is submitted in table No. 6 by classes.

Table No. 6.

Class	Service	Average annual consumption kw.hr.	Class demand rating kw.	Annual net cost to consumer
				$ c.
1 B	Hamlet lighting........	388	0.75	24.56
1 C	" "	1,627	2	56.62
2 A	House "	417	1	27.90
2 B	Small farm service.....	1,093	2	46.45
3	Light " "	833	3	55.14
4	Medium farm service...	2,085	5	87.99
5	" " " ...	2,073	5	93.70
6 A	Heavy " " ...	5,987	9	180.21
6 B	" " " ...	3,892	9	156.46
7 A	Special " " ...	13,579	15	327.25
7 B	" " " ...	18,438	15	584.48
8	Syndicate outfits.......	14,157	..	396.40

As a measure of increase in use of the service by the consumer, and reduction in average cost, the value of average statistics is for rural service largely nullified by the rapidity with which the number of consumers served has increased. Owing to the large increases in consumers served in recent years, the *average* length of time the 29,867 consumers served at the end of 1928 had been using the service is but little greater than the average time of service appertaining in 1923 to the 4,169 consumers then served. Having regard to this limitation of the statistics, however, it is of interest to note that, in the 52 rural power districts served throughout the five-year period, the increase of 375 per cent in number of consumers has been accompanied by an increase in bulk power supplied of 420 per cent. It may be concluded, therefore, that the average use of the service by individual consumers shows a tendency to increase with time that is comparable with the results found among urban consumers.

With respect to the cost of service to the consumer, it should be noted that the increase in number of consumers served has necessitated the construction of distribution lines almost to a proportionate extent The addition of new consumers to existing lines has been offset by the lower density in the new districts and in the portions of older districts more recently served. The 605 miles of line in service in 1923 had increased at the end of 1928 to 3,791 miles, by the addition of 1,815 miles in the 52 districts served up to 1923, and 1,371 miles in the 79 newer rural power districts.

Representative Results to Farm Consumers and Rural Industries

The results of using hydro-electric power service from the consumer's point of view may, however, representatively be illustrated by the information respecting installation, energy consumption and costs submitted below in detail with respect to two dairy farms, one chicken farm and two dairy industries. Data are given by billing periods, showing costs for two separated years in the three farm services, as well as total for a five-year period in one. Satisfaction to users is the final test of success and it is believed that rural hydro consumers are convinced of the merit of the service by seeing their reasonable bills.

The records for the rural industries are submitted in order to illustrate how such industries can be served by hydro-electric power advantageously, at relatively low cost, having regard to the somewhat adverse circumstances of rural electrical distribution.

Dairy Farm — Using Milking Machine
In Woodstock R.P.D.
Class 3 Service

Installation	Capacity
Lighting — Owner's farm, man's house and other buildings	1,600 watts
Electric irons — 2	1,200 "
Washing machine	186 "
3 h.p. motor	2,238 "
	5,224 watts

Operation — Year ending December 31, 1926.

Billing period	Consumption	Net bill
3 months ending May. 31	539 kw.hrs.	$23.04
" June 30	553 "	23.38
" Oct. 31	341 "	23.92
" Dec. 31	236 "	13.14
	1,669 kw.hrs.	$83.48

Rate 1926 [9] — Service charge — $4.10 per month.
Energy charges — 4 cents per kw.hr. for first 42 kw.hrs. used per month. 3 cents per kw. for the balance used per month.
Discount — 10 per cent for prompt payment.

Operation — Year ending December 31, 1929.

Billing period	Energy consumption	Net bill
3 months ending Jan. 31	549 kw.hrs.	$19.66
" Apr. 30	661 "	21.67
" July 31	586 "	20.32
" Oct. 31	400 "	17.06
	2,196 kw.hrs.	$78.71

Rate 1929 — Service charges — $3.20 per month.
Energy charges — 3 cents per kw.hr. for first 42 kw.hrs. used per month. 2 cents for the balance used per month.
Discount — 10 per cent for prompt payment.

Dairy-Farm
In Woodbridge R.P.D.
Class 5 service

For purpose of record, energy consumption on this farm was separately metered to segregate power, household uses, and lighting of barn, shed and yards.

Installation	Capacity
Lighting in house	1,240 watts
Electric iron	600 "
Washing machine	186 "
2 burner hotplate	1,000 "
Air heater	1,200 watts
Total	4,226 watts
Lighting in barn and other buildings	920 watts
Lighting in yard	120 "
Total	1,040 watts
Power — 5 h.p. motor in barn	3,746 "
Grand total	9,012 watts

Operation — Year ending Oct. 31, 1926

Billing period	Energy	Net bill
3 months ending Dec. 31, 1925	737 kw.hrs.	$ 25.87
3 " " Mar. 31, 1926	969 "	36.34
3 " " June 30, 1926	485 "	27.63
3 " " Oct. 31, 1926	776 "	39.17
	2,967 kw.hrs.	$129.01

Division: 1776 kw.hr. for power
933 " " household uses [10]
258 " " lighting barn, other buildings and yard.

Rate 1926 — Service charge — $4.90 per month.
Energy charges — 5 cents per kw.hr. for first 70 kw.hrs. used in each month.
2 cents per kw.hr. for balance used per month.
Discount — 10 per cent for prompt payment.

Operation — Year ending Oct. 31, 1929

Billing period 3 months ending	Energy consumption-kw.hr.				Net bill
	Power	Household uses	Lighting yards, barn, etc.	Total	
Jan. 31	953	206	144	1,303	$ 38.71
Apr. 30	525	100	65	690	27.68
July 31	468	88	16	572	25.55
Oct. 31	454	130	51	635	26.69
	2,400	524	276	3,200	$118.63

Rate 1929 — Service charge — $4.60 per month.
Energy charge — 3.5 cents per kw.hr. for first 70 kw.hrs. used per month.
2 cents per kw.hr. for balance used per month.
Discount — 10 per cent for prompt payment.

Total used and costs — 5 year period ending Oct. 31, 1929.

Power	10,016 kw.hrs.
Household uses	3,229 "
Lighting yards, barns, etc.	1,266 "
Total	14,511 kw.hrs.
Total cost	$607.12
Average per annum	$121.42

Chicken Farm
In Woodstock R.P.D.
Class 3 Service

Installation	*Capacity*
Lighting	2,000 watts
Electric iron	600 "
Washing machine	186 "
Furnace blower	125 "
Automatic water system	186 "
Vacuum cleaner	80 "
Electric range	8,250 "
Electric incubators [11]	2,070 "
Motor in incubator	376 "
Total	13,873 watts

[9] In 1922 the rates in this district were:
Service charge.... $5.63 per month.
Energy charges... 5.5 cents per kw.hr., for the first 42 kw.hrs. used per month.
2 cents per kw.hr. for the balance used per month.
Discount......... 10 per cent for prompt payment.

[10] Serious illness in home in 1926 required extensive use of electrical air heater.

[11] For heating and incubating, heat is supplied by Hydro-Electric service.

Operation — Year ending July 31, 1928

Billing period	Energy consumption	Net bill
3 months ending Oct. 31/27	276 kw.hrs.	$ 14.80
3 " " Jan. 30/28	465 "	18.86
3 " " Apr. 30/28	2,595 "	57.02
3 " " July 31/28	1,871 "	43.99
	5,207 kw.hrs.	$134.67

Note — Range installed early in the year.
Rate — Service charge — $3.40 per month.
1928 Energy charges 3 cents per kw.hr. for the first 42 kw.hrs. per month.
2 cents per kw.hr. for the balance used per month.
Discount — 10 per cent for prompt payment.

Operation — Year ending October 31, 1929

Billing period	Energy consumption	Net bill
3 months ending Jan. 31	1,386 kw.hrs.	$ 34.72
3 " " Apr. 30	2,970 "	63.23
3 " " July 31	1,991 "	45.61
3 " " Oct. 31	800 "	24.17
	7,147 kw.hrs.	$167.73

Rate — Service charge — $3.20 per month.
1929 Energy charges— 3 cents per kw.hr. for the first 42 kw.hrs. used per month.
2 cents per kw.hr. for the balance used per month.
Discount — 10 per cent for prompt payment.

Creamery — A Strictly Dairy Industry
In Goderich R.P.D.
Class "A" Power

Operation—Calendar Year 1929

Month	Demand by meter h.p.	Energy consumption kw.hr.	Net bill
January	20.11	2,980	$ 73.79
February	19.70	3,500	74.03
March	19.70	3,170	73.05
April	23.05	4,260	87.11
May	23.60	6,360	95.09
June	22.50	7,520	95.05
July	22.50	6,840	87.63
August	23.05	8,090	98.49
September	24.15	7,600	100.52
October	23.60	3,910	87.81
November	18.10	4,510	71.85
December	18.10	4,740	72.53
	258.16	63,480	$1,016.95

Average 21.51 h.p. = $47.30 per h.p. per year.
Rates — Service charge — $1.00 per h.p. per month.
Energy charges — 4.0 cents, 2.6 cents, 0.33 cents per kw.hr.
Discount — 10 per cent.

Creamery — A Strictly Dairy Industry
In Mitchell R.P.D.
Class "A" Power

Operation — Calendar Year 1929

Month	Connected Load h.p.	Consumption kw.hrs.	Net bill
January	22.5	876	$ 58.91
February	22.5	665	44.19
March	22.5	1,333	$62.03
April	22.5	1,519	66.38
May	22.5	2,187	71.65
June	22.5	3,746	76.28
July	22.5	2,980	74.01
August	22.5	4,664	79.01
September	22.5	2,201	71.69
October	22.5	1,761	70.39
November	22.5	1,581	67.82
December	22.5	690	45.09
Totals		24,203	$787.45

Average 22.5 h.p.
Average cost — $35.45 per h.p. per year.
Rates — Service charge — $1.00 per h.p. per month.
Energy charges — 4.0 cents, 2.6 cents, 0.33 cents per kw.hr.
Discount — 10 per cent.

Reduced Charges to Consumers

As a result of continued search for means of effecting economies in rural distribution costs, and of the additional assistance[12] afforded by the extension of the agricultural "grant-in-aid," it has been found possible to make a notable reduction in the charges to consumers, in respect both of the initial rates applicable in newly-formed rural power districts, and of the average rates charged in the rural areas of the province. The extent of the reduction in service charges from 1923 to 1928 is indicated by table No. 7.

Table No. 7—Reductions in Service Charges, 1923–1928

Classification of service	Annual service charges		
	Maximum for initial 25-cycle operation		Average paid by rural consumers of Ontario
	1923	1928	1928
1 B Hamlet lighting	$ 20.50	$ 19.44	$ 14.53
1 C Hamlet lighting and cooking	36.44	35.64	26.91
2 A House lighting	30.00	24.30	18.30
2 B Small farm service	47.40	37.26	27.99
3 Light farm service	60.82	49.14	36.61
4 Medium farm service	66.94	51.30	38.22
5 " " "	84.50	62.10	46.30
6 A Heavy " "	130.97	79.38	58.15
6 B " " "		89.64	67.30
7 A Special " "	188.90	117.72	87.24
7 B " " "		142.56	106.61

The maximum service charge for initial operation, both in 1923 and 1928, is based on the minimum requirement of three farm contracts or equivalent per mile of distribution line. Class 3 — light farm service — is the classification under which the great majority of farm consumers are served. Taking this class as representative, it will be observed that by 1928 the maximum service charge had been reduced nearly 20 per cent. The average paid by the consumers of the rural power districts of the province—including some 13.5 per cent of consumers served at the 1928 maximum rate, and the remainder at rates ranging from about ninety-five per cent to less than 50 per cent of the maximum — was in 1928 approximately 40 per cent less than the maximum service charge applicable in 1923. These averages take no account of cash rebates made to consumers in rural power districts amounting to some $230,000 during the past two years representing the accumulated excess of revenues produced by the charges made in previous years over costs of service and moderate surplus required to assure financial stability.

[12] See footnote 8.

With respect to reductions in rural service charges, it may be stated that reductions and adjustments are being made from time to time, and at the end of 1929, further reduction has been made to all rural classes as a result of the provincial government's active policy to assist agriculture as far as possible. The basis upon which this adjustment was made was that the net service charge to a farmer for Class 3 service should not be greater than $30 per year — this contrasts with the $36.61 in the table above — and adjustments in all other rural classes were made on a corresponding basis. From the consumer's standpoint, therefore, the economic results of the Commission's policies, as indicated by progressively lowered charges for service, may be said to have been eminently satisfactory.

Use of Electrical Equipment on Ontario Farms

In rural electrical service, even more markedly than in service to urban consumers, the economic results to the consumer are dependent upon the degree to which use is made of electrical equipment. Power-driven farm equipment is capable of effecting substantial economies in agricultural operations, and household appliances relieve the farm women of much drudgery.

In order to ascertain the extent to which electrical equipment and appliances are being installed in the homes and in the barns of farmers receiving service from the Commission's rural power districts, a survey was conducted among farm consumers as distinct from hamlet consumers. Returns have been received from nearly 60 per cent of all farm consumers in the province, the results of which are presented in table No. 8.

It will be noted that some pieces of equipment, particularly those which are intended to be belt driven by an electric motor, are not reported as very numerous. This may be accounted for by the fact that in making returns the consumers have not indicated the equipment which they drive with the motors which are installed and it may be safe to assume that there are more of these pieces of apparatus in operation than are indicated in the table.

Table No. 8—Electrical Equipment in Use by 7,074 Farm Consumers Reporting

	Number	Per cent saturation
Barn Equipment		
Electric motors	1,877	26.5%
" pump systems	1,610	22.7
" milk coolers	22	0.3
" churns	43	0.6
" drills	9	0.1
" water heaters	30	0.4
" soldering irons	18	0.2
" chick brooders	136	1.7
Milking machines	283	4.0
Feed grinders	322	4.5
Cream separators	397	5.5
Ensilage or straw cutters	120	1.7
Hay hoists	13	0.2
Tool grinders	200	2.8
Root pulpers	27	0.4
Fanning mills	27	0.4
Saws	26	0.4
Household Appliances		
Electric ranges	1,350	19.1%
" hotplates	1,155	16.3
" washers	3,514	49.7
" vacuum cleaners	654	9.2
" water heaters	222	3.0
" grates	75	1.0
" air heaters	688	9.7
" ironing machines	34	0.5
" irons	6,283	88.8
" refrigerators	194	2.7
" grills	158	2.2
" toasters	3,607	51.0
" churns	74	1.0
" radios	968	13.7
" percolators	143	2.0
" fans	136	1.9
" pumping systems	138	1.9
" sewing machines	18	0.2

In the case of electric motors and electric pumping equipment a large percentage of farmers are making use of the facilities of electric service.

The most interesting feature of this table, however, is the extent to which some of the household appliances are being employed. Electric ranges and hotplates have reached a degree of saturation almost equal to that existing in the urban municipalities of the province, while washing machines have been installed to a very much greater extent on the farm than is the case in urban municipalities. Data respecting other electrical appliances show that their popularity and usefulness are spreading in the rural districts. There are a number of rural power districts in the province where the farmers have shown an exceptional inclination to complete electrification of the barn and the home; among these are the districts of Brant, Preston and Woodstock. Table No. 9 shows the equipment installed in each district with the corresponding number of consumers involved.

Table No. 9—Summary of Equipment and Appliances in Use by Farm Customers in Three Well-Developed Agricultural Districts Supplied by Hydro Rural Electrical Service

	Brant	Preston	Woodstock
Number of consumers	212	175	241
Barn equipment			
Electric motors	76	92	130
" pump systems	49	41	95
" milk coolers	3	2	1
" churns	...	4	1
" drills	...	...	1
" water heaters	...	10	4
" soldering irons	2	4	...
" chick brooders	13	17	6
Milking machines	7	16	18
Feed grinders	5	39	25
Cream separators	8	32	11
Ensilage or straw cutters	1	26	3
Hay hoists	...	1	...
Tool grinders	...	22	13
Saws	...	3	1
Pulpers	...	2	2
Fanning mills	...	2	...
Household appliances			
Electric ranges	60	43	67
" hotplates	50	38	62
" washers	95	104	119
" vacuum cleaners	32	30	17
" water heaters	19	18	9
" grates	6	9	7
" air heaters	32	30	33
" ironers	...	5	1
" irons	193	158	235
" refrigerators	3	7	3
" grills	2	...	11
" toasters	108	97	159
" churns	1	13	...
" radios	24	34	37
" percolators	4	3	3
" fans	5	9	7
" sewing machines	...	2	1
" pumps	...	6	...
" grinders	...	2	...
" blankets	...	1	...

The effect of the installation of the more modern appliances is well illustrated in the average consumption of electricity by all consumers in these districts. In Brant, for instance, the average consumption among Class 3 customers is 1,649 kilowatt-hours per annum, in Preston 1,332 kilowatt-hours per annum and in Woodstock 1,430 kilowatt-hours per annum. These figures are materially higher than the average consumption among all Class 3 consumers in the province of 833 kilowatt-hours per annum. There are corresponding differences in the consumption among other classes of farm consumers and the general effect of the extensive use of electricity in these districts has been to materially reduce the average cost per kilowatt-hour to consumers in these districts over the general average. It is hoped that, as the farm consumers throughout the province reach the position where they are able to finance additional power-using equipment, the standard of electrical utilization now set by specific districts will be equalled and even surpassed, in all districts of Ontario.

Financial Results to the Utility

Respecting the economic results of rural electrical service to the utility, it can be stated that, notwithstanding the fact that on the average the consumers have been served but for a short time, the revenues yielded by the charges to consumers have been adequate. The results of operation in 1928 are as follows:

Rural Power Districts — Revenues and Expenses for 1928

Total capital investment in operation		$7,054,654.00
Revenues from consumers		1,342,624.86
Expenses		
Cost of bulk power	$472,594.56	
Cost of operation, etc	342,686.71	
Total operating expenses		815,281.27
Net return before depreciation		$ 527,343.59
Depreciation		123,666.45
Net return after depreciation		$ 403,677.14
Per cent return on total investment 5.7 per cent interest		146,919.58
Surplus		$ 256,757.56
Applied to capital retirement	31,380.07	
Reserved for obsolescence and contingencies	173,252.39	
Other free surplus	52,125.10	
	$256,757.56	

In interpreting the above results of operation, the effect of the government agricultural bonus should be taken into account. Nearly one-half of the $7,000,000 of capital investment for rural distribution having been granted by the province as part of its general policy of aiding agriculture, the charges to consumers are relieved of interest and sinking fund in respect of some $3,500,000, and the net return of 5.7 per cent after depreciation, figured on the total capital investment, — including the government "grant-in-aid" — is thus ample to ensure the financial soundness of this portion of the Commission's activities.

It is of interest to note that the total revenues of one and one-third million dollars represent the sum of the charges paid by nearly 30,000 rural consumers — an average charge per consumer per month of less than $4.00, for service which in the case of a large proportion of the consumers covers lighting of farm residences, lighting of out-buildings, electrical cooking and power for operation of agricultural machinery. The general conclusion to be drawn, therefore, respecting the economic results of the Commission's policies in the field of rural electrical supply is that, having regard to the circumstances in Ontario, these policies have been the means whereby service can be extended on a large scale to rural consumers at relatively low costs without detriment to the financial status of the undertaking, and with great economic benefit to the province as a whole.

In accordance with the suggestion that the greatest weight at the Second World Power Conference should be given to the distribution and utilization of electricity, and that reports were desired respecting experience with domestic and agricultural electricity tariff systems, in their relation to the use of electrical appliances, and also respecting experience as to the influence of these appliances on the load characteristics of the supply stations, the endeavour has been made to present as comprehensively as could be done within the limits of space assigned, a description of the results that have been achieved in the province of Ontario. It is hoped that the information that has been given respecting these important aspects of electrical supply, based on the experience of the Hydro-Electric Power Commission of Ontario in serving several hundred municipalities over a period of nearly twenty years, will be found to be of assistance to those who have to deal with the problems which arise in connection with modern electricity supply undertakings.

Storage Reservoirs in Canada

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

Statistics respecting the possibilities of the rivers in Canada for producing power have been compiled by the Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa. The last figures given out show that at low water about 20,000,000 h.p. might be generated, but on the basis of the flow available six months in the year or 50 per cent of the time, the amount of power possible would be 33,000,000 h.p. or one and two-thirds the possibility at low water.

The amount of power available in each province of the Dominion is given in table No. 1 for both the ordinary minimum flow and the ordinary six months flow.

To this table No. 1 has been added a column which shows the relation of the ordinary flow available six months in the year to the ordinary minimum.

In the western provinces of British Columbia and Alberta the ratio is 2.6 and 2.7 respectively, while for Ontario and Quebec the ratio is 1.3 and 1.5 respectively. This would seem to show that to increase the low water flow to the six months figures much more storage is required in British Columbia than is required in the central provinces

Table No. 1

Province	Available 24-hour power at 80 per cent efficiency		Relation six months flow to ordinary minimum
	At ordinary min. flow h.p.	At ordinary six months flow h.p.	
1	2	3	4
British Columbia	1,931,000	5,103,500	2.6
Alberta	390,000	1,049,500	2.7
Saskatchewan	542,000	1,082,000	2.0
Manitoba	3,309,000	5,344,500	1.6
Ontario	5,330,000	6,940,000	1.3
Quebec	8,459,000	13,064,000	1.5
New Brunswick	87,000	120,800	1.4
Nova Scotia	20,800	128,300	6.4
Prince Edward Island	3,000	5,300	1.8
Yukon and Northwest Territories	125,200	275,300	2.2
Canada	20,197,000	33,113,200	1.64

of Ontario and Quebec. The ratio may indicate also that the streams in the mountainous country of western Alberta and British Columbia have a longer period of relatively high water.

The amount of power which has been generated in the different provinces up to January 1st, 1930, has been computed as follows:

British Columbia	588,600 h.p.
Alberta	70,500
Manitoba	312,000
Saskatchewan	35,000
Ontario	1,952,400
Quebec	2,595,000
New Brunswick	112,600
Nova Scotia	109,100
Prince Edward Island	2,440
Yukon Territory	13,200
Total	5,790,840 h.p.

This tabulation has been derived from the statistics issued by the Department of the Interior, Ottawa, for January 1st, 1929, to which has been added the amount of power installed during 1929, as given out lately in trade publications, financial reviews and general summaries of power activities during the past year.

The improvement of the rivers for the production of power, if limited to the low water possibility, would mean in the majority of cases a prohibitive cost. The increase in the amount of water available during the low water periods can be obtained only by changing the distribution of the water from one season to another, that is holding the water into large storage basins during the excessive water supply. The increase in the low water flow means a proportionate increase in the amount of primary power which can be generated under a given head. In some cases, where such control has been realized, the low water flow has been increased to a figure higher than the flow available for six months of the year. It is not contended here that the regulation or control of the flow of all power streams is possible, however desirable it may be.

Storage reservoirs have been built quite extensively in all of the provinces where hydro-electric power is generated. In fact, it may be fair to state that all the important power developments have their supply of water assured by storage reservoirs.

With the increasing demand for power and cheap power, dependable power, the question of increasing the low water flow came very much to the front, more specially with respect to the most accessible sources of power. Comprehensive studies have been made throughout Canada of the quantity of water flowing into the principal streams. The initiative in this field of investigation was taken by the Water Power and Reclamation Service of the Department of the Interior at Ottawa. It is true that scattered and very limited investigations of individual streams had been made previously by private power interests, but the above-mentioned branch of the Dominion government has the merit of having organized the hydro-electric survey on a large and comprehensive scale, and properly coordinated the data made available. To this work, the provincial organizations have heartily co-operated, and the Water Resources papers which are issued from time to time form a most valuable guide for the proper and economic improvement of the power streams.

Seasonal Flow

The flow of the rivers is very variable. In the central provinces and the Maritime Provinces, it is generally at its maximum during the spring flood. On the Pacific coast, and more particularly in Vancouver island, the high water occurs in the winter, say November, December and January; in the rocky mountain streams of British Columbia the high water occurs in summer, say in May, June and July,—the streams being fed by the melting ice and snows of the high hills.

The minimum flow, except as above-mentioned, generally occurs during the winter months, in February or March. Generally speaking, the ordinary minimum flow reaches one-third of a cubic foot per square mile of drainage area in all of the eastern provinces. The maximum flow reaches up to ten cubic feet per second per square mile of watershed for the large basins, and from twenty-five to thirty for the smaller basins.

The streams draining the western plains of Alberta and Saskatchewan, and part of Manitoba, such as the Saskatchewan and Assiniboine rivers, have a very low minimum discharge, something of the order of one hundredth of one cubic foot per second, but these are not rated as power streams.

Practicability of Reservoirs

The only method by which the low water of the streams may be increased is by the construction of large reservoirs in which the flood waters, or part of them, are held back by control dams, and distributed during the low water periods.

At the time of spring floods, water flows in excessive volume, always causing inconvenience, and sometimes heavy damage to the riparian proprietors. The surplus water, which is thus stored, constitutes an improvement in the spring flood situation. The reservoirs, therefore, improve both the high water and low water conditions.

A complete control whereby a uniform flow would be available throughout the year is almost impossible to realize. In considering this question, one must bear in mind the fact that the amount of water flowing down a stream is quite different from one year to another,—there being high water years and low water years. Under those conditions, complete control is almost beyond hope.

It may be stated that the average yearly flow on the St. Maurice river, for example, is about 1.7 second-feet per square mile of drainage area. The low average yearly flow is about 1.2 cubic feet per second per square mile. With the present storage facilities, the flow of the stream is regulated to 1.06 second-feet per square mile.

Reservoirs

The construction of reservoirs has been carried out in most of the provinces, and a general outline of the extent to which they have been built in each province is given below.

No details as to cost, or as to the resulting improvement in the flow of the streams regulated are given, except in the case of the rivers in the province of Quebec, when they are controlled by the Quebec Streams Commission.

British Columbia

In British Columbia the principal power developments are those of the British Columbia Electric Power Company, located on Vancouver island, to serve the district of Victoria and vicinity, and the power plants of the same company supplying the city of Vancouver and surrounding district. On Vancouver island, no large amount of storage has been developed beyond the capacity of the ponds resulting from the construction of power dams. On the mainland, storage reservoirs have been created such as: Coquitlam lake, seven or eight miles northeast of Vancouver, with a capacity of 160,000 acre-feet to supply water to the Buntzen plant. The same company built a storage dam controlling the water from Alouette lake,— a reservoir with a capacity of 173,000 acre-feet. This water is diverted into Stave lake through a tunnel and a power plant under a head of about 160 feet. The tailrace of that plant is Stave lake, which has a capacity of 471,000 acre-feet. Stave lake discharges through the Stave falls power plant into the Stave river. On the same stream the Ruskin falls are now being developed. This system is known as the Alouette-Stave-Ruskin development and is located about twenty-five miles northeast of the city of Vancouver, — the system being tributary to the Fraser river.

A third power unit on a large scale is that of the Bridge river, also a tributary to the Fraser. The water of that stream will be diverted through a tunnel into Seton lake, which lies about 1,200 feet lower than the river at the point of diversion. This development is now under construction and, when completed in the next few years, will involve storage reservoirs having an aggregate capacity of 1,293,000 acre-feet. The power plant will be located on the shore of Seton lake about fifty miles north from the city of Vancouver.

Another district in the province of British Columbia, which is remarkable for the amount of power generated, lies in the southeast part of the province,—the Kootenay district, where are rich deposits of copper minerals, which are being extracted on a large scale. A certain amount of storage is available from the Kootenay lakes.

Alberta

In the province of Alberta, the power developed to this date is practically limited to plants on the Bow river, which rises in the Rocky mountains in the Banff district, and flows past the city of Calgary. The Calgary Power Company serves the city of Calgary and district with power generated at two sites on the Bow river. Storage reservoirs have been created in the Minnewanka lakes, with a capacity of 44,000 acre-feet. Lately the Ghost development has been completed and involves a reservoir with a capacity of 73,000 acre-feet.

Saskatchewan

In the province of Saskatchewan, practically no water power had been developed until the year 1929, when work was commenced on the Island falls power site on the Churchill river. This power is intended for the mining industry, more particularly the Flin Flon mine in the northwest section of the province of Manitoba. It may eventually be transmitted to the northern centres of population in Saskatchewan. No storage is mentioned in connection with this development,—the minimum flow of the Churchill river being, no doubt, sufficient for the present power requirements.

Manitoba

The principal power streams in this province are the Winnipeg and the Nelson rivers. The winnipeg has its source into Lake of the Woods, an international body of water located between the state of Minnesota and the province of Ontario, near its western boundary, and flows into Lake Winnipeg. The total fall between the two lakes is about 340 feet, of which 265 feet are within the limits of Manitoba. Power is developed on a large scale on the Winnipeg river by both the city of Winnipeg and the Winnipeg Electric Company, or subsidiaries.

The flow of the Winnipeg river is regulated to about 20,000 second-feet by a control of the discharge of Lake of the Woods and Lac Seul, on the English river, tributary to the Winnipeg. This control is performed by what is called "The Lake of the Woods control board" for lake elevations 1,056.0 to 1,061.25. The capacity of the lake between these limits is 5,000,000 acre-feet,—its area being 1,485 square miles. When the lake level reaches an elevation beyond these limits, control passes to an international board with a Canadian and a United States representative.

The Lac Seul reservoir has a capacity of 3,210,000 acre-feet,— the lake area being 421 square miles.

The Nelson river is the outlet of Lake Winnipeg, 715 feet above sea level, and flows into Hudson bay. Lake Winnipeg is supplied from the Saskatchewan and the Rouge, in addition to the Winnipeg river. No power has yet been developed on the Nelson.

Figure No. 1.—Reservoirs in Canada—British Columbia and Alberta.

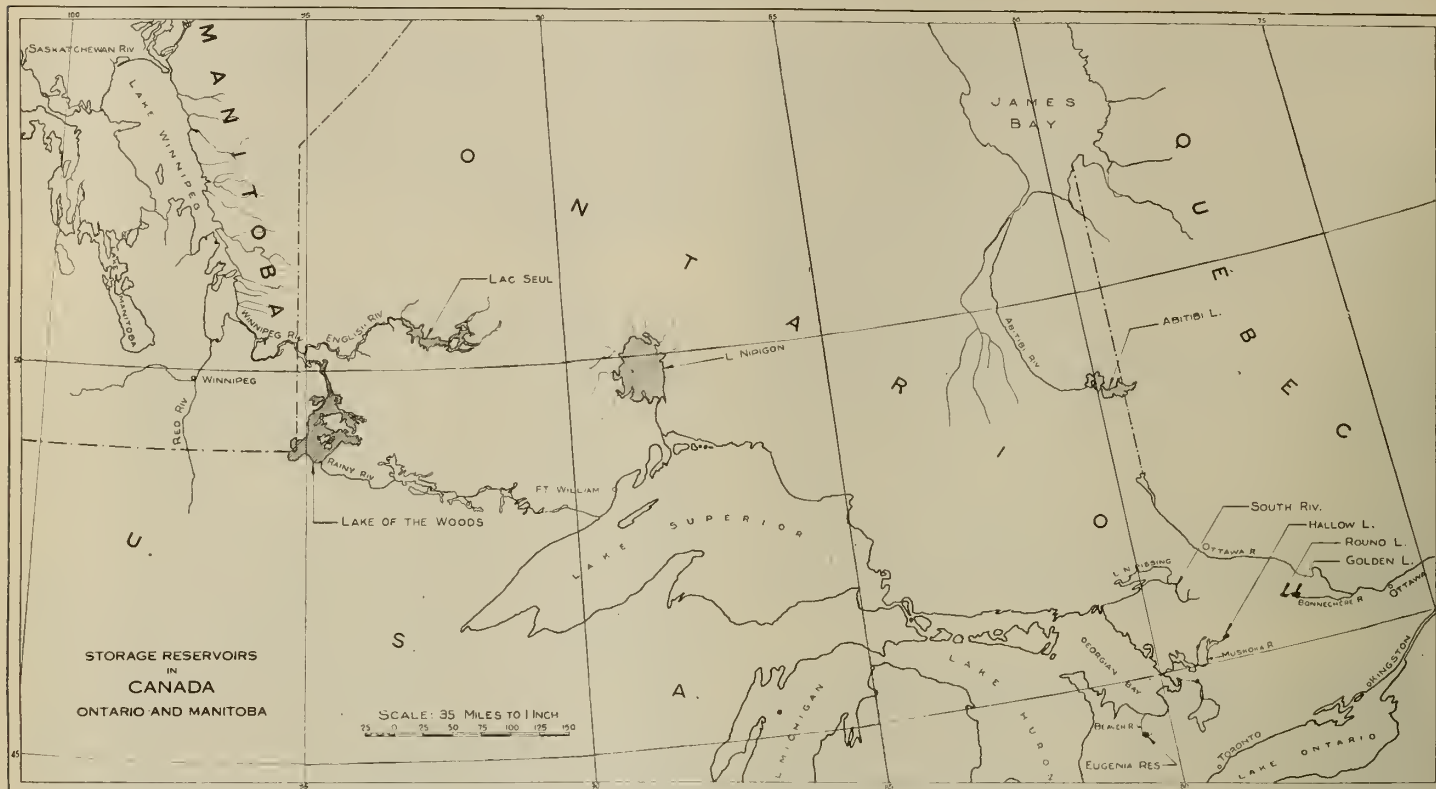

Figure No. 2.—Reservoirs in Canada—Manitoba and Ontario.

Ontario

In the province of Ontario, except in the northeast section, almost all the power is generated and distributed by the Hydro-Electric Power Commission of Ontario, acting as a trustee for the different municipalities it serves with power. The principal reservoirs owned and operated by the Commission are:

Lake Nipigon on the Nipigon river, north of Lake Superior. The capacity of that reservoir is 5,720,000 acre-feet. The minimum flow at the dam is 7,620 second-feet.

Hollow lake reservoir on the Muskoka river, district of Parry Sound. The reservoir capacity is 75,000 acre-feet; minimum flow 500 second-feet.

Eugenia falls on the Beaver river. Capacity of the reservoir 16,000 acre-feet; minimum flow 58 second-feet. This is a combined storage and power.

Round lake and Golden lake on Bonnechere river, a tributary to the Ottawa, and flowing through the town of Renfrew. Combined capacity of the two reservoirs 80,700 acre-feet; minimum flow at Renfrew 300 second-feet.

Five small reservoirs on the south river, district of Nipissing. Capacity 35,000 acre-feet; flow at Nipissing 200 second-feet.

Besides the above reservoirs, private companies have built some storage dams in the northern part of the province, namely:

The storage dam on the Spanish river at Turbine, built and owned by the International Nickel Company, to increase the flow of the Spanish river. Also control by the Abitibi Power and Paper Company of the flow from Lake Abitibi, a large body of water, 875 feet above mean sea level, lying partly in the province of Ontario and partly in the province of Quebec, and forming the source of the Abitibi river. It is controlled between high and low water limits,—a margin of six feet. The storage capacity between these limits is 1,340,000 acre-feet. Water is used to regulate the flow of the Abitibi river, from which power is generated by the Abitibi Power and Paper Company.

Ottawa River

The Ottawa river forms the boundary between the provinces of Ontario and Quebec.

Storage reservoirs have been built some years ago by the Dominion government in view of improving navigation. These reservoirs are located in Quinze lake and Kipawa lake, both completely in the province of Quebec, and into Lake Temiscamingue which is on the interprovincial boundary.

The flow of the Ottawa river is increased to 20,000 second-feet during low water periods, as against a minimum of 12,000 second-feet under natural conditions. These dams are operated and maintained by the Dominion government, and up to this time, no charge has been made to the power interests who benefit by the additional flow.

Province of Quebec

In the province of Quebec, storage reservoirs have been built by the Quebec Streams Commission and by private companies. These will form the text of a special chapter and need not be considered further at this stage.

New Brunswick

In New Brunswick, power is being produced by private companies and by the New Brunswick Power Commission, a governmental organization. This commission has developed on the Musquash river, about fifteen miles southwest of the city of St. John, a power plant where about 11,000 h.p. have been installed. Storage dams have been built in the Musquash valley and lakes. The capacity of the storage is 600,000 acre-feet.

Power has been developed lately at Grand falls on the St. John river. Storage is being provided on the tributaries of this stream,—said tributaries being located partly in the province of Quebec and partly into the state of Maine.

In the province of Quebec, a storage reservoir is being built into Lake Temiscouata, source of the Madawaska river. The water from that lake will be controlled on a depth of about seven feet above low water,—the natural high water not being raised.

Nova Scotia

In Nova Scotia, power is being generated and distributed by the Nova Scotia Power Commission, a governmental organization, and by private companies. This commission has reservoirs in connection with its St. Margaret's bay power, Sheet Harbour and Mersey river developments. Storage dams are located on the Tusket river at Carleton lake, Great Barren lake and Stoney Creek lake,—the aggregate capacity of the reservoirs being 50,000 acre-feet. Power is supplied at Yarmouth.

In the Sheet Harbour system on the East river, seven reservoirs have been built. These are scattered in the basins of the East river and supply water to the power stations of this system.

There has recently been completed on the Mersey river a combined power and storage dam at Upper Lake falls,—the storage being in Rossignol lake, and the capacity of the reservoir about 512,000 acre-feet. Power will be supplied to the Mersey Paper Company at Liverpool, N.S.

St. Lawrence System

Mention should be made here of the natural regulation of the St. Lawrence river due to the Great Lakes system. These Great Lakes form the most effective series of reservoirs, making the St. Lawrence the most regular stream known to the writer. The drainage area of these Great Lakes is 275,000 square miles. The combined area of the lakes themselves is about 95,000 square miles. The average flow out of this system for the period from 1860 to date has been about 241,000 second-feet,—the minimum flow being 180,000 second-feet and the average maximum 290,000 second-feet, a ratio better than two to one.

Mention is made of this natural advantage of the St. Lawrence because that river may be developed to produce about 5,000,000 h.p. in the section between Lake Ontario and Montreal,—Canada being entitled to 4,000,000 and the United States to 1,000,000 h.p., but the storage above-mentioned is provided by nature. There is no control of the flow from the lakes, and many studies of further improvements have shown that it would be very costly and even dangerous to interfere with natural conditions.

Reservoirs in Quebec

The writer now comes to the consideration of the storage reservoirs which have been built in the province of Quebec. They may be divided into three classes:

Those built and operated by the Quebec Streams Commission. These reservoirs are listed as follows:—

The Gouin storage and the Manouane system on the St. Maurice river;

Lake St. François and Lake Aylmer on the St. François river;

Three small reservoirs on the North river, north of Montreal;

Lake Kenogami reservoir in the Saguenay district;

Lake Brûlé and River Savane reservoirs in the Ste. Anne de Beaupré river, below the city of Quebec;

Lake Metis reservoir on the Metis river, in the district of Rimouski.

In the second class are the reservoirs built by power companies and operated by the Quebec Streams Commission:

The reservoirs on the Gatineau river, north of the city of Ottawa, namely the *Baskatong and Lake Cabonga*, the *Cedar Rapids reservoir* on river du Lièvre,—a work soon to be completed, and the *Mattawin storage dam* on the Mattawin river, a tributary to the St. Maurice river,—work now under construction.

In the third class are the storage dams built and operated by private companies. They are as follows:

On the Shipshaw river, reservoirs in lake Onatchiway and Pamascachiou, owned by Price Brothers and Company, Ltd., permit the regulation of the flow to about 1,000 second-feet.

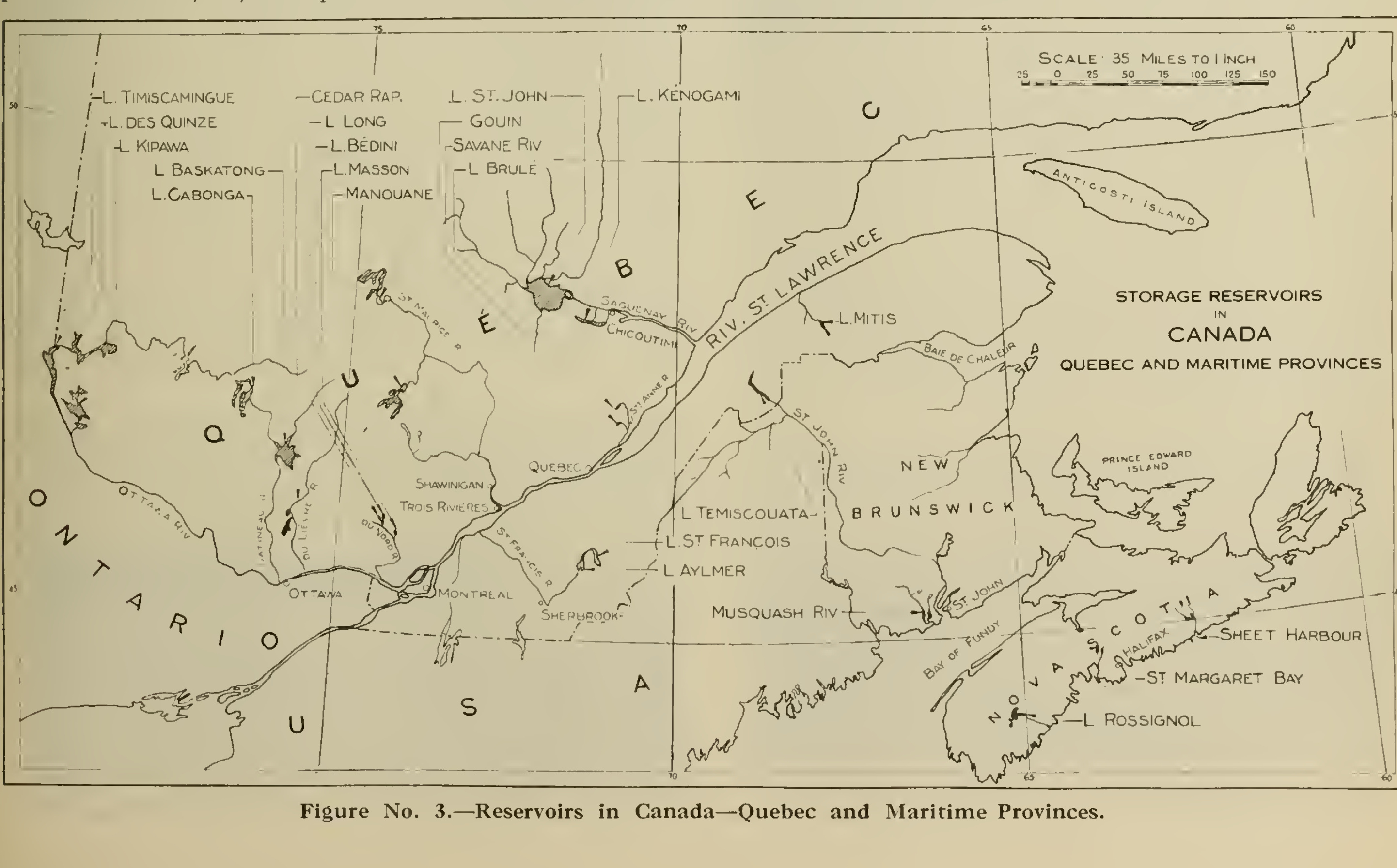

Figure No. 3.—Reservoirs in Canada—Quebec and Maritime Provinces.

Figure No. 4.—Gouin Dam—St. Maurice River—Quebec.

Lake St. John, head of the Saguenay river, is controlled between natural high and low water by a combined power and storage dam at Isle Maligne. The storage capacity is 3,850,000 acre-feet, and the flow of the Saguenay is regulated to 28,000 second-feet.

Three reservoirs on the Jacques-Cartier river, northwest of the city of Quebec, owned and operated by the Donnacona Paper Company.

Combined power and storage dam at the outlet of Lake Memphremagog, west of the city of Sherbrooke, on the Magog river, owned by the Dominion Textile Company, regulating the Magog river to 600 second-feet.

A combined power and storage dam at Megantic, at the outlet of Lake Megantic, at the head of the Chaudiere river, south of the city of Quebec.

Practicability of Reservoirs

The practicability of storage reservoirs in the province of Quebec was demonstrated in 1910 and 1911, through the initiative of the Shawinigan Water and Power Company, by the construction of relatively small reservoirs on the Manouane river, a tributary to the St. Maurice. This company had developed the famous Shawinigan falls on the St. Maurice and soon found that the amount of power it could generate from these falls could be increased very substantially and cheapened by increasing the low water flow. Uncertainty as to the quantity of water which would reach the plant under winter conditions, when let out of reservoirs located more than two hundred miles from the plant, was dissipated by the experiment with the Manouane reservoirs. It was found that the water let out from these dams reached the plant with no appreciable loss. This experiment was followed by attempts to regulate the flow on a much larger scale.

Reservoirs Built by the Quebec Streams Commission

The Quebec government, in 1912, authorized the Quebec Streams Commission to undertake the regulation of the flow of the St. Maurice river. In 1915, the same policy was followed in the case of the St. François river on the south shore of the St. Lawrence, and later extended to the Chicoutimi district with the control of Lake Kenogami; also the St. Anne de Beaupré river, the Metis river in the lower St. Lawrence, and river du Nord, northwest of of Montreal.

On the St. Maurice river, the Gouin dam controls a reservoir that has a capacity of 3,662,000 acre-feet. It is claimed to be the largest artificial reservoir in the world. The discharge of the St. Maurice has been increased from a minimum of 6,000 second-feet to 17,000 second-feet at Shawinigan,—practically three times as much primary power being made available.

On the St. François river, two storage dams were built, forming two reservoirs: Lake St. François with a capacity of 276,500 acre-feet, and Lake Aylmer with a capacity of 64,000 acre-feet. The low water flow of the stream is increased by 900 to 1,200 second-feet.

Lake Kenogami reservoir has a capacity of 312,000 acre-feet and supplies two streams, both highly developed for power, and upon which are located the principal pulp and paper mills of the Saguenay district, in the towns of Chicoutimi, Jonquière and Kenogami.

On the St. Anne de Beaupré river, two relatively small reservoirs have been built and water is supplied to the Laurentian Power Company's plant at Seven falls,—plant operated under a head of 410 feet. These reservoirs have a capacity of 12,000 acre-feet.

On the Metis river, one reservoir is operated to supply water to the Lower St. Lawrence Power Company, operating a power plant at Metis falls,—the minimum flow of the stream being regulated to 350 cubic feet per second. The capacity of the reservoir is 70,400 acre-feet.

On the North river, northwest of Montreal, three small reservoirs are operated by the commission and serve to increase the low water flow of the river which is highly developed for power. Capacity of the reservoirs 17,500 acre-feet.

The Quebec Streams Commission has spent to date in the vicinity of $10,000,000 to build the storage reservoirs above-mentioned. The cost of these reservoirs has been met by the commission with money advanced by the provincial government. All expenditures of the commission are duly accounted for and must be approved by order of the Lieutenant-Governor-in-Council.

Annual Charges

The power companies benefiting from the additional flow provided by the storage dams have to pay for the benefits which they derive. The unit price upon which each benefiting company or individual must pay is the same for all interests on the one stream, but varies considerably as between one stream to another. Each regulation project has to be considered separately when it comes to assessing the benefiting parties. Capital cost is the determining factor. The commission bases its charge on the amount required yearly to meet the interest on the capital invested in a reservoir, the amount required for the amortization of that capital in thirty years, and the cost of operation and maintenance of the works.

On the St. Maurice river for example, the charge agreed upon between the benefiting companies and the commission is equivalent to $3.65 per h.p.-year of the additional power produced with the additional flow.

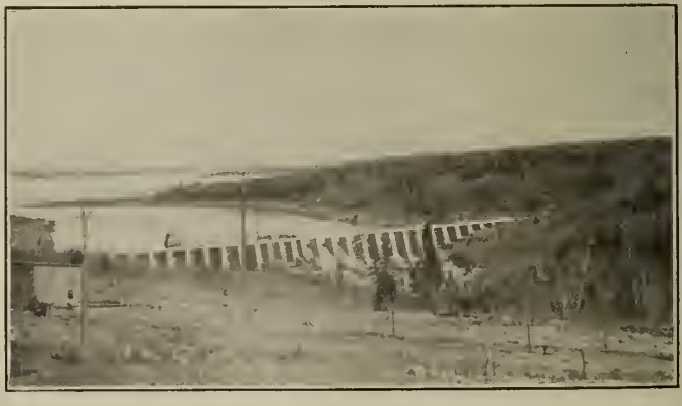

Figure No. 5.—Allard Dam—St. François River—Quebec.

Figure No. 6.—Taschereau Dam—Lake Kenogami Reservoir—Quebec.

On the St. François river, the charge is equivalent to $7.50 per h.p.-year of additional power.

The revenues, which the commission derives from the storage reservoirs it operates, were $751,993.92 in 1928-1929.

Legislation

Whenever, after duly investigating a storage proposition, the commission asked for authority to undertake the regulation of a particular stream, a special act of the legislature was passed for that particular proposal. A separate act of the legislature was passed for each of the streams which the commission has under control. The commission is not authorized by a general law. All these individual acts are practically similar in wording: authority is given to the commission to spend a sum not to exceed an amount mentioned in the act. Plans and specifications of the works must be approved by the Lieutenant-Governor-in-Council. The works must be advertised for tenders and a contract awarded to the lowest tenderer,—provided he can show proper qualifications. The commission is also authorized to acquire properties which may be affected by the proposed works; to build roads which may be required to replace flooded roads, bridges, dykes, telephone lines, etc. The commission is authorized also to negotiate contracts with the benefiting companies, and to impose a tariff in the case of companies refusing to accept the terms of the contract set out by the commission. The contract mutually agreed upon, as well as the tariff determined by the commission, must be approved by Order-in-Council.

Operation of Dams

The commission operates the storage dams to the best advantage of the interests using the water. While criticisms may have been heard in the first years that storage dams were operated, these were due to misconception as to the purpose for which these storage works were built, and their limited possibilities. It is realized from all quarters today, that the storage dams operated in the province of Quebec have reduced very materially the cost of power and have, moreover, assured permanency of power so essential to industry.

It used to be stated as more or less of an axiom that a water power site could be economically developed to use the flow available 60 per cent of the time, or seven months in the year. This meant that for a period of five months every year, a certain number of customers could not be served with power and had to close their plant, or else operate auxiliary steam plants. This condition of affairs was not satisfactory. Modern industry requires permanency in its power supply. It can then budget its production; its business is more stable. The necessity of seasonal employment is materially decreased, if not altogether eliminated. It may be stated here that seasonal unemployment has been one of the difficult problems with which Canada has been faced for years. Permanent mill operation assured by permanent water supply has been a great benefit to the industrial centres of the province of Quebec, more particularly those located around pulp and paper mills. The old saw-mill is practically a thing of the past. It used to operate with a large force during the open season, but was closed altogether during winter. The pulp and paper mill operates twenty-four hours a day, six days per week, all the year round, provided its power supply is not failing. In certain districts, such as the Saguenay, pulp mills were closed every winter,—hundreds of hands being thrown out of work. The Lake Kenogami storage was undertaken with a view to curing the unfortunate situation, and this it has done.

Dams Built by Power Companies and Operated by the Commission

While a number of storage dams have been built by the Quebec Streams Commission, and the capital cost paid by the commission, a certain number of dams have been built at the request of power companies, under the supervision and control of the commission and at the expense of

Figure No. 7.—Mercier Dam—Gatineau River—Quebec.

these companies. In other words, the benefiting companies, instead of having to reimburse the capital cost of the storage works by yearly instalments covering the interest and sinking fund, undertook to pay at once the capital cost. Needless to say that the annual charges of the commission are then limited to the cost of operation and maintenance of the dam, and a fixed amount to cover the privilege of flooding Crown lands when such are affected. This procedure was followed in the case of the Gatineau river where the Gatineau Power Company requested the commission to build the Mercier storage dam, which was completed in the spring of 1927. The reservoir which this dam creates has a capacity of 2,132,500 acre-feet, and permits the regulation of the flow of the Gatineau river to 9,000 second-feet,—this being three times the average low water flow of the river.

In 1929, storage dams were built to control the water from Lake Cabonga, a tributary to the Baskatong reservoir. This reservoir has a capacity of 1,033,000 acre-feet, and is intended to assure adequate supply of water for a regulation of the Gatineau to 10,000 second-feet during the lowest years.

The Gatineau river was unimproved until 1925. In that year, the possibility of increasing the low water flow of the stream had been proved, and a large scheme of power development was planned.

The falls and rapids of the Gatineau have been concentrated at a few points where water is used to generate power, namely: at Farmer's rapids under a head of 67 feet; Chelsea, under a head of 96 feet and at Paugan falls, under a head of 140 feet,—the three ponds covering a distance of about sixty miles in the river.

The three power plants above-mentioned have a capacity of 120,000, 170,000 and 272,000 h.p. respectively,—a total of 562,000 h.p. This improvement would not be possible without the regulation of the flow of the stream. The cost of the dams, the unwatering of the site, etc., would be prohibitive if the amount of power were about one-third of the present installed capacity.

A similar method is followed for the regulation of the flow of the Lièvre river, where the MacLaren Company has operated for years a saw mill and a pulp mill at Buckingham. This company has under construction a paper mill at Buckingham Junction, near the mouth of the River du Lièvre. For the operation of that paper mill, power will be generated on the Lièvre, mostly at High falls. In order to increase the low water flow of the stream, a storage dam is being built at Cedar rapids, about sixty miles from the mouth of the river. This storage dam is built by the company, according to plans approved by the commission and under the direction of the commission. The dam will be operated by the commission and will be its property.

The capacity of the reservoir will be 500,000 acre-feet, and will be sufficient to regulate the flow of the Lièvre river to 3,400 second-feet.

Benefiting Third Parties to Pay Share of Cost

Any person, or company, other than the company at whose expense the dam is built, which will benefit from this dam, will be called upon to pay its proportionate share of the interest and sinking fund of the capital expenditure, as well as its share of the cost of operation of the work. All amounts collected under the interest and sinking fund charges will be refunded to the company having paid the capital expenditure, and the obligations of the latter respecting the cost of operation and maintenance will be reduced to the extent of the amount collected from the third party under this item.

General Law Governing Construction of Storage Reservoirs

Prior to 1918, there was no law governing the construction of dams in the province of Quebec. No plans of these structures had to be filed with the provincial government, and it seems that in the case of most log driving dams, no plans were made at all. While investigating the control of the flow of rivers, it soon became evident that the provincial authorities should know the type, the location, the ownership of the dams then in existence, and that all future structures be approved by Order-in-Council before the work of constructed may be proceeded with.

In 1918, an act of the legislature (R. S. Quebec 1925, Chapter 46) was passed making it obligatory for owners of all dams in the province to file a plan for the dams then existing, and stipulating that all future structures may be built only after plans of such structures have been submitted to the Department of Lands and Forests, and approved by Order-in-Council. In this way, a reliable record is kept of the structures built; the area of public lands or private lands affected; conditions upon which the public land may be used,—either for flooding or otherwise. Many structures have been built under the provision of this law,—some simply to facilitate the driving of logs, others to increase the power possibilities of the streams. In this latter category are the dams which Price Brothers and Company have built on the Shipshaw river, Saguenay district; the dam built by Donnacona Paper Company on the Jacques-Cartier river. These structures are approved upon terms determined by the Department of Lands and Forests. Provision is made for compensation for flooded Crown lands; for benefits to other parties, if any; for royalty on the amount of additional power produced, etc.

Storage reservoirs become economical only when the water may be used under a certain minimum of head. On the St. François river for example, the stored water is used under an aggregate head of 240 feet through the different power plants. Under, say 100 feet of head, the storage proposition would not be economical.

On the St. Maurice river, the stored water is used under an aggregate head of 285 feet. Though this proposition was relatively cheap, owing to no improved land having to be expropriated, the proposal would not be practical if the head used were less than 100 feet.

Many a storage proposition had been investigated by the Quebec Streams Commission and will become practicable only when the improvements of these streams for power may be undertaken on a certain scale.

When a river has its flow regulated by storage, the power possibilities of that stream soon become developed to their maximum and the cost of the power is reduced to its possible minimum.

Control of the Reservoirs

The control of the reservoirs owned by the Quebec Streams Commission forms a branch of the commission's activities which increases yearly in importance. In order to use the available amount of water to the best advantage of all power owners and prevent waste, the organization must keep in daily touch with the operators at the dams and observers at different points along the stream, so that conditions are known exactly. The opening of the gates is directed from the head office in Montreal and no initiative is left to the operators, except in case of emergency when water rises suddenly for example.

The amount of discharge is checked in two ways. A determination is made by using discharge formula applicable to the shape of openings through which water is discharged and by metering the stream.

In tunnel openings, the formula used is

$Q = AV = AC\sqrt{2gH}$.

Q = discharge in cubic feet per second.

A = area of opening in square feet.

V = velocity in feet per second.

H = is the vertical distance between the centre of the openings and water level in the reservoir.

C = a coefficient that depends on the size and shape of openings.

A series of meterings made in the river below the Gouin dam, St. Maurice river, has shown that the value of C in the above formula varies from 0.65 for small openings to 0.96,—the openings being 7½ feet wide and 12 feet high.

For spillway gates, discharging freely over an ogee sill, we use for the formula:

$Q = CLH^{3/2}$.

Q = discharge in cubic feet per second.

L = clear width of opening.

H = height of water surface of reservoir above gate sill.

C = 3.2 for low heads to 3.8 for high heads.

For discharge over stop-logs, C is taken as 3.0 for one foot head and gradually increased to 3.7 for head of ten feet.

Stop-logs are not easily operated in more than ten feet of water.

When a certain amount of water has to be discharged, it is necessary to determine by formulae the size of openings required under conditions of water levels then prevailing. After these openings have been made and the river is adjusted to the new conditions, use is made of the gauge discharge relation as indicated by the meterings, and the openings sometimes have to be corrected.

Winter Conditions

An ice cover forms on these reservoirs under average conditions in November for shallow lakes, and in December for the large and deep lakes. The temperature of the water is 32° F. near the ice cover, but its temperature rises at greater depth: 32.5 to 32.7 at a depth of the order of 50 feet.

It follows that the water discharged during winter from the bottom gates is at a temperature above freezing and no ice cover forms below the storage dam until the water has cooled to 32° F. In the case of the Gouin dam, where water is discharged at the rate of 10,000 to 13,000 second-feet during the winter months, no ice cover forms for many miles and in the next 30 miles the ice is not safe to travel upon.

Same conditions prevail on the Gatineau river, for 30 miles below the storage dam.

All dams have been built to resist ice pressure. The Gouin dam has been built to resist an ice pressure of 50,000 pounds per lineal foot of dam, taking effect under full reservoir. This condition seems to have been too severe and structures subsequently built are calculated to resist an ice pressure of 20,000 pounds per lineal foot.

As a matter of fact, the ice cover does not form opposite the gate section of the dam whenever a gate is opened.

Reservoirs Paid by Benefiting Companies

It is to be noted that the revenues derived directly from the benefiting companies are sufficient to pay the interest on the capital cost, the sinking fund in thirty years, the cost of operation and maintenance of the structures. These works are altogether self-sustaining and do not involve any cost to the tax payers.

The indirect benefits which the province receives from the increased activities brought about by more dependable and cheaper power cannot be valued in dollars and cents, but are reflected in the general prosperity which results from a better use of a most important natural resource: falling water.

Fuel Investigations and Research in Canada

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Paper presented before the Second World Power Conference, Berlin, Germany, June 16-25, 1930.

Introduction

Organized effort to conduct fuel investigations and research in Canada began to assume definite form in 1908, when a comprehensive investigation of the coals of Canada was undertaken by the then newly created Department of Mines, in co-operation with Dr. Porter and others of McGill University.[1] Concurrently, the Mines Branch of that department established as a part of its organization a Fuels and Fuel Testing Division, which began to conduct special investigations such as boiler and producer gas tests, as well as chemical and physical examinations of fuels. For some years this was the only permanent organization in Canada which conducted fuel investigations and research.[2]

In 1916 a special investigation was undertaken, under the auspices of a special committee representing the joint interests of the Federal Government and the government of the province of Ontario, which had as its objective the development of an economic process for converting raw peat—of which the resources of Canada are very great—into a marketable fuel;[3] and in 1918, a board known as the Lignite Utilization Board, the membership of which was representative of the Federal Government and the governments of the provinces of Manitoba and Saskatchewan, was appointed for the purpose of developing a commercial process for converting Saskatchewan lignites, by low temperature carbonization and briquetting, into a fuel which it was hoped could compete on the open market with imported and other domestic fuels.[4] These two investigations were carried on more or less continuously for a period of about five years. In 1922 the Dominion Fuel Board [5] was created, which had as its objective the study of the fuel problems in Canada from a purely economic point of view. However, this board was responsible for various investigations, the chief one of which related to the utilization of coke as a household fuel to replace American anthracite, which was at that time the principal and practically sole fuel used for domestic purposes. While this was largely an economic problem, a considerable amount of investigational work was conducted on various Canadian coals, in order to determine their value for the manufacture of a domestic coke. When the Scientific and Industrial

(1) Results of this investigation are embodied in 7 volumes, entitled "Investigation of the Coals of Canada"—published in 1912.

(2) Results of these investigations are contained in the annual Summary Reports of the Mines Branch and in separate pamphlets.

(3) Results of the investigations conducted by this committee are contained in "The Final Report of the Peat Committee," published by the Mines Branch in 1926.

(4) The results of this investigation are embodied in the "First General Report of the Lignite Utilization Board" published in 1924.

(5) Results of the work done by this Board are contained in the "Interim Report of the Dominion Fuel Board," 1923, and the "Second Progress Report," 1923-1928.

Figure No. 1—Front and Side View of Laboratory Building.

Research Council of Alberta was created in January, 1924, a research organization was set up in the University of Alberta, to carry on fuel research and other investigations, with particular reference to the province of Alberta; and the Nova Scotia Technical College at Halifax, which is supported by the government of the province of Nova Scotia, has been engaged in later years on special fuel problems bearing on the mining and utilization of Nova Scotia coals. These constitute the principal organizations for carrying out fuel investigations and research, in Canada.

On account of the sparsity with which certain sections of the Dominion of Canada are populated, and the great distances separating the coal areas from industrial and more thickly populated centres, the various fuels required for industrial, commercial and domestic uses, are derived very largely from foreign sources—principally the United States. The imported fuels comprise: anthracite and coke for domestic purposes; bituminous coal for railway and industrial purposes; and crude oils for refining into motor spirits, lubricating oils and other products. When practically all classes of fuel could be obtained in great abundance, and at reasonably low cost, the peoples of the Dominion of Canada were not concerned with fuel problems or fuel research. It was only when a fuel shortage was threatened, and actually became a fact, that sufficient interest was aroused to create the necessary degree of enthusiasm for such investigations and research as would stimulate the use of native fuels. However, as stated above, owing to the location of the fuel resources—solid, liquid and gaseous—selection of the problems for investigation and research is influenced largely by economic considerations, such as freight rates, cost of mining, etc. Canada is not so favourably situated as some of the highly industrialized countries possessing large fuel resources, in regard to chemical and other industries which are dependent on solid fuels and their products, and on gaseous fuels, both natural and manufactured, consequently, a process or method for treating solid or other fuels, which might prove entirely commercial and profitable in European countries, for example, or in the United States, might prove to be entirely uneconomic when employed under conditions obtaining in Canada.

Outline of Investigations Conducted in Fuel Research Laboratories

The Fuel Research Laboratories of the Department of Mines are especially concerned with investigations which it appears would have an immediate commercial application, and while what is termed pure or academic research, is conducted, and on an increasing scale, an attempt is made to only carry on such research as will have a bearing on pressing economic problems. The principal investigations which have been conducted during the past few years pertain to:

(1) Chemical and physical survey of coal seams *in situ*.
(2) Investigation of problems concerning preparation of coals for markets.
(3) Testing of coals, on both small and large scales, with a view to improving the efficiency with which they can be utilized for various purposes, and to ascertain how their field of application can be extended.

The results of such investigative work afford a basis for the preparation of a 'use classification' of Canadian fuels. The large scale tests involved in these investigations include coal cleaning experiments and testing, according to various methods in use commercially, before and after cleaning, for (1) pulverized fuel burning, (2) high temperature carbonization, (3) low temperature carbonization, (4) domestic use, (5) briquetting and (6) determination of the value of gas and oils recovered in the course of carbonization, for the generation of power in internal combustion engines of different types, and for other purposes.

One of the functions of the Fuel Research Laboratories is to obtain as complete information as possible regarding commercial processes for the treatment of solid and other fuels, which are in the laboratory or semi-commercial stages of development, and also processes which are in successful commercial operation. These laboratories are also available for carrying out research on special problems with which coal operators and large consumers of coal are confronted. Such investigations and research will be conducted in co-operation with the parties specially interested.

At present the Fuel Research Laboratories are engaged in making a survey of the coking bituminous coals of Canada, and studying methods for improving the quality of coke by blending with other coals or by altering the methods employed for heat treatment, and in other ways improving the physical properties of the coke and raw coal. In this connection special mention may be made of full size by-product oven coking tests made in 1924 on coals from the Maritime provinces, and of special coking tests on bituminous coals from western Canada made in commercial by-product ovens at Winnipeg, the results of which showed that there is to be found in abundance in Canada coals quite suitable for the production of metallurgical and domestic coke.[6]

While low temperature carbonization was not looked upon by members of the staff of the Fuel Research Laboratories with much favour in past years, recent tests carried out on Nova Scotia coal, according to a well known low temperature carbonization process, have shown that a rather extensive field exists in certain portions of Canada for the introduction of some such process, inasmuch as a bituminous coal which is more or less unsuitable for the manufacture of a high temperature coke, when the objective is a domestic fuel, is an excellent fuel when submitted to the right low temperature treatment. While the laboratories are interested and are engaged on research work which has as its objective the conversion of solid fuels into liquid fuels, and the conversion of gases—both natural and manufactured—into fuels and other compounds, it must be borne in mind that the introduction of a process, even though technically feasible, would have a small chance of meeting with economic success at the present time when crude oil and its products can be obtained in great abundance, and at comparatively low cost. This state of affairs, of course, may change at any time, and in a few years a process which is now uneconomic may then be entirely economic and feasible.

[6] See Investigations of Fuels and Fuel Testing, 1924 and 1927.

Figure No. 2.—Large Scale Testing Floor showing Pulverized Fuel Boiler Installation.

Economic Utilization

So far as the Fuel Research Laboratories of the Department of Mines are concerned, its objective is not to conserve natural fuel resources—when conservation is used in the term 'to save'—but first of all to show how wastefulness in their utilization can be decreased or eliminated, and more especially to indicate means and ways for their more extensive development and use along economic lines. Conservation, of course, does not imply that a natural resource should be kept intact for some future generation, but that natural resources should be conserved for the best and most useful purpose, by utilizing them in such a manner that the products obtained from them can serve the largest number of purposes; and that only that portion of a fuel which is not suitable or cannot be used for more valuable purposes, be used for the generation of heat for steam raising, or for other purposes where heat is required. But the natural resources of any country will not be developed unless their development and utilization prove profitable, and the utilization of certain of the fuel deposits in Canada at the present time may not prove profitable if the fuel is used only for the generation of heat, consequently, fuel research must be conducted in order to ascertain whether other uses exist or can be found for such fuels: for example, oil is being used extensively on the British Columbia coast and by the railways traversing the Rocky mountains, in place of coal. The displacement of coal by oil has, therefore, placed a heavy burden on the coal operators who formerly supplied the coal for such purposes. The Fuel Research Laboratories are at present engaged in the conducting of large scale tests, accompanied by other investigations, on representative commercial samples of coal from the various collieries in British Columbia for the purpose of ascertaining their value as fuel for use in steam raising when burned in the pulverized form, and how the standard equipment available should be changed in order to adapt it to such use. The successful substitution of oil by powdered coal, both in stationary plants, where fuel oil is now burned, and perhaps on the railways and ocean-going steamships which are at present burning oil, would not only be of great assistance to colliery operators in western Canada, but would also reduce very appreciably importations of fuels in the liquid form from foreign sources—a phase, of course, which everyone must view as temporary.

Work of Other Fuel Research Organizations in Canada

As previously stated, fuel research is conducted by other organizations in Canada, e. g. the research staff of the Scientific and Industrial Research Council of Alberta.[7] This organization is conducting detailed laboratory work on the coals of Alberta, with a view to their scientific classification and suitability for various uses. During recent years the fuel investigations in Alberta have included a study of the general characteristics of the different coals as mined; special screening, weathering and storage tests; a study of the amenability to briquetting in the raw state; special laboratory carbonization and coking experiments; and tests in different types of domestic heating systems.

Valuable work has also been conducted on the tar sand deposits of Alberta with a view to developing a process for the economic separation of the bitumen content from the sand. Such a process would prove of great value and would make possible in the near future development of these immense deposits on a large scale. The raw bitumen thus separated has been and is being investigated by the Fuel Research Laboratories at Ottawa, especially in the direction of its utilization as a source of motor spirits, fuel oils, and other petroleum products, by high pressure and temperature cracking, with and without hydrogenation. In passing, it might be mentioned that the results of this work have confirmed that by the employment of high pressure and temperature cracking a large yield of motor spirits can be obtained from the bitumen content, and that the tar deposits as a whole would prove an almost inexhaustible source of motor spirits and other oil products, so far as Canada is concerned. A large amount of research has also been carried on by the Mines Branch, Department of Mines—as well as by the Industrial Research Council of Alberta—in connection with the utilization of both the raw tar sands and the bitumen content by itself, first, in the building of roads, and secondly, as a road oil. This work is still progressing.

A separate organization known as the "Turner Valley Gas Committee" was recently appointed to investigate means and ways of conserving the enormous quantity of natural gas which at present is surplus gas in the Turner Valley oil field, situated 40 miles south of Calgary, Alberta. The objective of the investigation being carried on by this committee is to determine the feasibility of piping long distances to industrial centres, and whether or not any of

(7) Investigations conducted by this organization are embodied in reports entitled "Annual Report of the Scientific and Industrial Research Council of Alberta."

Figure No. 3.—View of By-product Coke Oven Installation at Rear of Fuel Research Laboratories.

the processes for utilizing natural gas for the manufacture of motor spirits, chemicals, lampblack, or other substances, are economically feasible.

Investigative work is being carried out at the Nova Scotia Technical College on Nova Scotia coals,[8] to determine the most efficient grate setting for burning the various kinds of Nova Scotia coals under boilers for steam raising. The main objective of the tests involved is to indicate how existing small boiler installations can be easily and inexpensively altered to burn Nova Scotia coals more efficiently. Tests are also being carried out in a domestic hot water heater to ascertain how bituminous coals, coke, etc. should be burned in order to eliminate smoke, and to determine the efficiencies with which such coals can be burned. The weathering properties of slack coal when banked for winter storage and tests on commercial powdered fuel boiler plants have been and are being carried out.

Special work has been conducted at the Nova Scotia Technical College on the oil shales of Nova Scotia. This work is complementary to that conducted by the Federal Department of Mines on oil shales from other parts of the Dominion but mainly on the oil shales of the province of New Brunswick. The Federal Department developed a suitable laboratory retorting method and examined a large number of representative samples of oil shales. This work included a special study of the nature of the shale oil with a view to ascertaining its suitability for refining by high pressure cracking.

At present, the attention of the Department is directed to the examination of the oil shale resources of the Dominion with a view to their economic exploitation. In conjunction with this work research is being conducted on the conversion of solid fuels into liquid fuels and the manufacture of synthetic liquid fuels from gases—both natural and manufactured. Investigations related to the manufacture of motor spirits and other liquid fuels, according to pressure temperature cracking and other oil refining processes, will be extended. Oils resulting from the distillation of solid fuels at low temperatures, and the bitumen obtained from the tar sands of Alberta, will in the near future be subjected to detailed investigation and research.

Laboratory Facilities at Ottawa

The facilities of the Fuel Research Laboratories provide:

(a) Fully equipped chemical laboratories for routine analyses of all kinds of fuels—solid, liquid, and gaseous.
(b) Carbonization and research laboratory for research and plant control.
(c) Research laboratories for research on oils and gases—both natural and manufactured.
(d) Domestic furnace testing installation.
(e) Commercial size pulverized fuel boiler installation.
(f) Coal washing equipment, composed of wet and dry coal cleaning plants.
(g) Commercial scale by-product recovery coke oven with all accessories.
(h) Full size commercial scale briquetting installation.
(i) Gas producers.
(j) Internal combustion engines for testing the value of various oils obtained through the process of heat treating coals, oil shales, etc., for the production of power.

A large space is also provided for the erection of low temperature carbonization and other retorts for treating solid fuels and oil shales.

The Fuel Research Laboratories at Ottawa provide facilities for conducting investigations and research on, first, a small laboratory scale; second, a large laboratory scale; and third, a technical or semi-commercial scale. As an illustration, the investigational programme of the carbonization of solid fuels at high and low temperatures may be given. First, the coal in the seam is studied, and fundamental testing and research is conducted on a small scale on a large number of samples. This involves research on methods for examining the coal for its carbonization amenabilities and its classification as to coking properties, etc. For this investigation special tests on 20 (g.) samples are employed, according to high and low temperature carbonization practice. Then, on a select number of coals, tests are conducted on scales from 5 to 100 pounds, to indicate commercial yields of products, with special reference to the tar oils. This scale includes large scale laboratory tests, to secure sufficient tar oils for studying their refining properties, and also box coking tests for quality of coke to be expected in commercial practice. The results obtained in the small and large scale laboratory tests are subsequently checked, using a further selected number of coals on a technical or semi-commercial scale, either in semi-commercial high and low temperature carbonization installations at Ottawa or in commercial plants.

Supplementing the investigations on the different scales as outlined above, a limited amount of fundamental research of an academic nature is conducted on the raw fuels and the products therefrom, in co-operation with different Canadian universities. This is accomplished by certain members of a university staff interested in fuel research who spend their summer (vacation) time on special problems at the Fuel Research Laboratories, and on their return to their duties at the university, assign to undergraduates and graduate students, special small problems in fuel research, for thesis purposes.

The problems met with in Canada are in many respects dissimilar to those which are common to other countries. As stated previously, these laboratories are concerned chiefly with industrial research which has as the main objective the testing and investigation of processes developed on a technical, and those which have been successfully applied on a commercial scale in other countries, which it would appear could be applied to advantage in Canada. Pure research of an academic nature, while of immense value both to the present and future generations, requires more extensive and elaborate facilities and a much larger staff of specially trained men than contemplated by the Fuel Research Laboratories, and is not particularly the class of research which can be profitably carried out by a staff of engineers—chemical, mechanical, and mining, whose main objective is the application of science and engineering to industries in general; and while considerable pure research is being conducted in these laboratories, the staff depends very largely for its guidance on the academic research work on fuels conducted in the laboratories of other countries.

[8] The reports of the Nova Scotia Technical College are contained in the Annual Report of the Nova Scotia Department of Mines.

Institute Committees for 1930

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Zone C (French)	Geo. R. MacLeod B. Grandmont O. O. Lefebvre
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VOLUME XIII JULY 1930 No. 7

Amendments to the By-laws, 1930

At the meeting of Council held on May 30th, the scrutineers presented their report on the result of the ballot for the amendments to the By-laws, which closed on May 12th, 1930. The proposals to amend Sections 13 and 37 carried; those for Sections 34 and 75 were lost.

As a result the minimum term of office for councillors will become two years instead of one as at present, and the date after which a member whose annual fee is unpaid is considered in arrears will be June 30th instead of March 31st, also interest on overdue accounts will not be charged after June 1st, 1930.

In the case of Section 34 the necessary number of affirmative votes, namely two-thirds of all valid ballots, was not reached, four additional favourable votes being required for the amendment to carry.

The urgently needed additional revenue from members' fees will, therefore, not be available during 1931, and Council will no doubt have to consider what steps are necessary in order to make The Institute's expenditure balance its income.

The changes in Sections 13 and 37 will now be put in effect in accordance with the By-laws, and correction slips for insertion in members' copies of the By-laws will be issued as soon as possible.

Past-Presidents' Prize

Announcement is made by the Council of The Institute that the subject selected for papers to be submitted in competition for the Past-Presidents' Prize for the coming prize year (July 1st, 1930 to June 30th, 1931) will be

"ENGINEERING EDUCATION IN CANADA"

Two years ago the subject of "Engineering Education" was prescribed for the prize and seven papers were submitted. At the last Annual Meeting the Committee on the award of this prize reported that while several of the papers were of a high order, it was unable to recommend any one of them for the prize.

It is hoped that the papers in this competition will offer ideas and suggestions, both critical and constructive, which will be of value to Canadian universities and engineering schools, and which will also stimulate interest in the subject among practising engineers and employers of engineers. It is with this idea that the subject has again been chosen, and the following notes have been prepared by a committee of Council to suggest the treatment desired. It is not essential, however, that the arrangement of the papers should conform rigidly to that outlined below:—

(1) Curricula of Applied Science Faculties and Engineering Departments of Canadian Universities.

Pre-requisite admission standards; allocation of time between lecture and laboratory or workshop periods; tendency toward or away from specialization during regular four-year undergraduate course; recognition and guidance of special tendencies and abilities as revealed during the undergraduate course; place of cultural studies as distinguished from more strictly scientific and practical training; need and opportunities for intellectual and moral inspiration deriving from personal contacts with teaching staff; influence of organized recreation and participation in general college activities outside the class-room.

(2) The need and opportunity for organized collaboration by practising engineers and corporate or municipal bodies employing engineers, in the practical training of undergraduates during vacation periods and of young graduates in the early years following graduation.

The Institute and Specialized Branches of Engineering

It is a commonplace to say that the increasing complexity of modern life leads to greater specialization in the industries and professions. This in turn gives rise to many problems connected with professional education, training, and practice, for in many cases it is no longer possible for a professional man to cover the whole field of even the one division which he has chosen. For example, though all lawyers and medical men must have had the prescribed general professional training, a great number are dealing in their daily work only with some one sub-division of law or medicine.

Engineering is affected in a similar manner, and an important problem to be solved in carrying on the work of a Dominion-wide organization like The Engineering Institute of Canada, is how best to aid those of our members who have specialized in this way. They naturally desire the latest and most authoritative data in their particular branches of work, and wish to be in touch more particularly with their fellow-specialists for discussion of the problems in which they are mutually interested.

In the case of radio and aeronautical engineering, which hardly existed when The Institute took its present shape, the need is perhaps the greatest. The Council of The Institute has been considering this question for some time, and the progress made so far is summarized in an announcement published in a recent number of the E-I-C News*. Discussions are now pending, which, if brought to a successful conclusion, will mark a new feature of The Institute's work and its relations with other national engineering societies. The object desired is the further development of professional sections of our branches, and their co-operation with Canadian, British or American technical organizations dealing with specialized branches of engineering.

It is expected that the report of the committee which Council recently appointed to study this question will be presented at the Plenary Meeting of Council to be held in September next, and its proposals will be awaited with great interest.

Meeting of Council

A meeting of Council was held at eight o'clock p.m., on Friday, May 30th, 1930, with President A. J. Grant, M.E.I.C., in the chair, and five other members of Council present.

The minutes of the meeting held on May 6th, 1930, were taken as read and confirmed.

The Secretary presented a report submitted by the Executive Committee of the Ottawa Branch regarding the future policy of The Institute in connection with aeronautical and radio engineering. Group-Captain E. W. Stedman, M.E.I.C., and Major W. A. Steel, A.M.E.I.C., who were in attendance at the request of Council, gave a full explanation of the suggestions contained in the report, which involved the systematic development of professional sections of The Institute's branches, particularly in connection with aeronautical and radio engineering, and the co-ordination of their activities. It was suggested that space should be allocated regularly in the Journal to the proceedings of these specialized sections, and that negotiations should be carried on with other engineering societies specializing in these branches of engineering with a view of such co-operation as might be found possible.

Council gave this proposal sympathetic consideration, and after considerable discussion a committee was appointed under the chairmanship of Mr. J. A. McCrory, M.E.I.C., to consider the matter in detail and to bring in a report to the Plenary Meeting of Council to be held on September 22nd, 1930. The Secretary was directed to publish an announcement that this question was receiving consideration by Council.

The membership of the Gzowski Medal Committee for the year 1930 was approved as follows:

W. C. Adams, M.E.I.C., Chairman.
A. Duperron, M.E.I.C.
P. S. Gregory, M.E.I.C.
O. O. Lefebvre, M.E.I.C.
C. M. McKergow, M.E.I.C.

In order to avoid the possibility of conflict with other meetings it was decided that the Annual General Meeting of The Institute, called for January 22nd, 1931, should be adjourned to February 5th, 1931, instead of January 29th, 1931, as previously decided.

The report of the scrutineers was presented on the ballot for the amendments to the By-laws, and the amendments proposed to Sections 13 and 37 were declared to be carried, while those to Sections 34 and 75 were lost.

The membership of the Plummer Medal Committee for the year 1930 was approved as follows:

J. R. Donald, M.E.I.C., Chairman.
W. H. DeBlois, M.E.I.C.
W. G. H. Cam, M.E.I.C.
G. P. Cole, M.E.I.C.
N. P. Dalziel, M.E.I.C.

The membership of the Past-Presidents' Prize Committee for the year 1930 was approved as follows:

C. M. McKergow, M.E.I.C., Chairman.
F. A. Combe, M.E.I.C.
E. P. Fetherstonhaugh, M.E.I.C.
T. R. Loudon, M.E.I.C.
J. B. Porter, M.E.I.C.

The report of the Board of Examiners was presented regarding the examinations held in May 1930, and stated that out of ten candidates for admission as Associate Member, Junior or Student, six were successful in passing, while four failed.

A letter from the Executive Committee of the Winnipeg Branch was presented, transmitting a report of a committee of that Branch with respect to the recent Report of The Royal Commission on Technical and Professional Services. The Winnipeg Branch drew attention to the status of certain junior and assistant engineers contemplated in the grading recommended in the Commission's Report, and suggested that the Council of The Institute should take action in the matter. The Council, while in sympathy with the desire of the Branch that adequate treatment should be accorded to all the members of the Civil Service, directed the Secretary to point out that Council can see no practicable way of giving effect to the Branch recommendation.

Nine resignations were accepted, three reinstatements were effected, and a number of special cases were considered.

A number of application for admission and for transfer were considered, and the following elections and transfers were effected:

Elections		Transfers	
Associate Members	4	Assoc. Member to Member	1
Juniors	3	Junior to Member	1
Affiliate	1	Junior to Assoc. Member	12
Students admitted	9	Junior to Affiliate	1
		Student to Assoc. Member	12
		Student to Junior	3

The Council rose at twelve fifty-five a.m.

Recent Graduates in Engineering

In addition to the list of Juniors and Students of The Institute who have recently completed their course at the various universities, as published in the June issue of the Journal, congratulations are also in order to the following, results of which examinations were received too late for publishing with the list last month:—

McGill University

Honours, Medals and Prizes

Benard, Frederick, Mixcoac D.F., Mexico.—B.Sc., (El.); Honours in Electrical Engineering; Montreal Light, Heat and Power, Consolidated's First Prize.

Berenstein, Leslie, Montreal, Que.—B.Sc., (Ci.); Honours in Civil Engineering.

Cooper, Lawrence O'Toole, Schumacher, Ont.—B.Sc., (Me.); British Association Medal; Undergraduates' Society Second Prize for Summer Essay; Honours in Mechanical Engineering.

Francis, John Barten, Westmount, Que.—B.Sc., (El.); Montreal Light, Heat and Power Consolidated's Second Prize; Jenkins Bros. Limited Scholarship.

Haines, Julius Holmes, Montreal, Que.—B.Sc., (Ci.); Departmental Prize for Summer Essay.

Matheson, John Hegan Parks, New Glasgow, N.S.—B.Sc., (Chem.); Honours in Chemical Engineering.

Mellor, John Harold, Richelieu, Que.—B.Sc., (Mech.); Babcock and Wilcox Limited Scholarship.

Skelton, Cecil Hastings, Westmount, Que.—B.Sc., (Me.); Crosby Steam Gauge and Valve Company's Prize for Summer Essay.

*Vol. 3, No. 20, June 26th, 1930.

Thomas, William Frank, Montreal, Que.—B.Sc., (Mi.); Sir William Dawson Research Fellowship in Mining Engineering.
Yeomans, Richard Henry, Montreal, Que.—B.Sc., (El.); Undergraduates' Society's First Prize for Summer Essay.

Degree of B.Sc.

Berger, Bernard Avrom, B.Sc., (Me.), Outremont, Que.
Blanchet, Paul Maurice, B.Sc., (Ci.), Rothesay, N.B.
Boissonnault, Bertrand Octave, B.Sc., (Chem.), Outremont, Que.
Bowles, William Shedden, B.Sc., (Ci.), Westmount, Que.
Butler, Howard Claude, B.Sc., (Me.), Ottawa, Ont.
Calder, Frank, B.Sc., (Ci.), Montreal, Que.
Cosser, Walter Geoffrey, B.Sc., (Me.), Schumacher, Ont.
Dixon, Meredith F., B.Sc., (Me.), Montreal, Que.
Evans, Delano Ernest, B.Sc., (Ci.), Montreal, Que.
Fraser, Norman Innes, B.Sc., (Ci.), Kingston, Ont.
Hartney, James Rowan, B.Sc., (Me.), Regina, Sask.
Hutchinson, Walter John Basil, B.Sc., (El.), St. Vincent, B.W.I.
Jehu, Llewellyn, B.Sc., (Ci.), Lachine, Que.
Klein, Herman, B.Sc., (El.), Montreal, Que.
Koehler, Julius Wilbur, B.Sc., (El.), Swift Current, Sask.
Laing, Addison K., B.Sc., (Ci.), Hamilton, Ont.
Leverin, Harold Leicester, B.Sc., (Ci.), Ottawa, Ont.
McCabe, Russell Irving, B.Sc., (Me.), St. Johns, Que.
Magor, Philip Douglas, B.Sc., (El.), Westmount, Que.
Morrison, Thomas Jack, B.Sc., (Me.), Westmount, Que.
Nation, Frederick Spencer, B.Sc., (Ci.), Toronto, Ont.
Ogilvy, James Angus, B.Sc., (Mi.), Montreal, Que.
Rodger, Norman Elliott, B.Sc., (Ci.), Amherst, N.S.
Southam, William Watson, B.Sc., (El.), Hamilton, Ont.
Tait, Gordon Ewing, B.Sc., (Me.), Westmount, Que.
Timm, Charles Ritchie, B.Sc., (El.), Westmount, Que.
Wallace, Keith Bell, B.Sc., (Me.), Montreal, Que.
Wheatley, Eric Edmund, B.Sc., (Me.), Westmount, Que.

Degree of M.Sc.

Hardy, Robert McDonald, M.Sc., Winnipeg, Man.

University of Toronto

Degree of B.A.Sc. (with honours)

Fisher, Charles Boddy, B.A.Sc., (El.), Montreal, Que.
Morgan, James Clarence, B.A.Sc., (Chem.), Toronto, Ont.

University of Manitoba

Medals

Emerson, Robert Alton, Winnipeg, Man.—B.Sc., (Ci.); University Gold Medal; Joseph Doupe Gold Medal.
Woodhall, Thomas Latimer, Winnipeg, Man.—B.Sc., (El.), University Gold Medal.

Degree of B.Sc.

Bereskin, Abraham Isaac, B.Sc., (Ci.), Ottawa, Ont.
Cohen, Herman Mordecai, B.Sc., (El.), Winnipeg, Man.
Dempsey, Frank Craig, B.Sc., (Ci.), Carberry, Man.
Ferrier, Fred Clifford, B.Sc., (El.).
Ford, Albert, B.Sc., (Ci.), Winnipeg, Man.
Henderson, Robert Pritchard, B.Sc., (Ci.), Winnipeg, Man.
Hurst, William Donald, B.Sc., (Ci.), Winnipeg, Man.
Klempner, Harold, B.Sc., (Ci.), Winnipeg, Man.
Levin, Max, B.Sc., (Ci.), Winnipeg, Man.
Macdonald, Ernest Gordon, B.Sc., (Ci.), Winnipeg, Man.
McCalpin, Lloyd Alexander, B.Sc., (El.), Winnipeg, Man.
McCormick, Archibald Thomas, B.Sc., (El.), Winnipeg, Man.
McEachern, Sinclair, B.Sc., (Ci.), Winnipeg, Man.
Oddlafson, Edward William, B.Sc., (El.), Hanover, Ont.
Peters, Henry Frederick, B.Sc., (Ci.), Slave Falls, Man.
Stratton, Frederick Stephen, B.Sc., (El.), Winnipeg, Man.
Weselake, Edward Joseph, B.Sc., (El.), Winnipeg, Man.

Results of the May Examinations of The Institute

The report of the Board of Examiners, presented at the Meeting of Council held on May 30th, certified that the following candidates, having passed the examinations of The Institute, have satisfied the examiners as regards their educational qualifications for the class of membership named:

Schedule C. For admission to Associate Membership:—

R. A. Bradley, Jr.E.I.C.	St. Catharines, Ont.
W. S. Buchanan	Quebec, Que.
G. W. Holder, Jr.E.I.C.	Sturgeon Falls, Ont.
K. L. MacMillan	Mount Royal, Que.
W. N. McGuinness	Montreal, Que.
O. S. Platou	Montreal, Que.

OBITUARY

James Marmaduke McCarthy, M.E.I.C.

Members of The Institute will learn with regret of the death of James Marmaduke McCarthy, M.E.I.C., which occurred at Quebec, Que. on May 22nd, 1930.

Mr. McCarthy was born at Sorel, Que. on February 8th, 1864, and graduated from McGill University in 1887.

An engineer of great capabilities, Mr. McCarthy designed and constructed the substructures of many bridges in Canada and the United States, and was consulting engineer to the Province of Quebec in connection with the St. Lawrence river storage dam. He also designed and constructed waterworks systems, notably the system at Valcartier military camp at the outbreak of the World War. Following his retirement from civil engineering, Mr. McCarthy became associated with Price Brothers and Company, Ltd., later being named vice-president of this company, which position he held until his death.

He had many other interests, however, and in addition was vice-president of the American Light and Traction Company, president of the Quebec Elevator Company, a member of the firm of Emerson, McMillan and Company, bankers, New York, a director of the Quebec Power Company, the Royal Trust Company, the International Paper Company of Canada and of the International Hydraulic Company of New York.

Mr. McCarthy was a member of the Quebec Garrison Club, the New York Yacht Club and the Lawyers' Club of New York.

Mr. McCarthy joined The Institute as a Student on January 20th, 1887, became an Associate Member on February 27th, 1890, and transferred to full Membership on May 6th, 1897. He took an active interest in Institute affairs, and was a member of Council in 1900 and 1902.

PERSONALS

J. W. Lucas, S.E.I.C., who graduated from the University of Alberta in the spring, with the degree of B.Sc., is now with the Beauharnois Construction Company at Beauharnois, Que.

J. W. D. Farrell, A.M.E.I.C., superintendent of water works for Regina, Sask., has been appointed registrar of the recently established Professional Engineers Association of Saskatchewan.

J. I. Dore, S.E.I.C., who graduated from Queen's University this spring with the degree of B.Sc., is now connected with the Forest Products Laboratories of Canada, in Ottawa, Ont., as chemist in the wood preservation division.

C. L. Blackmore, Jr.E.I.C., a member of the staff of the Canadian International Paper Company, who was formerly stationed at Deer Lake, Newfoundland, has been transferred to Gatineau, Que. Mr. Blackmore graduated from McGill University in 1927 with the degree of B.Sc.

H. L. Swan, M.E.I.C., formerly assistant district engineer with the provincial department of Public Works at Merritt and Cranbrook, B.C., has been appointed district engineer, engineering district No. 1, with the provincial department, and is located at Victoria, B.C.

J. Inglin, A.M.E.I.C., formerly electrical engineer with the Imperial Tobacco Company of Canada, at Montreal, is now on the staff of the Fraser-Brace Engineering Company, and is located at Copper Cliff, Ont. Mr. Inglin graduated from the Swiss Federal College at Zurich, in 1921.

G. H. Wood, A.M.E.I.C., a member of the engineering staff of the Dominion Water Power and Reclamation Service, Department of the Interior, located at Niagara Falls, Ont., received the degree of C.E. at the commencement exercises at the University of Toronto held recently. Mr. Wood graduated from the same university in 1917 with the degree of B.A.Sc.

A. M. Johansen, S.E.I.C., has accepted a position as junior mechanical engineer with the Mexico Tramways Company and affiliated companies in Mexico. For an indefinite time, Mr. Johansen's address will be Bayonne, N.J. He graduated from McGill University in 1929 with the degree of B.Sc., and later was connected with Babcock-Wilcox and Goldie-McCulloch, Ltd., at Galt, Ont.

C. H. Attwood, A.M.E.I.C., has been appointed Deputy Minister of Mines and Natural Resources for Manitoba. Mr. Attwood was formerly chief engineer of the Dominion Water Power and Reclamation Service for the Manitoba district, having joined that Service in 1914, when he became engineer in charge of Alberta and Saskatchewan power and storage surveys with headquarters at Ottawa. Mr. Attwood was elected president of the Association of Professional Engineers of Manitoba for the year 1929, and at the present time is the representative of the Winnipeg Branch on the Council of The Institute.

Fred L. Macpherson, M.E.I.C., who has been on the staff of the provincial Department of Public Works since 1917, first as district engineer in the Kootenays and latterly as office engineer at headquarters, Parliament buildings, Victoria, has been assigned a new position as highway traffic and utilities engineer in that department with headquarters at the court house, Vancouver. Mr. Macpherson is in charge of the new offices opened up to take care of all work connected with the licensing and control of the operations of public passenger and freight vehicles under the Public Carrier Regulations, passed pursuant to part V of the "Highway Act 1930." All matters pertaining to traffic enumerations, the regulation of traffic on the provincial highways, and problems generally concerning the control thereof, are being administered from this office under the department of Public Works. The need for centralizing such work in the commercial capital of the province is evidenced by the rapidly increased use of the highways, particularly by commercial vehicles. Mr. Macpherson is no stranger to the Vancouver district since he was municipal engineer of the adjoining municipality of Burnaby from 1909 till 1917.

ELECTIONS AND TRANSFERS

At the meeting of Council held on May 30th, 1930, the following elections and transfers were effected:

Associate Members

KREBSER, Edward Meili, B.Sc., C.E., (Univ. of Vermont), asst. shop supt., The Canadian Bridge Company, Ltd., Walkerville, Ont.

CREIGHTON, Leslie Floyd, B.A., B.E., (Univ. of Sask.), asst. engr., Dept. of Highways, Govt. of Saskatchewan, Regina, Sask.

MOES, Geriacus, Cert. Engrg. (Liverpool Univ.), elect'l. engr., plant engr's. dept., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

SCOULAR, William Buick, B.Sc., (Glasgow Univ.), designing engr., mech'l. dept., Dominion Bridge Co. Ltd., Montreal, Que.

Juniors

BREWER, Harold Byron, B.Sc., (Univ. of N.B.), Canadian Industries Limited, MacMasterville, Que.

GRAY, Reginald Arthur George, Elect'l. Engrg. Diploma, (Regent St. Polytech.), asst. engr., elect'l. engr's. office, C.N.R., Montreal, Que.

WALKER, Egbert Ernest, (Grad. I.E.E.), check inspr., automatic telephone dept., Northern Electric Company, Ltd., Montreal, Que.

Affiliate

CROSBY, Irving Ballard, S.B., (Mass. Inst. Tech.), A.M., (Harvard Univ.), consltg. geologist, 6 Beacon Street, Boston, Mass.

Transferred from the class of Associate Member to that of Member

MIFFLEN, Sydney Clarence, B.Sc., (McGill Univ.), office engr., mining engrg. dept., Dominion Coal Company, Ltd., Glace Bay, N.S.

Transferred from the class of Junior to that of Member

TIPPET, Henry Jackson, division engr., The Connecticut Company, New Haven, Conn.

Transferred from the class of Junior to that of Associate Member

BONHAM, Robert Lincoln, B.Sc., (Queen's Univ.), asst. supt. of operation and mtce., Canada Creosoting Co. Ltd., Winnipeg, Man.

BUCHMANN, Karl Emil, B.A.Sc., (Univ. of Toronto), dftsman., International Nickel Company, Copper Cliff, Ont.

CAMPBELL, George Wilfred, asst. engr., Reclam. Branch, Dept. of Public Works, Winnipeg, Man.

FARNSWORTH, Raymond Harrington, B.Sc., (Queen's Univ.), chief dftsman., Price Bros. & Co. Ltd., Quebec, Que.

GUY, Richard W., B.Sc., (McGill Univ.), senior examiner, Elect'l. Standards Lab., Dept. of Trade and Commerce, Ottawa, Ont.

HADLEY, William Fraser, Lieut. Col., (Grad. R.M.C.), manager, Scott Estate, Hull, Que.

HUMPHREY, Harold William, B.Sc., (N.S. Tech. Coll.), engr., transmission constrn. dept., Public Service Electric & Gas Co., Newark, N.J.

JOHNSTONE, Ralph George, B.Sc., (N.S. Tech. Coll.), elect'l. engr., asst. to director of sales in paper gear dept., Harland Engineering Company, Montreal, Que.

MacKENZIE, Russell George, asst. engr., in charge of sidewalk constrn., City of Vancouver, B.C.

MEDLAR, George Elmer, engr. in charge of field and office work, Essex Border Utilities Commission, Windsor, Ont.

MOLKE, Eric Charles, Grad. Engr., (Univ. of Vienna), struct'l. engr., hydro-electric system, City of Winnipeg, Man.

PYBUS, Ralph Carr, B.Sc., (Univ. of Man), engr. for British Columbia, for Carter-Halls Aldinger Co. Ltd., Vancouver, B.C.

For transfer from the class of Junior to that of Affiliate

SALE, Charles P., B.A.Sc., (Univ. of Toronto), member of firm, Sale & Sale, Barristers, Solicitors, etc., Windsor, Ont.

Transferred from the class of Student to that of Associate Member

BLACK, Hugh Murray, B.Sc., (McGill Univ.), sales engr., English Electric Company of Canada, Ltd., Toronto, Ont.

BOYD, Ivan William, B.Sc., M.Sc., (Queen's Univ.), master mechanic, Siscoe Gold Mines, Ltd., Amos, Que.

BROOKS, Charles Lennox, B.Sc., (McGill Univ.), general traffic engr., Eastern Area, Bell Telephone Company of Canada, Montreal, Que.

CHAMBERS, Harold Joseph Ashbridge, B.A.Sc., (Univ. of Toronto), asst. engr., Canadian Bridge Company, Ltd., Walkerville, Ont.

CHESHIRE, William Vernon, B.Sc., (Univ. of Man.), on equipment service engr's. staff, Northern Electric Co. Ltd., Montreal, Que.

CRAIN, George Edwin, B.Sc., (McGill Univ.), sales mgr., Genesee Bridge Co., Rochester, N.Y.

EGGERTSON, E. Grettir, B.Sc., (Univ. of Man.), designing elect'l. engr., hydraulic dept., The Aluminum Company of America, Pittsburgh, Pa.

EYFORD, Cornell Thomas, B.Sc., (Univ. of Man.), distribution engr., Winnipeg Electric Company, Winnipeg, Man.

FAGAN, James Wilfrid, B.Sc., (McGill Univ.), production supt., Northern Electric Co. Ltd., Montreal, Que.

HERSCOVITCH, Charles, B.Sc., (McGill Univ.), estimating engr., Dominion Engineering Works, Ltd., Montreal, Que.

HILL, Stanley Clayton Howard, B.Sc., (McGill Univ.), asst. protection engr., operating dept., Shawinigan Water & Power Company, Montreal, Que.

JONES, Harry Anderson, B.Sc., (Univ. of Sask.), asst. engr., city engr's. dept., Regina, Sask.

Transferred from the class of Student to that of Junior

CORNISH, Wilfred Ernest, B.Sc., (Univ. of Man.), lecturer in elect'l. engrg., University of Alberta, Edmonton, Alta.

KELLETT, James Edward, B.Sc., (Univ. of Man.), res. engr., Manitoba Good Roads Board, Dauphin, Man.

PRUDHAM, William Merrill, B.A., B.Sc., (McGill Univ.), switchboard engr., Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Students admitted

ALLEN, Elmer Bertrand, (Undergrad., Univ. of Sask.), Govan. Sask.

BLACK, Frank Leslie, Undergrad., (N.S. Tech. Coll.), 169 Cornhill St., Moncton, N.B.

BUTLER, Howard Claude, B.Sc., (McGill Univ.), 48 Clarendon Avenue, Ottawa, Ont.

EVANS, Delano Ernest, B.Sc., (McGill Univ.), 1464 Mansfield St., Montreal, Que.

HARTNEY, James R., B.Sc., (McGill Univ.), 3483 Peel St., Montreal, Que.

HOWORTH, John, (Undergrad. Univ. of Man.), 100 Elm Park Road, St. Vital, Man.

MORRISON, Thomas Jack, B.Sc., (McGill Univ.), 456 Claremont Ave., Westmount, Que.

PATRIQUEN, Frank Andrew, B.Sc., (Univ. of N.B.), Fairville, N.B.

WOODHALL, Thomas Latimer, B.Sc., (Univ. of Man.), 441 College Ave., Winnipeg, Man.

BOOK REVIEW

American Railway Signaling Principles and Practices

Alternating Current Track Circuits

Published by the Signal Section, American Railway Association, New York, 1930, paper cover, 6 x 8¾ in., 83 pp., figs., charts, tables, $0.35.

"Alternating Current Track Circuits" is the subject of chapter XI of a book entitled "American Railway Signaling Principles and Practices", which is being prepared by the Signal Section of the American Railway Association. Each chapter, as written, is being published in pamphlet form, so that the information contained therein may be placed in the hands of those interested in railway signal work without waiting for the entire series; and chapter XI is the eighth chapter released to date*.

The booklet containing this chapter, which has been presented to The Institute through the courtesy of the publishers, deals with all phases of alternating current track circuits as used in railway signaling and points out that the use of alternating current for the operation of track circuits was developed in the year 1898, due to the return propulsion current of electrically operated roads interfering with the direct current track circuit. Stray earth currents and return propulsion current from adjacent electric lines also interfered with direct current track circuits in use on roads which were not electrically operated.

The various types of alternating current relays, track transformers, impedance bonds, etc., as well as formulae for the calculation of the ballast and rail resistance of an alternating current track circuit, are clearly explained. Instructions for the adjustment, operation and maintenance of alternating current track circuits, including the proper phase angles to be maintained between the two currents of a two-element relay are shown, and the chapter concludes with a useful series of questions on the subject matter.

*The titles of the series so far published are as follows:—

Chapter II — Symbols, Aspects and Indications.
" V — Batteries.
" VI — Direct Current Relays.
" VII — Direct Current Track Circuits.
" VIII — Transformers.
" X — Alternating Current Relays.
" XI — Alternating Current Track Circuits.
" XXIII — Highway Crossing Protection.

E. S. Taylor,
Signal Engineer, Eastern Lines,
Canadian Pacific Railway Company,
Montreal.

The Link Belt Company has recently patented a new metal for chains called "Promal." This metal is considerably harder than malleable iron and also has a higher average yield point and ultimate strength. The Company has made numerous tests on these Promal chains and particularly recommend them for four general classes of service: (1) chain drives, elevators and conveyors operating under gritty or abrasive conditions; (2) chain drives where greater strength is required than the corresponding size of malleable iron chain provides; (3) drag, scraper and flight conveyors where the chain drags and is subject to abrasion; and (4) heavy duty drives of comparatively high speed, short centres and large sprocket ratios.

Details of the physical properties of Promal, with specifications and prices of Promal chains may be obtained from Link-Belt Company, Indianapolis, by asking for Book No. 950.

BRANCH NEWS

Border Cities Branch

R. C. Leslie, A.M.E.I.C., Secretary-Treasurer.
H. J. Chambers, S.E.I.C., Branch News Editor.

The regular monthly meeting of the Border Cities Branch was held in the Prince Edward hotel on April 11th. The speakers for the evening, Mr. Hugh McIntosh and Mr. Austin Ion, both of the Bell Telephone Co. of Canada, were introduced by Mr. Reynett, district manager of the Bell Telephone Co. of Canada.

Mr. McIntosh in his address outlined the method of operation of the step-by-step automatic telephone system. Likening the entire system to a tree, with the roots representing the parties calling, the trunk being the switching apparatus, the limbs the various lines and the leaves the parties called, Mr. McIntosh then showed the manner in which the dialling of a number by the caller manipulates, by the impulses thus set up, the various switches in the system, ultimately connecting up the caller with the party called.

The electrical devices required in the step-by-step system, the speaker stated, are the dial, the line finder, the first, second and third signal switches and the connector switch. The dial is the means of setting the switches in operation. It also gives the signal and controls the speed with which the signal is given. Its rotation sends out impulses equivalent in number to the number dialled and at the same time temporarily disconnecting the receiver to prevent the clicking caused by these impulses returning to the ear of the caller. The line finder, the first, second and third signal and connector switches actuated by these impulses, bring themselves into alignment and open up a line of communication between the caller and the party called. Should the line to the party called, however, be found busy, the line is immediately grounded and sends back the "busy call."

Mr. McIntosh then briefly outlined the immense amount of study and investigation necessary in order to obviate any annoyances which might arise in operation. He stated that whereas fourteen line finders for two hundred subscribers was the estimated probable need, seventeen were actually used to guard against any congestion. In addition to this the speaker pointed out that a loading scheme split up into twenty-two groups was found necessary. These groups were arrived at by observation and were arranged according to the frequency with which certain types of subscribers use the telephone.

The speaker then concluded by stating that the need for the automatic telephone was due chiefly to the inability of the Bell Telephone Co. of Canada to see ahead a steady supply of suitable girls, due chiefly to the small families of modern parents, and also because these small families are becoming even smaller. This in due course he stated would make it economically imperative that the automatic system be adopted.

It was then moved by J. Cummings and seconded by R. Armstrong that a hearty vote of thanks be conveyed to the speaker by the Border Cities Branch. A vote of thanks was conveyed to Mr. McIntosh by O. Rolfson, A.M.E.I.C., the Chairman of the Branch.

Mr. Austin Ion then dealt very briefly on the mechanics of the automatic telephone system. The new office he stated was located in the wire centre of the system. He stated that it was necessary to order equipment two years ahead of when it would be needed. He also stated that the modern cable contains 1,200 pairs of wires whereas formerly there were only 400 pairs to a cable. The contact points of switches he pointed out are now made of "contact metal," they formerly being platinum. This change greatly reduced the cost of switches.

With reference to the equipment in the new building Mr. Ion stated that there would be a primary service of 2,200 volts. There will also be five direct current generators with a total of 1,500 amps. at 60 volts for charging the batteries. To give an idea of the immensity of the scheme the speaker stated that 2 tons of choke coils would be used. The equipment required for the automatic system, the speaker stated, was selected with stress being laid upon maintenance. He stated that the present machines are of necessity very sturdy in order to keep maintenance costs at a minimum.

In closing the speaker stated that the switch-over for the Border Cities will entail 12,500 telephones and will be made on July 5th at midnight by a group of men specially trained in this operation in order to avoid mishaps.

It was then moved by A. E. West and seconded by Mr. Baird that a hearty vote of thanks be conveyed to Mr. Ion by the Border Cities Branch. This was conveyed by Mr. Rolfson who thanked the speaker for his very illuminating address and the trouble he had gone to in the preparation of the equipment for its illustration.

Following this, moving pictures of trans-Atlantic telephony and the development of the present telephone system were shown. These showed briefly the engineering difficulties that have been overcome and the wide use to which the telephone is now being put.

Hamilton Branch

John R. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. A. M. Galilee, Affiliate E.I.C., Branch News Editor.

The first meeting of the newly elected executive committee of the Hamilton Branch was held in the Wentworth Arms hotel at 12.30 p.m., June 11th, 1930. Mr. McLaren was in the chair, with five other members of the executive present.

After the minutes of the previous meeting had been read and approved, several letters from Mr. Durley, General Secretary, were read and acted upon.

A letter from J. Stodart, M.E.I.C., regarding the Fire Prevention Campaign of the Hamilton Chamber of Commerce was read. Mr. Stodart was appointed permanent representative of the Branch on the general committee in connection with this campaign.

The following chairmen of committees were appointed with the option of selecting their own committees:—

Papers............ E. M. Coles, A.M.E.I.C.
Entertainment...... G. A. Colhoun, A.M.E.I.C.
Publicity.......... J. A. M. Galilee, Affil. E.I.C.
Membership........ F. H. Adams, A.M.E.I.C., with the following out of town representatives:
H. G. Bertram, M.E.I.C., Dundas.
G. R. Marston, A.M.E.I.C., Simcoe.
F. H. Midgley, M.E.I.C., Galt.
S. Shupe, M.E.I.C., Kitchener.

J. A. M. Galilee, Affil.E.I.C., was appointed Branch News Editor and was authorized to attend all meetings of the Executive Committee.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

The annual meeting was held on June 10th. M. J. Murphy, A.M.E.I.C., chairman of the Branch, presided. The annual report and financial statement was presented and on motion adopted. Scrutineers R. H. Emmerson, A.M.E.I.C., and T. H. Dickson, A.M.E.I.C., reported on the balloting for election of Branch officers and stated that a tie had resulted in the voting for the office of committee-man. A second ballot was canvassed, after which, it was announced that the following will act for the year 1930-31:

Chairman.....................L. H. Robinson, M.E.I.C.
Vice-Chairman.................G. E. Smith, A.M.E.I.C.
Secretary-Treasurer............V. C. Blackett, A.M.E.I.C.
Executive Committee...........E. T. Cain, A.M.E.I.C.
T. L. Landers, M.E.I.C.
J. G. MacKinnon, A.M.E.I.C.
C. S. G. Rogers, A.M.E.I.C.
A. S. Gunn, A.M.E.I.C.
A. F. Stewart, M.E.I.C.
(Ex-officio)....................M. J. Murphy, A.M.E.I.C.

A vote of thanks was tendered the retiring officers on motion of C. S. G. Rogers, A.M.E.I.C., seconded by E. T. Cain, A.M.E.I.C.

Tenth Annual Report

The ninth annual meeting of Moncton Branch was held on May 20th, 1929.

The Executive Committee held four meetings during the year. There were seven meetings of the Branch, two of which were open to the public. At these meetings, papers were read, addresses delivered and business transacted as follows:—

1929

Nov. 5.—A supper meeting was held in the Y.M.C.A. H. J. Crudge, A.M.E.I.C., building engineer, Canadian National Railways, Moncton, read a very interesting paper on "The New Canadian National Railway Hotel and Station at Halifax."

Dec. 12.—A supper meeting was held in the Y.M.C.A. A very instructive illustrated address was delivered by T. H. Dickson, B.A., B.Sc., A.M.E.I.C., on "The Construction, Operation and Maintenance of Unit Cars."

1930

Jan. 22.—A supper meeting was held in the Y.M.C.A. An address of unusual interest was delivered by J. A. Wilson, A.M.E.I.C., Controller of Civil Aviation, Ottawa, on the subject "The Progress of Aviation in Canada." This meeting was attended by members of the Moncton City Council, the staff of the local airport, and many prominent citizens.

Feb. 20.—A public meeting was held in the City Council Chamber. A very instructive paper was read by C. H. Wright, B.Sc., M.E.I.C., district manager and engineer of the Canadian General Electric Co., Halifax, on "Canada a Land of Opportunity."

April 14.—A supper meeting was held in the Y.M.C.A. G. S. Stairs, B.Sc., A.M.E.I.C., Director of L. E. Shaw Ltd., Avonport, N.S. and Chipman, N.B., read a very interesting paper on "Some Aspects of Clay and Burned Clay Products."

April 29.—A special meeting of the Branch was held for the purpose of discussing Institute affairs with the General Secretary, R. J. Durley, on the occasion of his annual visit to the Branch.

May 22.—A meeting was held for the purpose of nominating Branch officers for the season 1930-31.

A Maritime Professional Meeting was held in Moncton, under the auspices of this Branch, on July 30th and 31st, 1930. From the many kind words of appreciation received from visitors from other Branches, we are happy to believe that the meeting was a success in every way.

The attendance at our meetings during the past year has been very good, and L. H. Robinson, M.E.I.C., Chairman of the Papers Committee, is to be congratulated on the high standard of the addresses delivered. It is particularly gratifying to note that, of the five papers read at Branch meetings during the season, two are to appear in full in the Journal.

Our total membership shows a decrease of one, as compared with last year. It is with sincere regret that we record the removal, by death, of James Black Hegan, M.E.I.C., and Charles Ludlow Wetmore, M.E.I.C., two valued members of Moncton Branch.

The following is a statement of our membership at the present time:—

Membership

	Resident	Non-Resident	Total
Members	9	2	11
Associate Members	18	12	30
Juniors	2	2	4
Students	3	4	7
Branch Affiliates	2	0	2
	34	20	54

The thanks of the Executive of Moncton Branch are due to L. H. Robinson, M.E.I.C., Chairman of the Papers Committee, E. T. Cain, A.M.E.I.C., Chairman of the Entertainment Committee, The Moncton Tramways, Electricity and Gas Co. Ltd., for the loan of a moving picture projector, and the gentlemen who kindly furnished the musical entertainment for our meetings.

Financial Statement
(For the fiscal year June 1, 1929, to May 31, 1930.)

Receipts

Cash in bank, June 1st, 1929	$114.35	
Cash on hand, June 1st, 1929	3.16	
Rebates on dues	188.85	
Branch Affiliate dues	5.00	
Branch news	30.97	
Bank interest	4.61	
Supper meetings	102.00	
Headquarters grant, Maritime Professional Meeting	300.00	
Banquet and dance, Maritime Professional Meeting	151.50	
Miscellaneous rebates from Headquarters	51.94	
Miscellaneous	13.50	
		$965.88

Expenditures

Expenses, Branch meetings	$135.45	
Printing and advertising	62.66	
Telegraph and telephone	35.95	
Maritime Professional Meeting	430.86	
Rebate to Headquarters, acct. Maritime Professional Meeting	20.64	
Postage	2.36	
Miscellaneous	49.92	
Cash on hand and in bank, $226.32 + $1.72	228.04	
		$965.88

Assets

Balloptican lantern	$ 45.00	
Attache case	10.00	
Cash in bank	226.32	
Cash on hand	1.72	
		$283.04

Liabilities
None

M. J. Murphy, A.M.E.I.C., *Chairman.*
V. C. Blackett, A.M.E.I.C., *Secretary-Treasurer.*

Audited and found correct:
E. T. Cain, A.M.E.I.C.
R. H. Emmerson, A.M.E.I.C. } *Auditors.*

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

The Aluminum Industry in Canada

At the noon luncheon held at the Chateau Laurier on May 22nd, R. E. Parks, A.M.E.I.C., general superintendent of the Aluminum Company of Canada, Limited, at Arvida, Quebec, gave an address upon the subject of "The Arvida Operations of the Aluminum Company of Canada, Limited." John McLeish, M.E.I.C., chairman of the Ottawa Branch, was chairman of the luncheon meeting.

Mr. Parks in his opening remarks sketched the history of the aluminum industry to date. In 1924 when the American aluminum interests first began to consider the Saguenay as a possible location for a plant, the power development at Isle Maligne was nearing completion. They acquired a major interest in that development and the ownership of the Chute-à-Caron development, about 18 miles farther down the river.

Isle Maligne is capable of developing 350,000 primary horse power of which the Aluminum Company of Canada at Arvida have contracted for 100,000 h. p. The Chute-à-Caron development will, when fully completed, provide some 700,000 h. p.

This latter development will be in two steps. The present dam will be capable of producing 250,000 h. p. which it is intended will be available on February 15th, 1931. When this amount is insufficient, additional development is possible to make up the 700,000 h. p.

In connection with the Chute-à-Caron dam there was one engineering feature of particular interest. The river had to be entirely diverted to build the dam. A hole is being built into the dam which will be plugged at the proper time. The "plug" will be arranged by means of an obelisk—a concrete structure reinforced with cables, the structure being about 100 feet high and 45 feet square and shaped at its base to fit the bed of the river. The obelisk during its course of construction rests upon a platform with legs supporting it on the side next to the river. It will be set into place by having the supporting legs dynamited thus allowing the obelisk to drop into place. This method has been used before on small streams but never on such a large river.

The Arvida plant actually consists of three separate and distinct units devoted respectively to, first, the purifying of the bauxite or raw product to produce almost pure alumina, second, the making of the carbon electrodes for use in the electrolytic process of reduction of the alumina, and third, the making of the aluminum itself. These operations are carried on in three separate plants.

The first plant receives the bauxite from British Guiana in South America and removes the greatest portion of the impurities. In the old method of obtaining aluminum, chemical means were used, but at the Arvida plant a new process is utilized never commercially used before.

In electric furnaces the bauxite is mixed with sufficient coke under proper conditions to reduce the impurities at a high temperature—some 2,500 degrees centigrade. The iron, silicon, titanium and other impurities in the bauxite are reduced to the metallic, or elemental condition forming a ferro-alloy which sinks to the bottom and the aluminum oxide or alumina remains floating at the top. The molten purified alumina is decanted through a trough at the top of the furnace, and as it pours from the trough it is blown into a spray by means of steam nozzles. This spray is collected in a large steel-lined room in the form of small spheres known as "pills." This operation is the only spectacular part of the aluminum business. After some slight further purification by leaching with acid, this alumina is dried and is sent to the aluminum furnaces.

With regard to the carbon electrodes, petroleum coke is ground and mixed with coal tar pitch to produce a plastic mass which is pressed into blocks by means of large hydraulic presses. These blocks are baked in large electric furnaces to drive off the volatile matter. In these operations, careful control is required if the finished product is to be uniform in quality and sufficiently pure for the production of aluminum.

In the production of the aluminum the treated ore and the electrodes are brought into the final plant, the final separation being a simple electrolytic process.

In the electrolytic process, cryolite, found only in commercial quantities in Greenland, is made use of. This cryolite is a double fluoride of sodium and aluminum and when melted in a carbon-lined furnace has the property of dissolving aluminum oxide very much as coffee will dissolve sugar.

This discovery was made in 1886 by Charles M. Hall, a then recent graduate of Oberlin College, who made use of a small battery in his mother's wood shed to carry on his experiments. Some improvements have been made since this discovery but essentially there has been very little change.

In the process a direct current is led into the molten bath by means of the carbon electrodes previously mentioned and the aluminum that is "plated out" by the current collects on the bottom.

At Arvida 1,000 employees are divided up so that some 800 work at the plant itself and 200 on the railway and at Port Alfred. Of this number about 35 per cent are graduate engineers, mostly from Canadian universities. The town of Arvida has about 2,000 inhabitants but there is provision in the layout of the site for a future growth up to some 50,000 inhabitants.

In 1928, the American aluminum interests were reorganized. The old parent company, the Aluminum Company of America, only retained those properties within the borders of the United States. A new Canadian company was organized to take over those properties outside of the United States. This new Canadian company is known as Aluminum Limited, and it has properties all over the world, including some in Norway, England, Japan, India, Germany, Switzerland, etc., some 50 subsidiary companies in all.

The Canadian company, stated the speaker, is entirely separate from the American company and between the two there is keen competition which will undoubtedly increase as time goes on. When new uses are found for aluminum, when the markets are broadened, and the present properties are unable to take care of the demand, then the facilities at Arvida will be expanded. Conditions at Arvida are very favourable toward this expansion and a city of some 35,000 to 50,000 people will undoubtedly some day result.

Among the new uses for aluminum are their uses in the manufacture of shingles, ridge roll, doors, window frames, stair treads, decorative hardware, I-beams, construction of railway cars and street cars, sleeping cars, etc.

Other uses for aluminum are side rods for locomotives, collapsible tubes for toothpaste, aluminum foil for chewing gum and chocolate, acid tanks, turpentine stills, transmission cables, aeroplane parts, seaplane sheathing, citric acid pans, extended automobile moulding, bronze powder and for furniture.

At the commencement of his address, Mr. Parks extended a most cordial invitation to the members of the Ottawa Branch to visit the plant and to become guests of the Saguenay Branch of The Engineering Institute of Canada whenever they were in the vicinity of the Lake St. John country. At the conclusion of the address the chairman expressed to Mr. Parks the great appreciation of the local Branch for the interesting address.

The Colonial African Empire

Many of the members of the local Branch availed themselves of the opportunity afforded by a kind invitation extended to them from the Ottawa Military Institute to listen to an address on the subject of "The Colonial African Empire" on Monday evening, May 26th. The address was given at the offices of the Royal Canadian Air Force Photographic section, Department of National Defence, Jackson building, Ottawa. The speaker of the evening was Brigadier H. St. J. L. Winterbotham, C.M.G., D.S.O., who until about two years ago had been in charge of the Geographical section, General Staff, War Office, England. He was also for some time chairman of the Air Surveys Committee in Great Britain.

Brigadier Winterbotham during the past eighteen months has been visiting the various Crown Colonies throughout the Empire under a commission from the Colonial office, with the object of investigating and reporting upon the survey methods employed by them. His tour will shortly be completed and it was while en route to Jamaica from Hong Kong that he made an unofficial visit to Ottawa and took the opportunity to confer with the various survey branches of the Dominion Government services.

The speaker gave a brilliant word picture on the life, temperament, characteristics and customs of the many native tribes in the various great colonies and protectorates, interspersed with humorous and witty stories relating to the conditions at the outpost and shrewd observations on the best way to handle racial problems. His address was listened to with the greatest attention by his hearers.

Lieutenant-Colonel C. Beresford Topp, D.S.O., A.D.C., who presided, introduced the speaker, and at the conclusion of the address a hearty vote of thanks was extended to him by Major-General A. G. L. McNaughton, M.E.I.C., chief of the general staff, Department of National Defence, seconded by Major-General J. H. MacBrien.

Saskatchewan Branch

R. W. E. Loucks, A.M.E.I.C., Secretary-Treasurer.

May Meeting

The Saskatchewan Branch of The Institute met in the Kitchener hotel, Regina, on Friday evening, May 30th, some thirty-three members and guests being present. Vice-Chairman D. A. R. McCannel, M.E.I.C., occupied the chair.

Professional Association of Engineers

Mr. McCannel announced that the Professional Association of Engineers for Saskatchewan had appointed J. W. D. Farrell, A.M.E.I.C., superintendent of waterworks, Regina, as secretary and registrar of the association. He urged all engineers throughout the province to get in touch with Mr. Farrell with a view to registering as members of the association. The Engineers Act came into force on May 1st, 1930, and the first general meeting of the association will be held in Regina on September 5th next. Provisional officers are:—

President

Prof. C. J. MacKenzie, M.E.I.C., Dean of Engineering, University of Saskatchewan, Saskatoon, Sask.

Vice-President

D. A. R. McCannel, M.E.I.C., City Commissioner, City of Regina, Regina, Sask.

Councillors

J. R. C. Macredie, M.E.I.C., district engineer, C.P.R., Moose Jaw, Sask.

J. R. Cowley, electrical superintendent, Saskatoon, Sask.

W. H. Hastings, A.M.E.I.C., geologist and engineer, Department of Railways, Labour and Industries, Regina, Sask.

L. A. Thornton, M.E.I.C., Saskatchewan Power Commissioner, Regina, Sask.

J. E. Underwood, A.M.E.I.C., consulting engineer, Saskatoon, Sask.

R. N. Blackburn, M.E.I.C., chief mechanical superintendent, Department of Public Works, Regina, Sask.

W. R. Warren, A.M.E.I.C., Deputy Minister of Telephones, Regina, Sask.

H. S. Carpenter, M.E.I.C., Deputy Minister of Highways, Regina, Sask.

Old Friends as Visitors

The chairman welcomed R. O. Wynne-Roberts, M.E.I.C., and his son, L. W. Wynne-Roberts, A.M.E.I.C., to the meeting. Both of these gentlemen in years gone by, while residing in Regina, were active in the affairs of the engineering organizations of that time, commencing with the Regina Engineering Society and later the establishment of a Branch of the Canadian Society of Civil Engineers. Each has also served as chairman of the Toronto Branch of The Institute and Mr. L. W. Wynne-Roberts is now Councillor for that Branch.

Mr. R. O. Wynne-Roberts spoke reminiscently of his early associations in Regina. He expressed his pleasure at renewing old acquaintances and meeting old friends. He urged the members to invest their best in the society in order to get the best out of it.

Mr. L. W. Wynne-Roberts conveyed greetings from the Toronto Branch and extended an invitation to the members of the Saskatchewan Branch to visit Toronto and to participate in the annual meeting of The Institute which it is expected will shortly be held in that city.

The Rancho La Brea Tar Pits

One of the most interesting geological discoveries of the past century, the Rancho La Brea tar pits of southern California, was the subject of a non-technical address by Professor H. E. Simpson, State Geologist of the University of North Dakota.

Professor Simpson opened his address by commenting on the fact that Friday, May 30th, was Memorial Day across the line. "This has come to be a very sacred holiday or holy-day in the States" he declared. "It has taken on a new significance with the passing of the veterans of the Civil War and the coming of the Great War. May we make the day sacred to the boys of both countries who gave their lives for humanity."

He was not going to talk shop to the engineers present, he said. Rather he was going to take them to the field of scientific tragedy. He would relate to them "The Geological Story of the Rancho La Brea Tar Pits." These pits were located within the present limits of Los Angeles, California, and the thirty-two acres embracing these pits is now being converted into a park. Years ago when some Chinese workmen were digging asphalt from them for paving purposes they had discovered masses of bones embedded in the sticky mass, and had burned them on cool mornings to keep themselves warm.

One day, the speaker continued, a geologist saw a skull lying by the fire and recognized in it the skull of a sabre toothed tiger, a species long extinct in North America. Following this discovery, geologists immediately interested themselves in the animal remains embedded in the tar. Scientific exploration revealed the largest collection of pleistocene, or ice age, animals in the world to-day. The skeletons of many of these mammals are now mounted in the Los Angeles museum. It is believed that these animals existed from 200,000 to 500,000 years ago.

Professor Simpson described the formation of the tar pits along anticlinal ridges. Gas pressure had forced oil to the surface and explosions had blasted small craters along the top of the ridge. These craters had filled with a tarry deposit from the oil which had seeped up from below. Dust or water accumulating on the surface of the tar had made them into veritable death-traps for animals which ventured on the treacherous surface. Insects as small as flies and the most gigantic animals in North America, said the speaker, had been trapped in this natural tangle-foot. Some pits contained thousands of skeletons including probably every species of mammal then in existence in southern California. Seventeen elephants were caught in one pit. The carnivorous or meat eating animals outnumbered the herbivorous or vegetarian animals by ten to one.

Following the address Professor Simpson showed a series of lantern slides illustrating the pits and the animal remains found in them. He also exhibited specimens of the bones of some of the animal remains which had been perfectly preserved in the tar pits.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Sault Ste. Marie Branch was held in the Y.M.C.A., on May 30th, at 8 p.m., following a dinner.

R. S. McCormick, M.E.I.C., chief engineer of the Algoma Central Railway, spoke on the subject, "The Development of the Steam Locomotive in America." His paper is summarized as follows:

Transportation is the story of the industrial development of the world and the application of steam to transportation brought about the industrial revolution. The railroad and steamboat gave a world market for expansion to every factory, farm and mercantile establishment.

The development of the steam locomotive is the development of the science of railroading. Just one hundred years ago the first locomotive was used on a railroad in America. This was the Stourbridge Lion brought from England in 1829, and made a run of three miles and return, but it was too heavy for the roadbed, weighing as it did about five tons.

Old Ironsides was built in 1832 by Matthias Baldwin for the Philadelphia, Germantown and Morristown Railroad—such was the beginning of "Baldwin's." Old Ironsides attained a speed of thirty miles handling a load of thirty tons gross. It ran on a schedule but only in fair weather, horses being used on rainy days.

All these engines employed the three basic principles of Stephenson's Rocket, namely, a horizontal multitubular boiler, pistons directly connected to the driving wheels and the use of exhaust steam to furnish a draft.

Mr. Baldwin built other engines introducing ground metallic joints in place of canvas and red lead joints and adopting the 4-2-0 type of wheel arrangements.

About this time, 1835, the Norris locomotive works were established, Mr. Norris building engines with the driving wheels in front of instead of behind the firebox, thus giving greater tractive effort due to greater weight on the drivers.

The next logical step was the use of two pairs of driving-wheels, placing one pair in front of the fire box and one behind it. The original designer of this type which was and is yet known as the American or 4-4-0 type was Henry R. Campbell who, in 1836, had it built by James Brooks of Philadelphia.

In 1837 Garratt and Eastwick built a locomotive introducing the equalizing bar between the two pairs of drivers.

Ross Winans of Baltimore in 1846 produced a locomotive with four pairs of drivers coupled but very compactly grouped and held in a rigid frame as now employed in the Consolidation and Mikado type.

The first Canadian railway was a short line of sixteen miles connecting La Prairie and St. Johns, Quebec, opened for traffic in 1836, horses furnishing the motive power until in 1837 a locomotive was imported from England. The first engine to run in Ontario was the Lady Elgin built in Portland, Maine, and making its first run in 1852.

Early locomotive development in Canada followed the design of the United States builders. At present the two companies building engines are the Montreal Locomotive Works at Montreal, and the Canadian Locomotive Works at Kingston.

Many types of engines were introduced, differing in wheel arrangement. The American or 4-4-0 type already spoken of; the Atlantic, 4-4-2; the Pacific, 4-6-2; the Mountain, 4-8-2; the Mikado, 2-8-2; the Santa Fe, 2-10-2; and others. The two new engines built last year for the Algoma Central are of the Santa Fe type. The tractive effort of No. 50 is 60,250 pounds, handles 1,300 tons on heaviest grades, cylinder h.p. 2,590, and boiler pressure 250 pounds.

Many improvements have been made in the locomotive in the last few decades. In 1889 Baldwins' produced the first compound locomotive. One of the greatest forward steps was the introduction of the superheater. Other developments followed, such as the multiple throttle, the feedwater heater, the mechanical stoker and innumerable other appliances which go to make the modern locomotive what it is. Improvements and experimentation still continue. Operating conditions on our railways today demand the pulling of heavier trains at higher speeds at lower costs.

The steam engine has two competitors—the electric locomotive and oil-electrics. Electrification, at this date, is only possible economically by reason of a uniform regular traffic density. Under no other condition can it be justified for mail line tonnage haulage.

The oil-electric is a new departure in prime movers and is being experimented with in England, on the continent of Europe and in America. One of the chief obstacles in design of the new power is the transmission, as a variable transmission between engine and driving wheels is required. The capital cost of this type of power works against its adoption and maintenance costs are bound to be high.

It seems likely that the steam locomotive will remain for a long time the everyday motive power for hauling heavy tonnage over great distances at lowest ton rate costs.

A hearty vote of thanks was tendered Mr. McCormick for his interesting paper.

Preliminary Notice

of Applications for Admission and for Transfer

June 14th, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in September 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ARVESEN—RAGNER WOLL, of Sault Ste. Marie, Ont., Born at Sarpshorg, Norway, April 8th, 1884; Educ., Graduate, Porsgrund Tech. College, Norway, 1903; 1903-07, ap'ticeship, Randsford Paper Mills and Borregaad Paper Mills, Norway; 1907-08, asst. to mill supt., Vethugsfoss Paper Mills, Norway; 1908-09, dftsman., Riordon Paper Co.; 1909-10, on constrn., Can. Pacific Mills, B.C.; 1910-14, on constrn., Powell River Paper Co.; 1914-15, dftsman., Standard Steel Car Co., Baker, Pa.; 1916-17, designer, Price Bros. & Co. Ltd., Quebec; 1917-20, sulphite mill supt., Belgo Paper Company; 1920-22, mill engr. and supt., Holmen Hellefos Paper Co., Norway; 1922-23, designer, Bethlehem Steel Co., Wilmington, Del.; 1923-26, Charles Walmsley Company, Quebec; 1926 to date, designer, Abitibi Power & Paper Co. Sault Ste. Marie, Ont.

References: F. H. Barnes, A. L. Farnsworth, A. H. Russell, C. H. Speer, C. Stenhol.

BERLYN—MARTIN JOHN, of 984 Cote des Neiges Road, Montreal, Que., Born at Edghaston, Birmingham, England, Dec. 5th, 1902; Educ., M.A. (Hons. Mech. Science Tripos), Cambridge Univ., 1925. Assoc. Fellow, Royal Aeronautical Society; Three years from 1920, foundry pattern and machine shops, and D.O. at The British Lighting & Ignition Co., Aston, Birmingham, Eng.; 1925-27, asst. technician in aeroplane stress analysis at Sir W. G. Armstrong Whitworth Aircraft Ltd., Coventry, Eng.; 1927-28, in sole charge of aeroplane stress analysis at Canadian Vickers Ltd., Montreal; 1928-29, in sole charge of aeroplane stress analysis under W. T. Reid, in the Curtiss-Reid Aircraft Co. Ltd., Montreal; At present on technical staff of hydraulic dept., Dominion Engineering Works, Ltd., Lachine, Que.

References: H. M. MacKay, C. M. McKergow, C. E. Herd, H. S. Van Patter, E. W. Stedman, J. H. Parkin.

DAVIES—CLARENCE BERNARD, of Sault Ste. Marie, Ont., Born at Chelsea, Que., Sept. 21st, 1901; Educ., B.Sc., McGill Univ., 1923; 1923-25, operating and constrn. depts., E. B. Eddy Co. Ltd.; 1925-27, paper mill constrn., Port Alfred Pulp & Paper Co.; 1927-29, asst. sulphite supt., Kimerley Clark Co., and later Spruce Falls Power & Paper Co.; 1929 to date, sulphite mill supt., Sault Divn., Abitibi Power & Paper Co., Sault Ste. Marie, Ont.

References: A. L. Farnsworth, F. H. Barnes, R. A. Campbell.

de CHAZAL—MARC PHILIPPE, of 3454 Peel Street, Montreal, Que., Born at Johanneshurg, South Africa, July 26th, 1907; Educ., Matric. and Intermediate B.Sc., London University. Student, Inst. M.E., 1926; 1928-29, McGill Univ., completed third year, applied science; 1927-28, ap'tice repair shops, Mauritius Govt. Rlds.; 1929, gen. asst. to res. engr. on transmission line constrn., Shawinigan Engineering Co., and at present, instr'man. on concrete storage dam at St. Michel des Saints, for same company.

References: C. M. McKergow, E. Brown, R. DeL. French, H. M. MacKay, C. R. Lindsey, C. L. Luscombe, H. B. Montizambert, J. Stadler, J. W. H. Ford.

DELGADO—PERCY GEORGE, of 2294 Hingston Ave., Montreal, Que., Born at Falmouth, Jamaica, B.W.I., Jan. 9th, 1888; Educ., Cambridge Univ. certs. for Junior and Senior Local Exams. 1905-07, 2 years, McGill Univ.; 1907-08, Coniagas Mines; 1911, transmission line constrn., Shawinigan Water & Power Co.; 1911-12, dfting., Northern Electric & Mfg. Co. Ltd.; 1912-14, survey and general municipal work, City of Westmount; 1914-30, with the City of Westmount as asst. city engr., responsible for surveys, designs and estimates for all work constructed by the engrg. dept. and assisted in supervising actual constrn.

References: P. E. Jarman, L. E. Schlemm, G. M. Pitts, M. D. Barclay, G. J. Dodd.

DICKSON—FRANK, of Sault Ste. Marie, Ont., Born at Buckley Wells, Bury, Lancs., England, April 27th, 1904; Educ., 1919-23, Bury School of Technology; 1919-24, ap'ticeship with J. H. Riley & Co. Ltd., Bury, Lancs., covering practical and theoretical engrg., dfting. work on design and detail of bleaching, dyeing and finishing machinery; 1924-28, with C. Walmsley & Co. Ltd., Bury, England, paper making engrs., 18 mos. in estimating dept. on dfting mill layouts, design of new machines and estimation of paper machinery. 2½ years in dfting. engrg. dept. on design and detailing paper machinery and general equipment. Also assisted erection in field at different mills; Nov. 1928 to Aug. 1929, with International Paper Co. at Kipawa Mills at Temiskaming, as mtce. dftsman., repairs, alterations and design of new machinery in every dept. of mill, and erection of same; Aug. 1929 to date, with the Ahitibi Power & Paper Co., Sault Ste. Marie, Ont., as engrg. dftsman., on design and detail of new machinery and struct'l. work.

References: F. H. Barnes, F. Smallwood, A. H. Russell, A. L. Farnsworth, A. A. Rose.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

KNIGHT—JAMES A., of Beauharnois, Que., Born at Toronto, Ont., Sept. 17th, 1892; Educ., B.A.Sc., Univ. of Toronto, 1914. 1910-15, (summers), asst. to gen. contractor, J. J. Knight; 1916-19, overseas, Can. Engrs.; 1919-26, designing dftsman., H.E.P.C. of Ontario, on Queenston, Nipigon and smaller developments; 1926-27, asst. testing engr. with above; 1928 (Jan.) to 1930, hydraulic engr., on Chute-à-Caron development, Alcoa Power Co.; Jan. 1930 to date, designing engr., with Beauharnois Construction Company, Beauharnois, Que.

References: C. H. Mitchell, F. H. Cothran, R. J. Durley, M. V. Sauer, T. R. Loudon J. G. R. Wainwright.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

CAMPKIN—WILBERT LEE, of 2136 Angus Street, Regina, Sask., Born at Indian Head, Sask., Dec. 10th. 1896; Educ., High School Telephone course, Southern California Telephone Co., Los Angeles, 1917-18. Private study; 1915-19, with Southern Calif. Telephone Co., building telephone lines and equipment; 1919 to date, with Sask. Govt. Telephones as follows: 1919-24, maintaining auto. central office telephone equipment; 1924-26, asst. to wire chief at Regina main exchange. Responsible for install'n. and mtce. of auto. telephone central office equipment, motors, generators, storage batteries, toll switchboards and telephone repeaters; 1927-30, placed in charge of installing central office equipment throughout prov. of Sask., and at present head installer of telephone central office equipment and equipment supervisor.

References: S. R. Muirhead, W. R. Warren, J. D. Peters, J. N. DeStein, D. A. R. McCannel.

DeLONG—ROBERT KEYS, of Hampton, N.B., Born at Shannon, N.B., Jan. 6th, 1895; Educ., I.C.S. and N.S. Tech. College surveying and mapping courses, 1915; Passed Deputy Land Surveyors Exams. in N.B., 1924, in P.E.I., 1925; Member, Prof. Engrs. N.B., 1928; 1913-14, location survey, 1916-17, on constrn., Saint John & Quebec Rly. Co.; 1918 to date, with C.N.R. as follows: 1918-20, transitman; 1920-23, i/c right of way, bridge surveys and constrn.; 1923 (Jan.-Sept.), transitman and dftsman.; 1923-26, principal asst. under div. engr. in standardization of rly. line on P.E.I.; 1926-27, principal asst. under divn. engr., in yard alterations and trainshed constrn. at Saint John, N.B.; 1927 to date, gen. rly. engrg., mtce. of way dept., divn. engr's. staff, Moncton, N.B.

References: F. O. Condon, G. C. Torrens, A. S. Gunn, E. G. Evans, V. C. Blackett, A. Scott, E. T. Cain, J. R. Freeman.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

CHADWICK—AUSTIN RALPH, of Montreal, Que.. Born at Niagara Falls, Ont., July 16th, 1901; Educ., B.A.Sc., Univ. of Toronto, 1924; 1917 (3 mos.); 1918 (2 mos.), 1919 (3 mos.), timekpr. and officeman, with the Foundation Co. Ltd.; With Roger Miller & Sons Ltd., on breakwater constrn. as follows: 1920 (6 mos.), cost acct.; 1921 (6 mos.), carpenter; 1922 (6 mos.), fireman; 1923 (4 mos.), field engr.; 1923 (2 mos.), levelman on road constrn. for Ontario Govt.; 1924-28, with The Foundation Company as follows: 1924 (3 mos.), engrg. bridge pier repairs (Quebec); 1924-25 engr., subway constrn; 1925-26, office mgr. and engr., power house condenser system (U.S.A.); 1926-28, office mgr., Chicago office; 1928 to date, mgr. and director, Construction Equipment Co. Ltd., Montreal, Que.

References: R. E. Chadwick, F. G. Rutley, W. Griesback, H. V. Serson, C. N. Mitchell.

KYLE—JOHN SHERIDAN, of Hamilton, Ont., Born at Winnipeg, Manitoba, July 22nd, 1905; Educ., B.Sc., Univ. of Alta , 1928; Summers—1925, chainman, 1926-27, rodman, engrg. dept., C.N.R., Alberta Dist.; 1928-30, student ap'tice course, Canadian Westinghouse Company, Hamilton, Ont.; From June 16th, 1930, elect'l. engr., C.N.R., Toronto, Ont.

References: W. F. McLaren, G. W. Arnold, R. S. L. Wilson, R. W. Boyle, R. W. Ross, J. R. Dunbar.

MASSEY—DENTON, of Toronto, Ont., Born at Toronto, June 20th, 1900; Educ., B.Sc., Mass. Inst. of Tech., 1924; 1924-25, shops; 1926-28, asst. to supt. of Toronto works, i/c planning dept., and 1928 to date, asst. to supt. of Toronto works, i/c overhead and costs divn., Massey-Harris Co. Ltd., Toronto.

References: E. L. Cousins, R. P. Fairbairn, C. H. Mitchell, E. A. Allcut, T. R. Loudon.

MOORE—ALEXANDER GLYDON, of Montreal, Que., Born at Hazelbrook, P.E.I., March 2nd, 1901; Educ., B.Sc. (E.E.), N.S. Tech. Coll., 1925; 1925-27, inspn. and tests, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; 1927 (2 mos.), Bell Telephone Co. of Canada; 1927-28, elec. mtce., asst. elec. supt., Asbestos Corpn.; 1928-30, engr., on transmission, distribution, design and mtce., substation layout, Electric Service Corpn., Shawinigan Falls; 1930 (3 mos.), temporary work on appraisals, Arthur Surveyer & Co., Montreal; June 1st, 1930—elect'l engr., underground distribution dept., Montreal Light Heat & Power Cons., Montreal, Que.

References: E. Nenniger, W. F. McKnight, G. A. McClintock.

McKILLOP—DOUGLAS BRUCE, of Saunders, Alta., Born at Carnduff, Sask., April 4th, 1903; Educ., B.Sc., Queen's Univ., 1929; 1923, inspr., city engr's. dept., Regina, Sask.; 1925, contractor's foreman, Regina; 1925-27, inspr., bridge engr's dept., 1927-28, instr'man. (asst. engr.), and 1928 to date, res. engr., bridge engr's dept., C.N.R., Western Region.

References: W. Walkden, A. Macphail, W. P. Wilgar, D. S. Ellis, L. T. Rutledge, D. A. R. McCannel.

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ELECTRICAL ENGINEER, M.Sc., A.M.E.I.C., graduate, seven years experience in high tension calculation design and construction, seeks connection. Location immaterial. Age 30. Married. Apply to Box No. 7-W.

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Situations Wanted

CIVIL ENGINEER, graduate, age 32, A.M.E.I.C. Ten years experience; seven years on design, construction, erection work and maintenance of paper mill and mine buildings and machinery. Three years on hydro-electric work in charge of surveys and field investigations. Present position, associate hydro-electric engineer, U. S. Engineers on office investigation, design and estimates; desires permanent position in Canada. Apply to Box No. 362-W.

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MECHANICAL AND CIVIL ENGINEER, experienced as construction superintendent, mechanical superintendent, and chief engineer, desires position. Especially equipped to make reports on mill and town developments, personnel, etc. Bilinguist. All references furnished to interested parties. Apply to Box 411-W.

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ELECTRICAL ENGINEER, preferably graduate Canadian university, with test floor experience. Opening offers permanent employment for right applicant along lines of plant maintenance and with every possibility of considerable new construction work in the near future. Please give complete information in first letter, stating age, experience, and salary expected, to Box No. 561-V.

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SALES ENGINEER. Canadian stoker manufacturers desire services of experienced mechanical engineer to take charge of distribution. Location Montreal. Apply at once to Box No. 580-V.

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THE

ENGINEERING JOURNAL

THE JOURNAL OF
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Water Power in Brazil

A. W. K. Billings, M.E.I.C.,
Vice-President in Charge of Construction and of the Hydraulic Developments in Brazil, Brazilian Traction, Light & Power Co. Ltd.

Paper read before the Montreal Branch of The Engineering Institute of Canada, April 3rd, 1930.

The consideration of "Water Power in Brazil" by The Engineering Institute of Canada is specially appropriate. Brazil is the richest country in the world in potential water power; its present development of this important resource is due principally to Canadian enterprise and capital.

Thirty two years ago a noted American engineer, Fred S. Pearson, one of the pioneers in public utility engineering saw the opportunities in many Central and South American countries and enlisted the aid of a group of Canadians, known to many of you. With their support in the following seventeen years until his death in the sinking of the Lusitania he transformed and developed the public utilities of São Paulo, Rio de Janeiro, Mexico City and Barcelona. It is fitting here to couple with his name those of Sir William Mackenzie, who boldly backed these enterprises, Sir Alexander Mackenzie, who guided the Brazilian Company for over twenty-five years, and of F. A. Huntress, who directed it technically for twenty years.

To-day the light, power, transportation, gas and telephone services of São Paulo, Rio de Janeiro, Santos, and of the surrounding region, representing over two thirds of the water power developed in Brazil, are directly due to the courage and enterprise of this one Canadian Company, the Brazilian Traction, known there as the "Light" or the "Canadian Company". It is one of the largest public utilities outside of Canada and the United States.

American capital only recently has started to come in and by extensive purchases within the last three years of smaller companies outside the region served by the Brazilian Traction now owns about one-sixth of Brazil's developed water power.

Extent of Brazil

Brazil is relatively undeveloped and, over a great area, even unexplored and unknown. It comprises half the area and half the population of South America. It has approximately the same size as Canada or the United States, excluding Alaska, but extends over a much greater range of climate from the great forests of the equatorial valley of the Amazon, the world's greatest river, to the plains of the temperate zone in the extreme southern portion. It has a population of 39,000,000. The language of the country is Portuguese. It is bounded by ten of the twelve countries of South America, that is, by all these except Chile and Ecuador.

Only a small part of this enormous area is of interest in connection with water power. The Amazon valley in Brazil has no appreciable water power nor need of it. The relatively unknown subtropical region further south has great potential wealth in agricultural and other directions but has little known water power and no population or market for such power. Therefore attention will be confined to the plateaus of the southern portion, temperate in climate, well populated with fine types of Brazilians and of European settlers. This region produces, among other things, seventy per cent of the world's supply of coffee and has many important cities and towns. These include Rio de Janeiro of 1,300,000 population, usually considered the most beautiful city and harbour in the world, São Paulo of 1,050,000 population, a modern city and, next to Los Angeles, the most rapidly growing city of its class, and Santos, a city of 160,000 and an important seaport. This temperate portion of Brazil extends roughly parallel to the coast from twenty degrees to thirty-two degrees south. Here only are found the population, industries, market and transportation facilities which justify and require ample power supply, and also the physical and topographical conditions which permit such supply by water power.

Physiography

This portion of Brazil is endowed naturally with marvellous riches in potential water power because of a simple and very favourable surface formation and climate.

Anyone visiting Brazil sees for several hundred miles along the coast what appears to be and is called a mountain range, the Serra do Mar. It is really the edge of a great plateau. The geological formation along the coast is one of the most ancient—the Archaic or pre-Cambrian. The ancient rocks forming the plateaus are decomposed to considerable depths but the surface is not eroded very deeply nor are there many harder ridges protruding. The

SOUTHERN BRAZIL

TABLE NO. 1—HYDRO ELECTRIC PLANTS IN BRAZIL—BRAZILIAN TRACTION LIGHT AND POWER COMPANY LIMITED

March 1930.

Plants of the Rio de Janeiro Tramway, Light and Power Company Limited.	Normal kv.a.	Actual maximum h.p.
Parahyba	83,000	116,000
Lages	50,000	85,000
Plants of the Sao Paulo Tramway Light and Power Company Limited.		
Parnahyba	20,000	28,000
Sorocaba	55,000	75,000
Rasgao	22,500	32,000
Serra	68,000	96,000
" (on order to be installed)	(55,000)	(70,000)
Plants of the subsidiary companies of the Sao Paulo Tramway Light & Power Co. Ltd.		
T.S.P.T.L. & P.C.L. Sao Jose dos Campos section		1,000
Companhia Ituana Forca e Luz		15,000
Companhia Luz e Forca de Jundiahy		1,400
Cia. Luz e Forca Norte de Sao Paulo		4,400
Cia. Forca e Luz Jacarehy		750
Empreza de Electricidade Sao Paulo-Rio		4,040
Cia. Luz e Forca de Guaratingueta		1,125
Emp. Hydro Electrica de Bocaina		1,100
Emp. de Electricidade de Sao Sebastiao		65
Total horse power installed		460,880 (530,880)

Itatinga supply to Santos not included (10,000 h.p.)

highest point in Brazil is the peak of Itatiaia, half way between Rio and São Paulo, which is merely the highest point of the edge of one of these several plateau steps, and is only 9,100 feet above sea level.

Ages ago the nearly level peneplain, consisting mainly of granite, gneiss and similar rock, rose very slowly, breaking along faults parallel to the present coast, until today we see this plateau in one or several steps with the floor tilting very gently inland, away from the ocean. This raising and tilting, which formed the Serra do Mar, geologically was rapid. Few of the rivers draining this plateau could keep pace with the rising of the land by cutting down their courses to the ocean. The result is that with few exceptions the rivers of this region flow to the interior forming the great river basin of the Parana and Paraguay rivers.

The slope of these rivers is almost imperceptible, starting at, say, one in three thousand, and erosion is consequently not marked. The valleys are shallow and broad and the country resembles rolling prairie. The result is that the heavy rains which fall on this plateau, even a few miles from the precipitous slope of the Serra do Mar, flow in sluggish rivers northwest to the Parana, then southwest to the River Plate at Buenos Aires, reaching the Atlantic ocean only after twenty-five hundred miles of travel.

A few important rivers, including the São Francisco, Doce and Parahyba, are exceptions to the usual rule and after flowing for a long distance east, parallel to the faults, turn directly to the ocean—the first named in one great fall, Paulo Affonso, and the other two in a series of cascades along their lower courses.

The great rivers flowing to the interior cross many beds of harder rock, usually basalt, appearing either as a fault or as an anticline, and the resulting cascades and rapids, including all the famous falls of Brazil, cut long canyons in these beds of hard rock.

This extensive plateau or series of steps gently sloping toward the interior receives the prevailing southeast winds from the south Atlantic which are, of course, heavily charged with moisture. Along the narrow hot coastal plain the resulting rainfall is six to seven feet per year but the expansion and cooling through a few degrees of these breezes as they are forced to ascend abruptly twenty-five hundred feet at the edge of the plateau causes very heavy rainfall along this crest, decreasing further inland to an average of from four and a half to five feet.

At the crest of the plateau at the Serra do Cubatão development of the Brazilian Traction Company the average annual rainfall is about sixteen feet. Last year it was twenty-two and one half feet and in each of two months —February and December—was fifty-two inches. The heaviest daily rainfall was eleven and one half inches. Nearby the São Paulo Railway has recorded seven and a half inches of rain in one and a half hours, and such downpours on the precipitous slopes of a mountain side, particularly of the highly decomposed nature of these, can do great damage unless proper precautions are taken in the design and construction of engineering works.

Such rainfall is exceeded in a few other places. Without discussing British Columbia, the Ghats back of Bombay and Calcutta have a rainfall of thirty feet in the seven weeks of the normal moonsoon season.

In Brazil, these heavy rainfalls occur only at the edge of each plateau. The evaporation from a free water surface at the crest of the Serra is only about two feet per year while twenty miles inland the rainfall has dropped to five feet and the evaporation from a free water surface has increased to nearly as much. These conditions then continue fairly uniform over a great part of the plateau to the north.

The runoff, expressed in percentages, must be approximated with such variable rainfall, but is approximately 33 to 83 per cent, averaging 53 per cent on the drainage areas nearest the Serra.

Hydrology

With such variations of climate in a few miles it is essential to organize proper observations and records of rainfall, evaporation, stream flow, humidity, air and water temperatures and so forth. For this work the Company employs more than one hundred observers and uses twenty-four automatic stream flow recorders for isolated locations, visited usually once per month.

Space is too limited to discuss the relation to the water supply of variations in the solar radiation as evidenced by the cycle of visible sun spots, radio interference, the variations of ocean temperatures and currents, fluctuations of inland lake levels, the varves or bands of different colours in the clays deposited below glaciers, rings of trees as measured extending even three thousand years back, and similar indications. The importance of this difficult and involved subject is just becoming evident and in Brazil this study is especially important as the relation of weather to the solar radiation cycle seems clear. In the interior of Canada and the United States conditions are different.

In a few places small rivers have broken away from the parent system and have cut their way through the edge of the plateau to reach the ocean. In other cases one river has captured the headwaters of another.

All such phenomena are obviously of the greatest interest to the engineer, even more than to the geologist, for they suggest projects of magnitude which, by taking advantage of such conditions, are cheaper than those following conventional methods.

Statistics

In these days of world power congresses it is the fashion to collect and publish statistics of the potential water power of each country. It seems to the writer that much of this effort is wasted. First, there is the difficulty of defining what really constitutes potential water power and for what portion of the year it must be available in order to be counted; second, in countries like Africa and South America which have the greatest potential resources of this kind the lack of exploration or of observations of flow and fall make such statistics the wildest of guesses; and third, the visible water powers are often secondary in economic importance and value to the invisible water powers, obtainable by diversion. This is particularly true in Brazil. Only those water powers which can be developed commercially within a reasonable period and which will command a market are, in the writer's opinion, worth consideration and study.

The statistics usually given for Brazil, which are far more incomplete than they appear, show about 43,000,000 h.p. in the visible falls above 10,000 h.p. Estimates of these vary from 20,000,000 h.p. to 60,000,000 h.p.

Waterfalls

No attempt will be made to catalogue the many great waterfalls of Brazil which are seldom seen even by the Brazilians themselves. Nearly all of them are relatively inaccessible and in the author's opinion they will play a small part in the economic future of Brazil. In fact, by obstructing navigation on these great rivers they will retard rather than advance the development of the country. Only a few which are closer to the centres of population will be developed and thus become an asset.

The number of large falls on many of these rivers is astonishing. That Rio Grande which in part of its course forms the northern boundary of the State of São Paulo, has in seven of the better known falls at least 1,800,000 h.p. and much more exists in unnamed falls. Yet even this power will hardly be developed to an appreciable extent.

Argentina has studied two of these great waterfalls, Iguassu and Guayra, because of its lack of water power, but the development of petroleum deposits, the increasing economy of thermal stations located at the point of consumption, the administrative difficulties due to lack of international treaties, and the physical difficulties of distance, isolation and backwater conditions all count heavily against the possible development of such powers even for Argentina. The "Chade" Company in Buenos Aires put in last year the first sixth (two units of 75,000-h.p. each) and is now putting in the second sixth of what will ultimately be a 900,000-h.p. steam station.

In the portion of Brazil where power is of importance the local conditions favour cheap water power development close at hand so that these more remote falls are of little interest. Steam plants cost in Brazil as much or more than hydro-electric plants even for the initial installation, besides which there is the considerable expenditure for imported fuel. Oil fuel costs about $16.00 per ton at present and coal in proportion. It is therefore rare to find any steam power or thermal plants in this part of Brazil except those required as a reserve under public service contracts.

There are no coal mines of value in Brazil but it is probable that petroleum will be found in the southwestern portion, particularly in the state of Paraná and the adjacent portion of the state of São Paulo. This however will not affect appreciably the water power situation except to postpone still further the development of the remote waterfalls.

All of these natural falls suffer the serious disadvantage of very high backwater in the long narrow canyons down-

Figure No. 1.—Map of Southeastern Part of Brazil.

Figure No. 2.—Rio de Janeiro (view from Corcovado).

stream which result from the erosion by the fall itself. Thus the Paulo Affonso fall is reduced in flood season by over ninety feet, that is from 262 feet in the dry season to 170 feet in the wet season,—similarly the Iguassu fall is diminished 105 feet from 230 feet to 125 feet, the Guayra fall by 117 feet from 380 feet to 263 feet and so on.

Some of the largest falls, for example Urubú-Pungá on the Paraná and Itapura on the lower Tieté, become mere rapids in the flood season while others, such as Pirapora on the São Francisco, disappear altogether at such seasons.

It will be of interest to describe in a few words several of the larger falls. The greatest of all and probably the largest in the world is the Guayra fall on the Paraná at the place where this river becomes the boundary between Brazil and Paraguay. Estimates of this power vary from twelve million to twenty million horse power. Some are even higher and go as high as forty million horse power.

The Guayra fall, better known in Brazil as Sete Quedas, is typical of many others. The Paraná river at this point is conservatively estimated to have a minimum flow of 408,000 second-feet or double the average flow of the Niagara river at Niagara, while in flood season it has a flow several times as great, probably exceeding 2,660,000 second-feet.

The total drop of 385 feet applies to nearly twenty-five miles of river. Between the main falls and Porto Mendes, the head of navigation from Argentina, the river is a raging torrent between 500 and 600 feet deep. In the flood season the water level above the falls rises only about eight feet whereas below the falls it rises 125 feet.

There is a considerable transport of produce, especially maté, the tea of the Argentine, around the falls by rail. Large steamers can come up to Porto Mendes but above the falls for the maté transportation and other traffic smaller steamers of not over 300 tons are used.

Another similar fall, smaller than Guayra but still estimated to have from 3,000,000 to 14,000,000 h.p., is the Santa Maria fall on the Iguassu river, more usually referred to as the Iguassu fall. This is often illustrated and described in books of travel because it is easily reached by river navigation up the Paraná from Buenos Aires. The backwater is excessive, approximately 125 feet, while the dry season flow is only 12,400 second feet. It is on the boundary between Argentina and Brazil. The many studies made by the Argentine government and private interests indicate that it cannot be developed economically. In addition to this Brazil and Argentina have not agreed on any method of developing the falls, which would normally be done in Brazilian territory.

Another noted waterfall is that of Paulo Affonso on the São Francisco river between the states of Alagoas and Sergipe. There is a possibility that this fall may be developed as it is the principal obstacle to navigation on this river, which, if eliminated, would facilitate the development of an important region. Mineral wealth in this section may require a considerable amount of power. A project has been advanced for pumping water from this river by the power thus produced through a divide into an extensive and well populated section which for centuries has been scourged by frequent droughts and famines.

This fall of Paulo Affonso has approximately 262 feet head and 35,000 second feet in the dry season but only 164 feet head with about 354,000 second feet in the flood season. There are therefore 800,000 h.p. available but on account of physical conditions the economic development of any considerable amount of power is not easy.

Another river which is known by the government explorations to have considerable water power is that Rio Grande river, already mentioned. On account of the location of this river with relation to the important States of Minas and São Paulo it is possible that some of these falls may be developed—in fact, 10,000 h.p. has already been developed on a branch of the main river at the fall called Marimbondo. The cost of diversion dams across such large rivers is great and the initial step is therefore heavily penalized. Such plants, even if constructed later, will probably operate in parallel with high head storage plants as such interconnection appears economically desirable.

The flow of the Parahyba river, already mentioned, reaches 283,000 second feet in the lower portion and the amount of power along its course is large. It is probable that plants on this river will be developed to operate in parallel with high head storage plants elsewhere. The Brazilian Traction Company possesses the principal rights on this river and has already built one plant at Ilha dos Pombos with 120,000 h.p. installed and an ultimate capacity of slightly over 200,000 h.p.

Another river of less importance from the standpoint of water power but likely to be developed because of its proximity to the largest deposit of high grade iron ore in the world, is the Rio Doce, 220 miles north of Rio. This iron ore deposit has been known and its development has been advocated for very many years but the work has not yet been commenced. When started the ore will be shipped to Germany and England and perhaps the United States, and not less than five per cent, of the ore thus exported will be refined locally into steel products.

Glancing briefly at some of the typical power plants in Brazil, it may be noted that when the earlier ones were built the largest water wheel units were only 5,000 kw. and the largest steam turbines were even smaller. Today the largest hydraulic turbines are in the reaction type about 80,000 h.p. and in the impulse type about 70,000 h.p. whilst steam turbines reach 260,000 h.p. in a single unit.

It should also be noted that whereas thermal plants, either steam or internal combustion, are relatively uniform in design, hydraulic plants differ greatly because each must be adapted to the particular local conditions. Hardly any two hydraulic plants are alike and each has to be built where the head and flow are obtainable most economically. The difficulties encountered call for an entirely different order of engineering than steam plants, which are usually constructed in large cities and amply provided with all facilities.

Marmelos

The first hydro-electric plant in Brazil was built in 1889 at Marmelos on the Parahybuna river near Juiz de Fora. This had initially one 60-h.p. unit, later two more, and three 400-h.p. units were added.

Parnahyba

The first plant of importance, a remarkable plant for its day, was that of Parnahyba, on the Tieté river near São Paulo. The original installation consisted of three horizontal wheels of 2,000 h.p. each under seventy-five feet head direct connected to generators with transmission at 20,000 volts a distance of 17 miles. Both in size of direct connected hydraulic unit and transmission voltage and distance this plant was quite exceptional and went into operation in 1901. It was later increased to about 28,000 h.p. and is still operating as one of the four plants of the Brazilian Traction supplying São Paulo, but will eventually be replaced by a station forming part of the Serra development later described.

Bananeiras

Another of the older installations is that of Bananeiras supplying Bahia, a city of 300,000 people, 850 miles northeast of Rio. Due to construction difficulties this plant was not completed when first built. The American interests are now building a large reinforced concrete multiple arch dam, the largest in South America, which will increase the storage by 74,000,000 tons and the capacity to 12,000 h.p. with provision for 12,000 additional later when required.

Itatinga Plant

The power for the supply of the Santos Docks is produced by the Itatinga plant built in 1912 on the slope of the Serra do Mar. It consists of a diversion dam, a covered canal running at the base of precipitous cliffs, connecting by individual penstocks to five 4,000-h.p. units operating under a static head of 2,070 feet. The transmission to Santos is over 20 miles of 40,000-volt line; this plant has for many years supplied in part also the city of Santos, the balance of the power required coming from the Serra plant.

Usina Isabel

A small plant of special interest is the Usina Isabel now owned by the Brazilian Traction and located on the

Figure No. 3.—Harbour of Rio de Janeiro.

Figure No. 4.—Ilha dos Pombos Development supplying Rio. North Channel Dam looking North—South Sector No. 3 discharging Two Thousand Cubic Feet per Second

Mantiqueira range about midway between Rio and São Paulo. It has only 4,000 h.p. but operates under the unusual head of 3,080 feet.

This plant was built during the war, and by a curious error in marking the profile the pipeline arrived from Germany with the bottom portion light and the top portion designed for full head. The Brazilian engineers were not daunted by this but revised the location, substituting canal for part of it, juggled the new line to suit the bends and pipe as actually furnished, and had left over about one third of the total tonnage which they sold at a profit. So they deserve credit not only for building what is still a high head plant but for overcoming under necessity a serious difficulty.

Chaminé

The American interests are also building a 10,000-h.p. plant called Chaminé about 30 miles southeast of Curityba, capital of the State of Paraná. The power will be transmitted 34 miles at 66,000 volts. A reinforced concrete diversion dam turns the water into a pressure tunnel 6½ feet in diameter and 6,880 feet long and penstocks 1,120 feet long, giving 788 feet head. Provision is made for two more units or a total of 20,000 h.p. when needed.

Rasgão Plant

About a century and a half ago, the search for gold along the Tieté river northeast of São Paulo caused an attempt to divert the river across a narrow neck and thus lay bare the bed in a loop of several miles in length. Many slaves must have been employed, for a deep cut, later called the Rasgão, was made but the work was abandoned when hard rock was encountered.

Later the Brazilian Traction Company projected a small plant here, but there was little expectation of building it until a prospective drought prompted a rapid decision in 1924 to build a 32,000-h.p. plant. This commenced operation 11½ months after the first cabled proposal to undertake this construction. This rush job was executed under difficulties particularly in the shipment and receipt of the equipment.

This plant operates in parallel with the Serra, Sorocaba and Parnahyba plants in serving the São Paulo district. The head is 80 feet; the units have a maximum capacity of 16,000 h.p. each; the transmission distance is 27 miles at 88 kv.

Sorocaba

The Sorocaba installation was the second plant, built in 1912, to augment the supply of the city of São Paulo and the surrounding region. It has today 78,000 h.p. with reaction turbines under 680 feet static head. The transmission is over 48 miles at 88,000 volts, while one pair of circuits supplying the Paulista Railway reaches to a distance of 197 miles. The reservoir has an available storage of 234,000,000 tons.

Ribeirão das Lages

Another important installation is that of Ribeirão das Lages owned by the Brazilian Traction Company. It has a capacity of 85,000 h.p. and is the first plant built in 1906 for supplying the city of Rio de Janeiro and vicinity. This includes a reservoir of 192,000,000 tons available storage, now supplemented by the diversion of a tributary of the Parahyba river called the Pirahy. The regulated flow is brought through two 8-foot feeders 5,400 feet long to a valve house from which descend eight penstocks connected to multiple jet vertical impulse wheels operating under 1,020 feet static head. This power is transmitted 53 miles at 88,000 volts and the plant operates in parallel with a larger plant at Ilha dos Pombos on the Parahyba river.

Ilha dos Pombos

The second largest plant in Brazil has been built on the lower portion of the Parahyba river by the Brazilian Traction Company. Eight Stoney gates and three large automatic sector gates of reinforced concrete form a diversion dam and turn the flow from the two existing channels on either side of the island called Ilha dos Pombos, into an ancient channel.

By dredging the pasture land off the rock bed of this ancient channel a canal one and a half miles long was formed, which gives a head of 112 feet, diminishing in the

Table No. 2—Hydro-Electric Plants of the Emprezas Electricas Brasileiras, S.A. Group

As of December 31, 1929

	Plant name	Kw. capacity	Year installed	River	State
Cia. Energia Electrica da Bahia	Paraguassu	9,000	1908	Paraguassu	Bahia
Cia. Central Brasileira de Forca Electrica	Fructeiras	3,000	1913	Fructeiras	Esp. Santos
" " " " " "	Jucu	2,240	1908	Jucu	" "
Cia. Forca e Luz de Minas Geraes	Rio das Pedras	10,720	1907	Rio das Pedras	Minas Geraes
" " " " "	Freitas	200	1895	Arrades	" "
" " " " "	Petit	980	*	Santa Barbara	" "
Cia. Brasileira de Energia Electrica	Piabanha	9,000	1908	Piabanha	Rio de Janeiro
" " " "	Fagundes	4,800	1926	Fagundes	" "
Emp. Forca Luz de Ribeirao Preto	Sao Joaquim	4,608	1922	Sapucahy	Sao Paulo
" " " "	Dourados	6,400	1927	Sapucahy	" "
" " " "	Buritys	800	1922	Bandeiro	" "
Cia. Paulista de Forca e Luz	Avanhandava	2,780	1927	Tiete	" "
" " " "	Lencoes	1,412	1918	Lencoes	" "
" " " "	Dois Corregos	180	1910	Jahu	" "
" " " "	Botucatu	216	1907	Pardo	" "
Emp. Forca e Luz do Jahu	Gaviao Peixoto	3,360	1926	Jacare Grande	" "
Cia. Central Electrica de Icem	Marimbondo	6,400	1928	Rio Grande	" "
Cia. Electricidade de Taquaratinga	Rib. dos Porcos	180	1909	Rib. dos Porcos	" "
Cia. Forca e Luz Jaboticabal	Corrego Rico	280	1909	Corrego Rico	" "
Cia. Douradense de Electricidade	Sao Lourenco	180	1912	Sao Lourenco	" "
Emp. de Electricidade de Araraquara	Chibarro	2,680	1909	Chibarro	" "
Cia. Franca de Electricidade	Esmeril	1,460	1912	Esmeril	" "
Cia. Forca e Luz de Brotas	Brotas	470	1914	Jacare Pipira	" "
" " " "	Tres Saltos	640	1926	Pinheirinho	" "
Cia. Campinhos de Traccao Luz e Forca	Salto Grande	2,000	1905	Atibaia	" "
" " " " "	Jaguary	6,800	1919	Jaguary	" "
The Southern Brazil Electric Co.	Piracicaba	1,080	1893	Piracicaba	" "
Cia. Mogyana de Luz e Forza	Pinhal (old)	732	1908	Mogyguassu	" "
" " " "	Pinhal (new)	400	1928	"	" "
" " " "	Ponte Nova	80	*	"	" "
Emp. Electrica de Amparo	Serra Negra	240	*	Rio do Peixe	" "
" " "	Bocaina de Amparo	140	*	Rio Jaguary	" "
Cia. Forca e Luz "Carioba"	Villa Americana	2,340	*	Atibaia	" "
Emp. de Melhoramentos Urbanos de Paranagua	Paranagua	638	*	Miranda and Santa Cruz	Parana
Cia. Traccao, Luz e Forca de Florianopolis	Maroim	600	1919	Maroim	Santa Catharina
Total kw. installed capacity		87,036			

*Data not available.

flood season to slightly less than one hundred feet. The extreme minimum flow of the river is 7,000 second-feet, the maximum 283,000 second-feet or about one third more than the flow of the Niagara river at Niagara.

A power house of simple design utilizes this head with three reaction units already installed totalling 116,000 h.p. and provision for two more, or 204,000 h.p. altogether. There is only one floor to the main building, the entire

Figure No. 5.—Rio Grande Reservoir and Dam; Pump House in Centre.

Figure No. 6.—Serra Development—Cascatinha Dike, Dam and Intake, Surge Tank, Coastal Plain and Praia Grande in Distance.

control being on a gallery level with the exciter platform. The plant is arranged electrically on the unit system, the switches and high tension structure are on the roof, and the transmission is by four circuits on two tower-lines 94 miles at 132,000 volts to Rio de Janeiro.

The automatic reinforced concrete sector gates mentioned are the largest yet built. Each gate is 148 feet long, 35 feet in radius, 24 feet in clear depth of water over the sill, and weighs over 2,100 tons. It floats rising and falling into the sector chamber below according to the water pressure in the chamber. This pressure is controlled by a large ring gate, controlled in turn by a small funnel in water at the upstream pool level so that the vertical movement of this funnel moves the gate correspondingly, and for any given position of the funnel a variation of river flow and level causes the main sector gate to rise or fall until the level is restored. Each of these gates can pass at normal water level 1,800 tons of water per second.

These sector gates are very sensitive, regulating the pool level to a fraction of an inch. They are ideal for large reservoirs discharging clear water but are almost too sensitive, as the resulting variation of flow is somewhat dangerous to people who happen to go down to the riverbed below. The standard Stoney gate seems preferable, and for streams carrying much sand, boulders, and debris, we prefer roller gates or similar types in which the gate proper and all its mechanism except the sill itself, lifts out of the flow.

Serra Development

The largest development in South America is the Serra do Cubatão plant of the Brazilian Traction Company near São Paulo, which has at present installed two units producing 96,000 h.p. maximum and on order a third unit of 70,000 h.p. maximum. The ultimate capacity of this one project is approximately 750,000 h.p. The present transmission is 21 miles at 88 kv. later 132 kv. or 154 kv.

This development takes advantage, in a logical way, of the topographic and climatic advantages already discussed. Nevertheless it has attracted a great deal of attention and favourable comment, in fact is treated in the Brazilian press very much as if it were a new kind of Columbus' egg. Usually an hydro-electric development is so isolated that no one sees it or cares to see it. This one however is on the principal highway connecting São Paulo and its seaport Santos, travelled daily by thousands. It is plain that the plan is merely the common-sense working out of obvious facts, yet the public interest aroused in Brazil is gratifying, even if at times somewhat embarrassing.

At any time during twenty years this plan could have been easily determined from the topographic maps of this region of which thousands of copies were sold to the public. Anyone capable of tracing the contours on these maps can imagine the whole plan. Yet no one did this and three independent investigations passed by the region as devoid of interest, even though it was on the principal highway and included the only cascade on the Serra which is visible from the seaport. This seems a somewhat remarkable fact.

Examining the contour map it is evident that if a dam were built across the Tieté river below the city of São Paulo and the crest gradually raised, the resulting lake would inundate the lower portion of the city until a level between the 725 and 750 meter contours above sea level were reached, when the water would flow over several low depressions in the very flat divide or watershed between the Tieté and the coastal plain and bay of Santos, and for this diversion direct to the ocean a head of 725 meters thus becomes available.

In order to avoid flooding the city and the more important valleys it is obviously possible to build a number of low dams in the affluents, where the land is unpopulated and worth little, and to connect the resulting reservoirs by canals and tunnels across the low divides. This is the original Serra project of about 320,000 h.p.

It was later seen that further improvement could be obtained by omitting the interconnecting canals and tunnels, letting the ordinary excess flow and the stored waters pass down the Tieté and then be pumped into the main reservoir. This makes tributary a much larger drainage area.

The enlarged project includes a storage reservoir of available capacity 1,040,000,000 tons, a connection by pumping to an existing one of 194,000,000 tons, eight others to be constructed as needed, all totalling 2,500,000,000 tons or 3,500,000,000 kw.h. reserve storage; the corresponding regulated flow, ultimately about 3,500 second-feet, passes as needed through a variable head auxiliary power plant of 20,000 h.p. into a small reservoir of 25,000,000 tons, which serves as a natural channel to reach the crest of the Serra. Here the flow down the existing gorge is closed by a concrete dam and turned aside through a short tunnel and siphon to the top of a steep spur, down which the penstocks lead to the power house. Each penstock is slightly over five feet in diameter at the top reducing progressively to 43 inches at the bottom in the present lines and 49 inches in the third and future lines, and a little over 5,000 feet long on the slope. The net static head is 2,360 feet plus from 10 to 60 feet at the auxiliary power station.

Pumping for Storage and Flood Control

The conditions described of heavy rainfall and very slight grade to the rivers result each year in prolonged flooding of all the valleys in this region. While the velocity is low this flooding effectually prevents normal development and the elimination of such flooding by rectification of the river channels has long been discussed but not yet started nor would it alone be effective at reasonable cost.

Storage of these flood waters, such as projected in the original Serra plan, is advantageous but insufficient; diversion of these flood flows or the regulated flow to the ocean direct helps greatly. The combination of all three elements, storage, diversion, and rectification on a sufficiently large scale, is effective and the next few years will see a considerable part of the flooding immediately adjacent to São Paulo and downstream eliminated by such works.

After the 750,000,000 kw.h. available without pumping is utilized the pumping lifts are from 40 to 88 feet for the next step, providing 500,000,000 kw.h. primary power per year, and 16 feet additional for the third step providing over 1,100,000,000 kw.h. primary and 650,000,000 kw.h. secondary power per year, and so on when economically justified by future demand.

Obviously these pumped storage supplies use principally power otherwise wasted, rarely requiring primary power or on-peak power, and give in primary power when needed, at moderate additional investment and expense, from 13 to 24 times as much as the secondary power used in pumping.

Pumping will be done also, if possible, during floods even when the reservoirs are full, in order to spill direct to the ocean as much of the excess flow up to 5,000 second feet as is practicable. This will aid materially in solving the remainder of the flood prevention problem.

The rectification of the Rio Grande and Pinheiros rivers, requiring several million yards of dredging, that of the Tieté itself (now projected by the City of São Paulo and requiring a similar amount of dredging), and the flood prevention will benefit greatly the valuable valley lands, and these will bear a considerable part of the cost of this work.

Dredging Procedure

In the dredging marked success has been obtained with electrically driven suction dredges. At present there are

Figure No. 7.—Serra Development supplying São Paulo.

Figure No. 8.—Serra Development—View of 12-inch Suction Dredge.

five of these, each 12-inch discharge with 250 to 350 h.p. in motors, the power being delivered by a submarine cable running along the pontoon line.

The necessary material is hauled to the places where the nearest highway crosses these meandering streams, full of logs and obstructions. A suitable spot in the cleared swamp is chosen, the hull and machinery erected, the swamp drainage is obstructed temporarily to form a pool and the dredge then starts digging its channel.

Meanwhile the dense undergrowth and forest are cut down and burned or removed to the side, the stumps are grubbed to the slight extent possible and the power and telephone lines erected along the future channel. These swamps have usually a layer of one to three yards of vegetable matter and peat in a tangle of tree trunks and roots. This gives considerable trouble and requires raising and cleaning of the cutter and repriming of the dredge every few minutes. This material caves and slides toward the cutter sometimes 200 feet in advance.

The material underlying the swamp is decomposed granite or gneiss. Where this material has become kaolin mixed with sand it is very easy digging; where less completely decomposed a monitor or powerful water jet is often used to facilitate the cutting. Wash-borings are made in advance always to determine the conditions. The dredge material is pumped to dumps or if near enough to dikes, dams and roadfills, and held by brush to the desired slopes, leaving finally the clay and sand several hundred yards from its original location.

For some of the larger dams the hills are taken down by dredge and monitor as borrowpits. At other times the dredged channels rectifying the tortuous meanderings of the river furnish such fill for these dams. Elsewhere powerful pumps, 450 h.p. each, and monitors with booster pumps of 200 h.p. serve to build roadfills and dikes.

Sanitation

In general the districts served by the Brazilian Traction are healthful and therefore prosperous and important industrially. It must not be thought that malaria is unimportant; malignant tertiary malaria is more to be feared than yellow fever for several reasons, yet in Brazil as elsewhere the public in general is very careless.

The coastal plain almost everywhere in Brazil is infected with malaria; the higher plateau and much of the lower areas further inland are not. It is essential in all work that great care in sanitation be exercised from the very beginning, the Company has had complete success in its recent work when even governmental work nearby has been infected and seriously delayed. Extreme vigilance is necessary, especially where police powers are not held and military discipline in the enforcement of sanitary measures is lacking.

Every labourer is examined when first recruited before transportation is furnished, and again at the job before commencing work. Men who show enlarged spleen or other evidence of malarial infection are rejected. In doubtful cases (and lately in all cases for work in the coastal plain where recent work by others in the vicinity has been badly infected) a drop of blood is tested microscopically. This test is repeated frequently in watching the sanitary conditions in the camps, and in curing any imported cases.

In transmission line construction through the swamps, for example back of Rio, where malaria is endemic and in

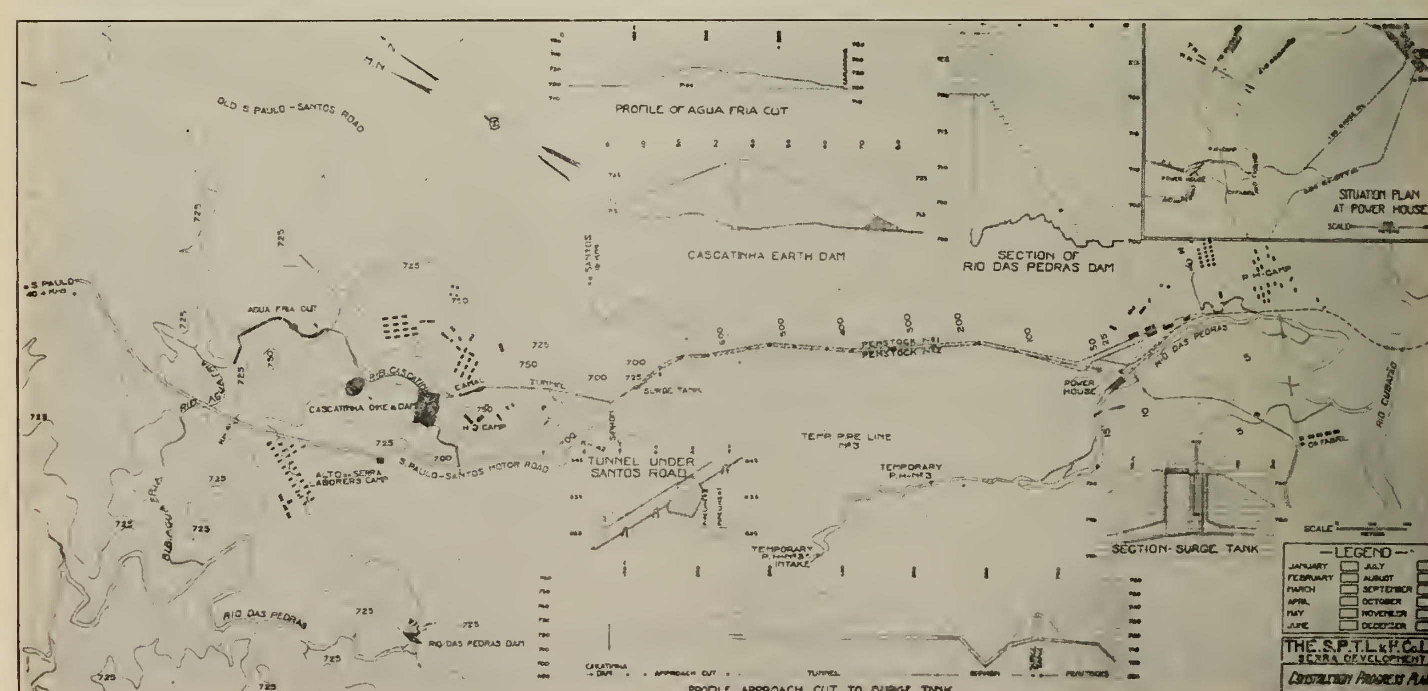

Figure No. 9.—Serra Development—Construction Progress Plan.

the past nearly depopulated these swampy districts, all men are sent in by trucks on the highways after daylight and brought out before dusk.

This policy has succeeded perfectly. Occasional cases are found during the season, but all have been proven to be imported, and so far in several years work with several thousand men, no cases have been contracted or transmitted in the Company's camps, nor has any woman or child come down with malaria.

Labour

On any such work one finds a conglomeration of labourers of every nationality. The country is drawn on entirely although newly arrived immigrants are attracted because of steady work, proper medical attention, regular pay, food at wholesale cost, and fair treatment, while they are learning the language and becoming accustomed to the country. Unfortunately elsewhere in Brazil there is often exploitation of the labourer. The Company have always tried to give the men a square deal and for these reasons labourers anywhere in Brazil come willingly when they hear that the "Light" needs men.

At the Serra the climate is hard on the Brazilians who are unaccustomed to the continual rains and cold. In the first year and a half of the Serra construction, to build up a force of 3,800 men over 26,000 men were brought in from all parts of Brazil.

Water Transportation

The reservoirs and dredged channels on the plateau and the Cubatão river and tidal channels on the coastal plain lend themselves also to the solution of a very pressing transportation problem, the remedying of the congestion of the port of Santos and of the means of transportation between this and São Paulo.

Seventy years ago the São Paulo Railway was granted the exclusive right to operate a railway between these points in a zone forty miles wide; the resulting railway, with its inclined planes and extensive protection against rains and slides, has the reputation of being the most costly railway in the world; consequently its charges average nearly half of the trans-Atlantic freight rate. Its equipment is insufficient and negotiations to modify the old concession and modernize the transport by the construction of an adhesion line, electrically operated, have not yet succeeded.

The plan, which would be carried out if the new electric line is not built, would be the discharge of part of the freight into lighters of two hundred tons capacity of a uniform special design, the towing of these to the base of the Serra adjacent to the power house, the lifting of these to the lake at the crest by inclined planes and the further towing of these lighters to any point on the rectified channels of the rivers at São Paulo. Two of the three dams would be passed by mechanical boat lifts, smaller and simpler than those on the Trent canal at Kirkfield and Peterborough; the third would be passed by an ordinary lock.

This water transport can compete with the railways both now and later, and the remedying of this congestion which occurs every few years and each year works serious injury to the commerce of the port and state is essential.

Market

One naturally asks, where can this power be sold? This portion of Brazil is largely, for its rapid development and prosperity, dependent, up to the present time, on coffee production and textile manufacturing. Little is known of the mineral wealth but the indications are that this is by no means small. Years of investigation and the commencing of development will be necessary before one can speak confidently of these possibilities but it is believed that extensive mineral exploitation and metallurgical development will be seen in Brazil in the near future.

Bauxite, which today is so essential as the raw material for the production of aluminum, and which occurs principally in semi-tropical countries like Brazil, is known to exist over wide areas but has not been prospected or developed. Manganese, lead and silver, some gold, diamonds in quantity, phosphate rock, nickel, and other minerals of importance are known to exist, even comparatively close to the thickly settled portions, but so far have received too little attention to be able to speak with confidence of the practical possibilities.

The fact remains that the load grows, in spite of the temporary reverses and setbacks to which any new, rapidly developing country is subject. Many years work in public utility work in foreign countries where one's expectations are usually exceeded by the actual results, makes the writer an optimist, and even though a pessimist is sometimes defined as "a man who has done business with an optimist," he is very confident of the future in a new country like Brazil. What they need most is systematic investigation of their great but unknown natural resources. The rest will follow.

In résumé, Brazil is half of South America but the southern part only is of interest from the standpoint of water power. Natural conditions, simple but unusual, favour greatly not only the existence of enormous water power in isolated though spectacular waterfalls but also the practical utilization of invisible waterpowers of much greater value in the populated and highly developed districts around Rio and São Paulo. The development of water power in Brazil is a great factor in its progress. It justifies fully the pride which Brazilians feel in their country and the pride which Canadians should take in the fact that such development has been led and is still being led by Canadian interests.

The Toronto Sewerage System

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Paper read before the Montreal Branch of The Engineering Institute of Canada, March 27th, 1930.

The city of Toronto is situated on the north shore of Lake Ontario, occupying a waterfront of about 10 miles in length. It has an area of 35 square miles, a population of 606,370, and is served by 719 miles of sewers. From the point of view of drainage, it is well situated, the north city limit being 350 feet above lake level, with a fairly even fall to the lake, and, generally speaking, a fall eastward and westward to the Don and Humber rivers, respectively.

With the exception of certain low-lying areas near the lake front, Toronto is sewered on the combined system; that is to say, both sewage and storm water are carried in the same sewers to the lower part of the city. There the sewage is taken into the high and low level intercepting sewers, by means of which it is conveyed to the sewage disposal plant, and storm water in excess of three times the dry weather flow is discharged into the lake and Toronto bay from a number of storm overflow sewers.

For the districts known as North Toronto, a complete sewerage system has recently been installed, together with a separate sewage treatment plant, and none of the sewage from this district is taken into the before mentioned interceptors.

The low-lying areas along the lake front and Toronto bay are sewered on the separate system, the sanitary sewers conveying the sewage to four different points, where it is raised by means of pumps into the interceptors, and the storm sewers discharging directly into the lake. All buildings in these districts are provided with separate drains for sewage and storm water.

The sewage from the high level interceptor is discharged by gravity, and that from the low level interceptor is raised by means of pumps to the sewage disposal plant, which is situated on the lake front, near the east end of the city. The effluent from this plant is discharged into the lake in deep water, 2,300 feet from the shore.

As a typical example of the sewer work carried out in Toronto, a brief description will be given of the design and construction of the North Toronto sewerage system, which includes 13 miles of trunk sewers, 65 miles of lateral sewers, and a very up-to-date activated sludge treatment plant. The total cost of this work was nearly $10,000,000.

Prior to annexation by the city in 1912, North Toronto was a separate municipality, with a population of about 5,000. It was partially served by a sewerage system only capable of taking the sanitary flow, which was treated at three small disposal plants. Directly following annexation, the city, anticipating the growth and improvements which would take place, commenced the preparation of a comprehensive sewerage scheme, the construction of which, due to the Great War and other delays, was not proceeded with until 1926.

North Toronto covers an area of 2,800 acres, and has a population of 50,000 at the present time. The accompanying map (figure No. 1) gives a diagram of the recently constructed trunk sewers, which follow more or less the general slope of the ground from northwest to southeast.

As a preliminary to the design of the system, surveys were made of the various creeks and watersheds, and the

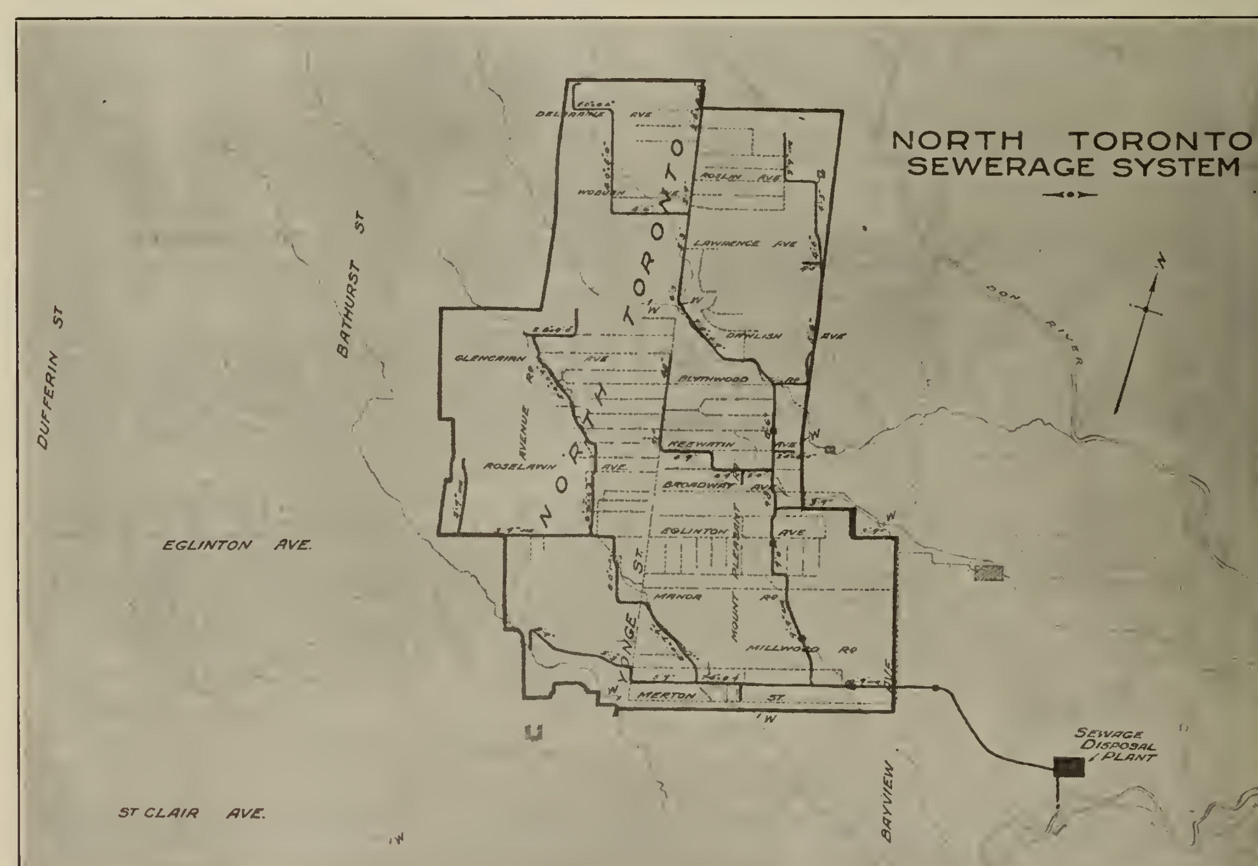

Figure No. 1.—Plan of North Toronto Sewerage System.

extent of the drainage areas was computed. Gauging weirs were built in the creek beds, and records kept of the flow for over ten years. The method of gauging was to place a box about 50 feet back from the weir in which small hooks were set. Corks were hung on the hooks, and as the water entered through holes in the bottom of the box these floated off and indicated the maximum depth of water flowing over the weir. The information thus obtained led to the conclusion that the heaviest flow from unimproved land occurs during the spring run-off, and is caused by melting snow. For areas of about 1,000 acres, the greatest run-off recorded was two-tenths of a cubic foot per second per acre.

These gaugings, considered along with the rainfall records, indicate that the run-off of melting snow is never coincident with a thunderstorm of extreme intensity. The latter is the more important factor, and causes a much greater run-off from an improved area. The North Toronto sewers, therefore, were made large enough at the upper end to take the run-off of melting snow from the unimproved portion of the drainage area lying to the northwest of the city limits, but only a very small allowance was made for the drainage of this area in the larger sewers towards the lower end, as the creek flow becomes an almost negligible quantity at the time when maximum run-off is to be expected from the improved city area. When the lands lying outside the city are built up and served with improvements, it is expected that their drainage will be taken care of by means other than as provided by the city sewers.

The Department of Works, Toronto, maintains three tipping-bucket rain-gauges, with automatic recorders, in the east, west, and north sections of the city. From these, together with the records received regularly from the meteorological office, which is centrally located, the rate of rainfall to be allowed for in sewer design is determined.

In figure No. 2 is shown a characteristic rainfall curve compiled from the heaviest storms of each month over a period of 24 years. This curve is merely typical of the variation in intensity throughout the duration of a heavy storm. The dotted curves show the rate of rainfall for storms of extreme intensity which occurred between 1918 and 1930. Storms of like intensity may be expected about once a year, but are usually of short duration. A rainfall at the rate of six inches per hour over a period of five minutes is an extremely heavy storm for this district. The heavy line shows the rainfall rates allowed for in the design of sewers in Toronto. At a first glance it would seem that a greater rate than two inches per hour should be allowed for the first ten minutes, but a storm of extreme intensity is always of short duration, and, owing to unevenness of ground surface and various other causes, the run-off in the earlier part of the storm is much retarded. It is, therefore, safe to assume that from five to ten minutes elapse before the rain-water is fully concentrated in the sewers, and during this time the intensity of the storm is considerably reduced. Experience in Toronto shows that sewers designed on the stepped curve shown in figure No. 2 are of sufficient capacity to deal with the heaviest storms, and where such sewers have been surcharged the trouble has been caused by some peculiar local condition not allowed for in the design. One other very important factor enters into the calculation of storm water run-off, and that is the permeability of the surfaces to be drained. The tendency of recent years has been towards wider pavements, the paving of lanes, and smaller lots with houses built closer together and usually with garages and paved side drives and yards, resulting in a considerable increase of impervious surface. Measurements taken recently in fully built-up residential districts where streets are paved show that the impervious surface averages about 56 per cent of the total area. The whole of the rainfall on any area does not reach the sewers,

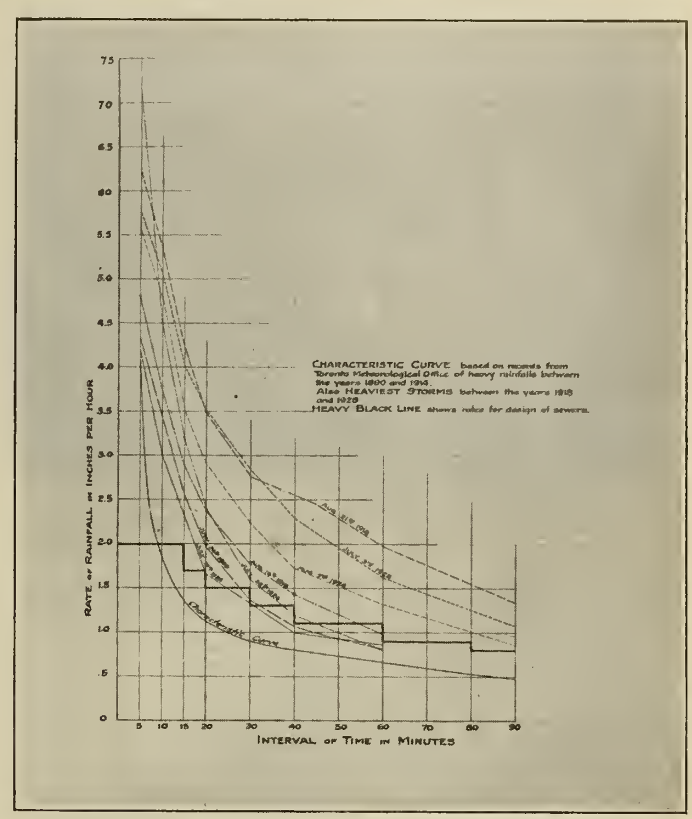

Figure No. 2.

and the amount to be allowed for becomes a matter of experience rather than measurement. The practice in this city is to allow a coefficient of impermeability varying from .45 for residential areas to .8 for fully built-up areas in the centre of the city. An allowance of .2 is considered sufficient for park lands.

Preliminary to the design of the North Toronto system, the approximate lines of the main trunks were decided on. Borings were taken along these lines to determine the strata through which the sewers would pass, and tentative profiles were plotted. To reach the site selected for the sewage treatment works, the trunk from the most northerly section necessarily crossed a deep ravine which intersects the area, and in this ravine there are certain lands which have to be served. As the land southward immediately rises 70 feet, the trunk sewers from this point on were very deep, reaching about 95 feet below the surface as a maximum. Tunneling was obviously the only method to be adopted for construction under these conditions, and, as the strata through which the sewers would pass consisted largely of wet sand and clay, a considerable pressure on the sewers had to be allowed for. No reliable information could be found as to pressures which might be expected in undisturbed ground at such a depth, and, therefore, it was decided to build circular sewers and allow for the full pressure of wet sand from the surface down. The main sewer, 10 feet 9 inches in diameter, has a five-ring brick wall, or an equivalent thickness, of first-class concrete, viz., about 22½ inches.

In order to obtain information for future guidance, Goldbeck pressure cells were built in outside the sewer wall in various locations, and tests of the earth pressures are being made from time to time. This experimental work is being carried out by the University of Toronto, in conjunction with the Department of Works of the city. As might be expected, earth pressures have been increasing on the cells at very different rates under various conditions of depth and strata, and as much as 30 pounds per square

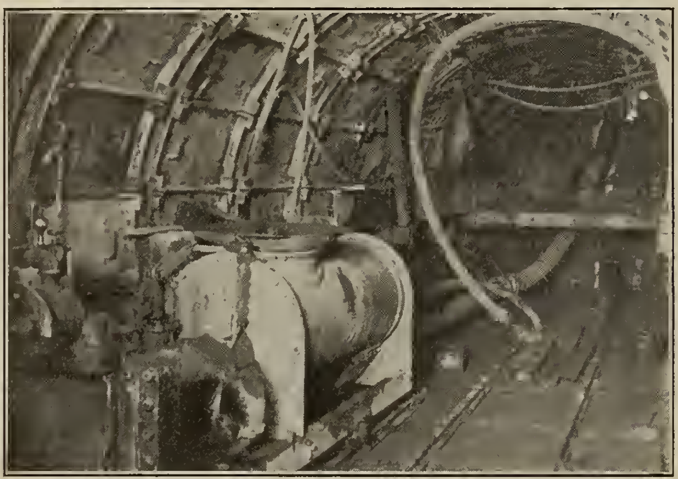

Figure No. 3.—Placing Concrete in Leaside Sewer.

inch have been recorded. It is hoped that the figures obtained will be published when the tests are complete.

The construction of sewers by the tunneling method is fairly simple in good ground at moderate depths, but considerable difficulty is encountered where the work has to be carried out in water-bearing strata, the difficulty increasing with the depth. In the North Toronto system it was necessary to carry out the construction of the main sewers very largely under compressed air to keep the tunnels free from water. Working shafts were placed about 2,000 feet apart, and were usually constructed by sinking concrete caissons from the ground surface to the sewer level. The caissons, with an air lock built in each, were sunk by mining below the bottom and allowing the constructed portion to sink a few feet. Another length was then built on at the top, and the process of mining and sinking was repeated until a point below the invert level of the sewer was reached. After constructing about 50 feet of sewer in each direction from this shaft, air locks were built in both sections of the sewer, and, when these were in commission, the vertical air lock was taken out, leaving the shaft clear to facilitate operations. Ground conditions made it necessary to carry out a large part of the work under air pressures of between 20 and 30 pounds per square inch in order to keep the headings fairly dry. At such pressures the working conditions are somewhat dangerous, and shortly after construction commenced a considerable amount of compressed air sickness occurred amongst the workmen. The seriousness of the situation was quickly recognized, and regulations governing the use of compressed air on such work were drawn up by the Provincial Board of Health, in conjunction with the Department of Works and the Department of Public Health of the city, and after consultation with the contractors who were carrying out the work. The regulations, which were put into force immediately, called for a limitation of the hours of work in accordance with increasing pressures; regular medical examination of workers; proper wash and rest rooms; a supply of hot coffee and sugar; identification badges for workmen, and, in addition to other requirements, the maintenance of a medical compressed air lock. For pressures up to 22 pounds per square inch. working hours are limited to two shifts per day of four hours each; from 22 to 29 pounds, two shifts of three hours each; and from 29 to 34 pounds, two shifts of two hours each. A further reduction in working hours is made for higher pressures. The period of decompression on coming out of compressed air is very important, and varies from 15 minutes for 22 pounds per square inch to 40 minutes for 40 pounds per square inch. An inspector was specially appointed by the provincial authorities to see that the regulations were properly carried out. All air locks were fitted with recording pressure gauges as a check on the method of air lock operation. The effect of the enforcement of the regulations was very marked, and sickness was much reduced.

The most common form of compressed air sickness affects the limbs, and is generally known as the "bends." Whilst under pressure, the blood is called upon to absorb an excess amount of oxygen and nitrogen. The former is more readily absorbed than the latter, and small bubbles of nitrogen are formed in the blood stream. Some of these bubbles settle in the joints, and expand when the worker passes to atmospheric pressure, causing violent pains in, and incapacity to use, the limbs. An attack is sometimes delayed as much as an hour after leaving the air lock. The most effective remedy is for the worker to return under pressure, and whilst this is being slowly reduced, to move and gently exercise the limbs. Another frequent form of compressed air sickness, commonly known as the "staggers," affects the balancing nerves, so that the worker is sometimes unable to stand. A prolonged period in hospital is often required before a cure can be effected.

The medical lock is usually in the form of a steel boiler, with a diaphragm across the middle, and air-tight doors in one end and in the diaphragm. One compartment is fitted with an electric heater and a bed for the use of the patient. The doctor or attendant can remain in the outer compartment at any desired pressure, observe the patient through a glass bull's-eye in the middle door, and regulate the pressure in either compartment by means of suitable valves and gauges.

The pressure and volume of compressed air necessary for the construction of any particular piece of tunnel work depends upon several factors, and cannot be determined by any rule. The nature of the sub-strata, the ground-water level, the size of the sewer, and the depth below the surface of the ground all have to be taken into consideration, and the engineer has to be guided simply by experience in determining what plant he will provide. In the North Toronto work, air pressures varied between ten and thirty pounds per square inch, and at one shaft the volume of free air used ran as high as 7,000 cubic feet per minute.

A general plan of the North Toronto trunk system is shown in figure No. 1. The work was divided into 25 contracts, and 292 contracts were let for the lateral sewers. Alternative bids were received for trunk sewer construction in brick or concrete, and where the price was the same, or the difference in price very small, brick construction was favoured. Generally speaking, all trunks constructed in

Figure No. 4.—Balliol Street Sewer showing "Flying Arch" Method of Construction.

open cut were of concrete, whilst brickwork was more usual in tunnel construction. As a result, about 80 per cent of the whole trunk system was of brickwork. The lateral sewers were almost entirely of vitrified tile pipe, but a comparatively small quantity of reinforced concrete pipe was used for sizes between 30 and 42 inches in diameter.

The brick sewers in tunnel were constructed by the usual method, which is well known and does not vary greatly. Concrete construction allows rather more variation in method, particularly in the manner of mixing and placing the concrete. Steel inner forms were used in all cases, and the placing of concrete was usually done by hand, with very good results. In one of the larger sewers, the contractors installed a mixing plant on the surface, and constructed a pipe chute to the tunnel behind the air lock, through which all concrete was conveyed. The chute discharged directly into hoppers on wheels, which were run along the tunnel and dumped into a concrete placer. The placer shown in figure No. 3 was operated by compressed air, and discharged the concrete through a flexible hose into place behind the forms. This method was found to be very satisfactory, and the results were excellent. No reinforcing material was used in the concrete sewers in tunnel construction. In practically all cases the tunnels were sheeted with timber before the sewer wall was built, and all sheeting was left in place.

In ground where it was difficult to hold the air pressure and keep the tunnel dry, the contractor was allowed to excavate for, and construct the top half of the sewer first, carrying this forward for a few shifts before constructing the invert. This is known as the "flying arch" method of construction, and is illustrated by figure No. 4. It should be used only as an emergency method, as the construction of short lengths of complete cross-section is more satisfactory. In such cases it was found necessary to take particular care with the joint at the springing line, in order to get a bond between the top and bottom sections of the sewer. As construction progressed, cement grout was forced under heavy pressure through pipes placed in the wall of the sewer to fill up all open joints in the work and cavities that might be left between the completed sewer and the surface of the excavation. Finally, any small leaks were caulked and filled, and rough spots in the sewer were finished off. Grouting after completion of the sewer wall was found to be necessary in both brick and concrete sewers where these passed through water-bearing strata.

It will readily be seen that very careful engineering work was necessary in transferring the line for the sewer from the surface down a shaft, producing this through the air locks, and sometimes around two or three curves to meet a similar line coming from a shaft two thousand feet away. Careful checking was always carried out by an engineer independently of the resident engineer on the job, and on joining up, the headings were never found to be more than an inch or two off line.

An activated sludge treatment plant has been built in the valley of the Don river to treat the sewage conveyed by this system, and the effluent is discharged into the river. The plant consists of grit chambers, preliminary and final sedimentation tanks, aeration tanks, sludge digestion tanks, glass-covered sludge drying beds, and storm water tanks. It is a very complete plant of the most modern type, designed by Dr. George G. Nasmith and Mr. Harrison P. Eddy, consulting engineers.

The whole of the work in connection with the above system was carried out under the direction of Mr. R. C. Harris, Commissioner of Works for the City of Toronto.

A Short Monograph on Nomography (Part II)*

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We have now discussed the elementary types of alignment charts which are composed of straight line scales. The simpler formulae involving three variables may be adapted to one or other of these types by suitable transformation.

Equations in three variables of a slightly more complicated nature may require treatment which will give charts containing one or more curved lines in place of the straight lines. The most general case, that having three curved lines, is given by the determinant form

$$\begin{vmatrix} f_1\alpha & f_2\alpha & 1 \\ \phi_1\beta & \phi_2\beta & 1 \\ \psi_1\gamma & \psi_2\gamma & 1 \end{vmatrix} = 0.$$

Here the α scale is given by the relations

$$x = f_1\alpha\,; \quad y = f_2\alpha\,;$$

which result in a curved locus unless these functions of α are linear. Similarly for the β and γ scales.

Two Parallel and One Curved Scale

We will consider first the case with one curved line. The determinant for this chart may be expressed

$$\begin{vmatrix} f_1\alpha & f_2\alpha & 1 \\ 0 & \beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0.$$

*Part I of this paper was published in the June 1930 issue of The Journal.

It is evident that this determinant is more difficult to transform, as one of the constants in the first column has been replaced by a function. If it is found that this form gives an α scale which lies outside the β and γ scales, and if it is considered desirable to bring the α scale between the other two scales (as for instance when the α scale is found to extend to a great distance from the others), the determinant may be expressed in the alternative form

$$\begin{vmatrix} \dfrac{-f_1\alpha}{1-2f_1\alpha} & \dfrac{f_2\alpha}{1-2f_1\alpha} & 1 \\ 0 & \beta & 1 \\ 1 & -\gamma & 1 \end{vmatrix} = 0.$$

Here we have simply reversed the γ scale with respect to the β scale.

The key determinants for the two kinds of transformation (enlargement of one of the scales and translation vertically) follow. The steps traversed in arriving at these transformations are not given but are left as an exercise for the reader.

Equation:— $f_1\alpha\,(\beta - \gamma) + f_2\alpha - \beta = 0$

or $$\frac{f_1\alpha - 1}{f_1\alpha}\,\beta - \gamma + \frac{f_2\alpha}{f_1\alpha} = 0$$

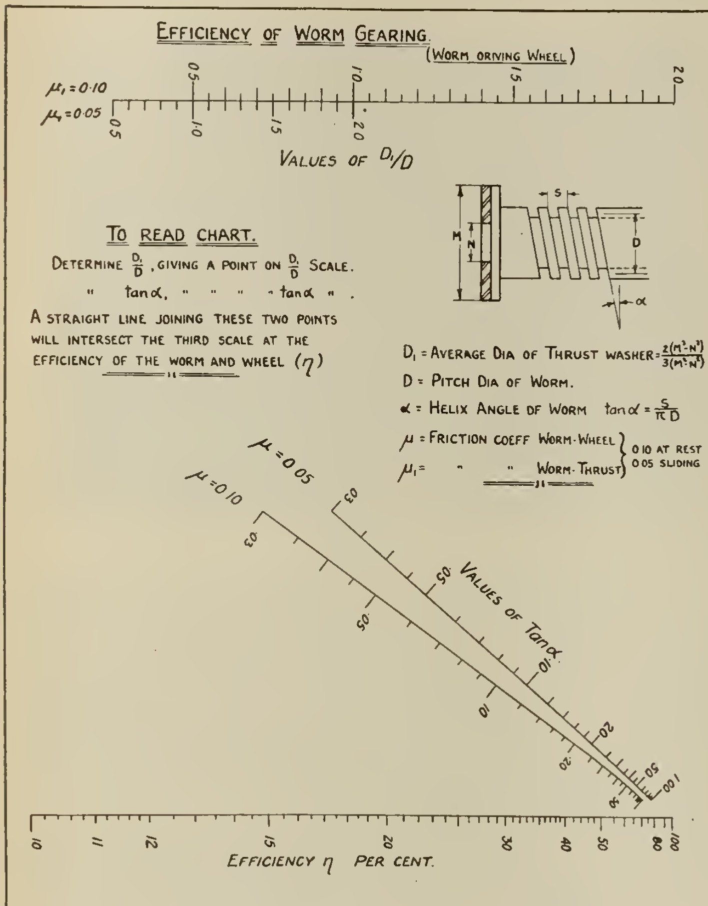

Figure No. 15.

(*a*) Case when $f_1\alpha$ has values lying between 0 and 1.

$$\begin{vmatrix} f_1 & f_2 & 1 \\ 0 & \beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{f_1}{(1-m)f_1+m} & \dfrac{mf_2}{(1-m)f_1+m} & 1 \\ 0 & \beta & 1 \\ 1 & m\gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{f_1}{(1-m)f_1+m} & \dfrac{mf_2+nf_1}{(1-m)f_1+m} & 1 \\ 0 & \beta & 1 \\ 1 & m\gamma+n & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{mf_1}{(m-1)f_1+1} & \dfrac{mf_2}{(m-1)f_1+1} & 1 \\ 0 & m\beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{mf_1}{(m-1)f_1+1} & \dfrac{m(f_2+nf_1)}{(m-1)f_1+1} & 1 \\ 0 & m\beta & 1 \\ 1 & \gamma+n & 1 \end{vmatrix} = 0$$

(*b*) Case when $f_1\alpha$ has values either greater than 1 or negative.

$$\begin{vmatrix} \dfrac{f_1}{(1+m)f_1-m} & \dfrac{-mf_2}{(1+m)f_1-m} & 1 \\ 0 & \beta & 1 \\ 1 & -m\gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{f_1}{(1+m)f_1-m} & \dfrac{-mf_2+nf_1}{(1+m)f_1-m} & 1 \\ 0 & \beta & 1 \\ 1 & -m\gamma+n & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{mf_1}{(1+m)f_1-1} & \dfrac{mf_2}{(1+m)f_1-1} & 1 \\ 0 & -m\beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{mf_1}{(1+m)f_1-1} & \dfrac{m(f_2+nf_1)}{(1+m)f_1-1} & 1 \\ 0 & -m\beta & 1 \\ 1 & \gamma+n & 1 \end{vmatrix} = 0$$

Note that m is assumed as positive, n may be either positive or negative.

Illustration. The equation for the efficiency of worm gearing with the worm driving the wheel is

$$\eta = \frac{\tan\alpha}{\left\{\tan(\alpha+\phi) + \dfrac{D_1}{D}\tan\phi_1\right\}}$$

(See figure No. 15)

Here ϕ and ϕ_1 are constants, denoting angles of friction. η, α, D_1 and D are the variables, the last two being suitably combined in the form D_1/D, thus reducing the number of variables to three. We see that it is necessary to form a determinant with $\tan\alpha$ and $\tan(\alpha+\phi)$ in the same row. If we denote

$$\tan\alpha \text{ by } A_1;\ \tan(\alpha+\phi) \text{ by } A_2;\ \frac{D_1}{D}\tan\phi_1 \text{ by } B;$$

and η by C, the equation takes the form $C(A_2+B) = A_1$. The first trial determinant is, say,

$$\begin{vmatrix} C & 0 & 1 \\ 0 & A_2 & 1 \\ \dfrac{A_1}{A_2} & -B & 1 \end{vmatrix} = 0$$

This was obtained by filling in the C, A_2 and $-B$, to represent $C(A_2+B)$; then it was found that $\dfrac{A_1}{A_2}$ was necessary in the lower left hand corner, with the two zeros as shown.

If we divide the second column by $-A_2B$ this becomes

$$\begin{vmatrix} C & 0 & 1 \\ 0 & -\dfrac{1}{B} & 1 \\ \dfrac{A_1}{A_2} & \dfrac{1}{A_2} & 1 \end{vmatrix} = 0.$$

In this form the C and B scales are perpendicular to each other; therefore we transform as follows:—

$$\rightarrow \begin{vmatrix} C & 0 & 1 \\ 0 & -1 & B \\ A_1 & 1 & A_2 \end{vmatrix} \rightarrow \begin{vmatrix} 1 & 0 & \dfrac{1}{C} \\ 0 & -1 & B \\ A_1 & 1 & A_2 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 1 & 0+1 & \dfrac{1}{C} \\ 0 & -1+0 & B \\ A_1 & 1+A_1 & A_2 \end{vmatrix} \text{ or } \begin{vmatrix} 1 & 1 & \dfrac{1}{C} \\ 0 & -1 & B \\ A_1 & 1+A_1 & A_2 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 1 & 1 & \dfrac{1}{C} \\ 0 & -1 & B \\ \dfrac{A_1}{1+A_1} & 1 & \dfrac{A_2}{1+A_1} \end{vmatrix} \rightarrow \begin{vmatrix} 1 & \dfrac{1}{C} & 1 \\ 0 & -B & 1 \\ \dfrac{A_1}{1+A_1} & \dfrac{A_2}{1+A_1} & 1 \end{vmatrix} = 0$$

We could have found this determinant form by a purely analytical transformation of the equation $C\,(A_2 + B) = A_1$ to the form

$$\frac{f_1\alpha - 1}{f_1\alpha}\,\beta - \gamma + \frac{f_2\alpha}{f_1\alpha} = 0$$

Thus our equation gives

$$A_2 + B = \frac{A_1}{C} \quad \text{or} \quad \frac{A_2}{A_1} + \frac{1}{A_1}\,B = \frac{1}{C}$$

or

$$\frac{1}{A_1}\,B - \frac{1}{C} + \frac{A_2}{A_1} = 0$$

Here B corresponds to β; $\frac{1}{C}$ corresponds to γ;

$$\frac{1}{A_1} = \frac{f_1\alpha - 1}{f_1\alpha}; \quad \frac{A_2}{A_1} = \frac{f_2\alpha}{f_1\alpha};$$

Hence the determinant form

$$\begin{vmatrix} f_1\alpha & f_2\alpha & 1 \\ 0 & \beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0$$

corresponds to

$$\begin{vmatrix} \frac{A_1}{A_1 - 1} & \frac{A_2}{A_1 - 1} & 1 \\ 0 & B & 1 \\ 1 & \frac{1}{C} & 1 \end{vmatrix} = 0.$$

Transforming this to give a $(-B)$ scale by using $m = -1$ we obtain

$$\begin{vmatrix} \frac{A_1}{1 + A_1} & \frac{A_2}{1 + A_1} & 1 \\ 0 & -B & 1 \\ 1 & \frac{1}{C} & 1 \end{vmatrix} = 0.$$

Returning to the equation for the efficiency of worm gearing, it is assumed that the efficiency range is from 10 to 100%. Therefore $\frac{1}{C}$ varies between 10 and 1, or over 9 units. The $\frac{D_1}{D}$ range is assumed as 0.5 to 2, and using a value of $\tan\phi_1 = 0.10$ this gives a range for the B scale of $-B = -0.05$ to -0.2, approximately 0.2 units. It is seen that the A scale lies between the other two scales since A_1 is always positive.

Our first transformation will therefore be the magnifying of the B scale 45 times (i.e. $9 \div 0.2$). Substituting $m = 45$ in the key determinant concerning $m\beta$, we get

$$\frac{mf_1}{f_1\,(m-1) + 1} = \frac{45\,A_1}{44\,A_1 + (1 + A_1)} = \frac{45\,A_1}{1 + 45\,A_1}$$

since

$$f_1 = \frac{A_1}{1 + A_1}$$

similarly

$$\frac{mf_2}{f_1\,(m-1) + 1} = \frac{45\,A_2}{1 + 45\,A_1}$$

and our determinant becomes

$$\begin{vmatrix} \frac{45\,A_1}{1 + 45\,A_1} & \frac{45\,A_2}{1 + 45\,A_1} & 1 \\ 0 & -45\,B & 1 \\ 1 & \frac{1}{C} & 1 \end{vmatrix} = 0.$$

Here it is seen that the C scale is 10 units higher than the B scale, because $\frac{1}{C}$ has a range from 1 to 10, and $-45\,B$ has a range from 0 to -9. Therefore use the value $n = -10$ and obtain the final form

$$\begin{vmatrix} \frac{45\,A_1}{1 + 45\,A_1} & \frac{45\,(A_2 - 10\,A_1)}{1 + 45\,A_1} & 1 \\ 0 & -45\,B & 1 \\ 1 & \frac{1}{C} - 10 & 1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} \frac{45\tan\alpha}{1 + 45\tan\alpha} & \frac{5\,(10\tan\alpha - \tan\overline{\alpha + \phi})}{1 + 45\tan\alpha} & 1 \\ 0 & 5\frac{D_1}{D}\tan\phi_1 & 1 \\ 1 & \frac{1}{9}\left(10 - \frac{1}{\eta}\right) & 1 \end{vmatrix} = 0$$

The chart has been constructed for two values of $\tan\phi_1$ (0.05 and 0.10) and also for two values of $\tan\phi$ (0.05 and 0.10). This is done to make the nomogram more comprehensive. In any particular problem interpolation can be made quite easily in case some intermediate value of $\tan\phi$ or of $\tan\phi_1$ is to be used.

For purposes of comparison a second chart has been made in which the α scale lies outside the other two scales. Here we use the key determinant containing the term $-m\beta$, where m is chosen equal to 50. This choice is made instead of 45 in order to reduce the length of the α scale. The resulting form is

$$\begin{vmatrix} \frac{50\tan\alpha}{50\tan\alpha - 1} & \frac{50\tan(\alpha + \phi)}{50\tan\alpha - 1} & 1 \\ 0 & 50\,\frac{D_1}{D_1}\tan\phi_1 & 1 \\ 1 & \frac{1}{\eta} & 1 \end{vmatrix} = 0$$

(See figure No. 16)

No further transformation is necessary since the two parallel scales are found to lie opposite each other in this form.

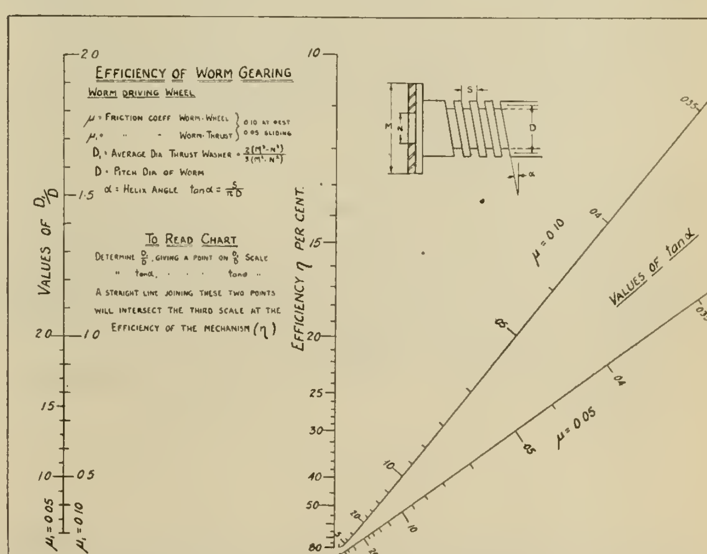

Figure No. 16.

In some cases the determinant form

$$\begin{vmatrix} f_1\alpha & f_2\alpha & 1 \\ 0 & \beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} = 0$$

is not suitable because better results might be obtained by using the reciprocal scales $\frac{1}{\beta}$ and $\frac{1}{\gamma}$. The new form is found to be

$$\begin{vmatrix} \frac{f_1\alpha}{f_2\alpha} & \frac{1 - f_1\alpha}{f_2\alpha} & 1 \\ 0 & \frac{1}{\beta} & 1 \\ \frac{1}{\gamma} & 0 & 1 \end{vmatrix} = 0$$

This gives two perpendicular scales in place of the parallel scales, a result which seems to follow in general whenever two scales are changed to their reciprocals.

If the above form is found to give an α scale unsuitable for plotting (for instance one lying beyond the quadrant of the $\beta\gamma$ scales) the modified form

$$\begin{vmatrix} \frac{f_1\alpha}{f_2\alpha-(m-n)f_1\alpha+m} & \frac{1-f_1\alpha}{f_2\alpha-(m-n)f_1\alpha+m} & 1 \\ 0 & \frac{1}{\beta+m} & 1 \\ \frac{1}{\gamma+n} & 0 & 1 \end{vmatrix} = 0$$

may be used.

By a suitable choice of m and n the β and γ scales may be translated laterally. If either one is translated across to the other side of the origin, it will be found that the α scale has been brought within the $\beta\gamma$ quadrant. Suppose, for instance β has a range of values from 1 to 20. then $\frac{1}{\beta}$ will be graduated from 1 unit to $\frac{1}{20}$ unit above the origin. By choosing $m = -21$, the $\frac{1}{\beta + m}$ scale will be graduated from $\frac{1}{20}$ to 1 unit below the origin, and still in the same direction.

Of course we may in any case use different sizes for our scales along the X and the Y directions. This use of different scale sizes is equivalent to multiplying either the first column, or the second column by some constant.

In case one of the variables β or γ has a range of values passing through zero, thus making the expression $\frac{1}{\beta}$ or $\frac{1}{\gamma}$ indeterminate for the zero value of the variable, the form just given in which m and n are to be given suitable values will overcome the difficulty.

No illustration has been chosen for this case since it is not used to any great extent. Parallel scale charts are preferable where possible because of the greater accuracy obtainable. In charts with perpendicular scales only half the area of the paper is utilized.

The more general case with three curved scales, given by the form

$$\begin{vmatrix} \alpha_1 & \alpha_2 & 1 \\ \beta_1 & \beta_2 & 1 \\ \gamma_1 & \gamma_2 & 1 \end{vmatrix} = 0$$

cannot be treated in any routine manner. Sometimes, however, depending on the form of the equation in the particular case, suitable multiples of columns one and two may be taken and manipulated in such a manner as to eliminate one of the variable elements of the determinant, giving the new form

$$\rightarrow \begin{vmatrix} n\alpha_1 + m\alpha_2 + l & \alpha_2 & 1 \\ n\beta_1 + m\beta_2 + l & \beta_2 & 1 \\ n\gamma_1 + m\gamma_2 + l & \gamma_2 & 1 \end{vmatrix} = \begin{vmatrix} \alpha_3 & \alpha_2 & 1 \\ \beta_3 & \beta_2 & 1 \\ 0 & \gamma_2 & 1 \end{vmatrix} = 0$$

which gives two curved scales and one straight scale.

There is not much transformation possible here, except to the forms

$$\begin{vmatrix} \frac{\alpha_3}{\alpha_2} & \frac{1}{\alpha_2} & 1 \\ \frac{\beta_3}{\beta_2} & \frac{1}{\beta_2} & 1 \\ 0 & \frac{1}{\gamma_2} & 1 \end{vmatrix} = 0 \qquad \begin{vmatrix} \alpha_3 & a\alpha_2 + b\alpha_3 + c & 1 \\ \beta_3 & a\beta_2 + b\beta_3 + c & 1 \\ 0 & a\gamma_2 + c & 1 \end{vmatrix} = 0$$

Equations Containing Four Variables

There are two main methods of making nomograms for these equations. (a) The first may be called the "successive partial solution" method. To illustrate this method, let us consider the example $\alpha + \beta + \gamma + \delta = 0$. A nomogram is first made for the equation $\alpha + \beta = P$ which may take the form of three parallel scales for α, β, and P. Given values of α and β will thus secure corresponding values of P. The next step is to construct a nomogram for the relation $P + \gamma + \delta = 0$, which also may take the form of three parallel scales for P, γ, and δ. If care is taken to have the P scale the same in both of these nomograms, they may be superimposed on each other and the same P scale may be used in connection with γ and δ as is used with α and β. The P scale is generally called the support scale. Our chart will then be made up of five scales for α, β, P, γ, and δ.

The advantage of these charts is that they are easy to construct. They are used almost exclusively in cases in which the scales may be constructed along sets of parallel lines. For this reason they have a limited application. They have also the disadvantage that errors in reading are accumulative particularly in cases involving five or six variables. (b) The second method employs a combination of the alignment chart and the intersection chart. An example is given in the chart for yield of bonds to maturity (figure No. 17). Here the two variables n = time and Y = yield, are represented by sets of lines, the Y lines being straight and the n lines slightly curved. The intersection of an n and a Y line gives a point which is collinear with a point on the I scale on one side and a point on the Present Value scale on the other.

The simplest case for such a chart is given by the form

$$\begin{vmatrix} \alpha & \beta & 1 \\ 0 & \gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0$$

Here the two sets of lines $x = \alpha$ and $y = \beta$ will determine (by their intersection) points (α, β) which must be collinear with points on the γ and δ scales.

A slightly more complicated case is given by the equation

$$\begin{vmatrix} f_1(\alpha, \beta) & f_2(\alpha, \beta) & 1 \\ 0 & \gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0$$

Here the sets of lines for α and β need not be straight, and they are in general inclined to the principal axes. In order to plot these sets of lines it is necessary to take the equations $x = f_1(\alpha, \beta)$; $y = f_2(\alpha, \beta)$ and eliminate one or other of the variables from them, obtaining two new equations

$$F_1(x, y) = \phi\alpha \text{ and } F_2(x, y) = \psi\beta.$$

By substituting particular values for α and β these equations will give us curves which may be plotted as ordinary graphs in x and y. If this elimination cannot be effected without excessive labour, it will be necessary to substitute in the equations $x = f_1(\alpha, \beta)$ and $y = f_2(\alpha, \beta)$ simultaneous values of α and β and evaluate corresponding values of x and y. These points may then be plotted, and all points having the same value of α (or the same value of β) joined up.

It may be a difficult matter to express the given equation in one of the determinant forms given above. There are two ways of proceeding. (*a*) The first is by transforming the given equation analytically until it has the appearance of the expanded form of the determinant, e.g., $\alpha(\gamma - \delta) + \beta - \gamma = 0$

or $$f_1(\alpha, \beta)(\gamma - \delta) + f_2(\alpha, \beta) - \gamma = 0.$$

(*b*) The second is by putting the given equation immediately into some determinant form which may suggest itself in a haphazard way, and then transforming this determinant by use of the set of rules.

A systematic method of attack during this stage of the work seems impossible to formulate. A given equation may or may not be expressible in this type of chart. The nature of the results of the investigation depends on the form of the equation and on the ingenuity and experience of the student.

Let us assume that we have obtained the form

$$\begin{vmatrix} \alpha & \beta & 1 \\ 0 & \gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0$$

The transformations of this determinant are similar to those in the case of the nomogram with two straight and one curved scale.

They are:

$$\begin{vmatrix} \dfrac{\alpha}{(1-m)\alpha + m} & \dfrac{m\beta}{(1-m)\alpha + m} & 1 \\ 0 & \gamma & 1 \\ 1 & m\delta & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{\alpha}{(1-m)\alpha + m} & \dfrac{m\beta + n\alpha}{(1-m)\alpha + m} & 1 \\ 0 & \gamma & 1 \\ 1 & m\delta + n & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{m\alpha}{(m-1)\alpha + 1} & \dfrac{m\beta}{(m-1)\alpha + 1} & 1 \\ 0 & m\gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{m\alpha}{(m-1)\alpha + 1} & \dfrac{m(\beta + n\alpha)}{(m-1)\alpha + 1} & 1 \\ 0 & m\gamma & 1 \\ 1 & \delta + n & 1 \end{vmatrix} = 0$$

(Suitable for cases in which α lies between 0 and 1, or does not extend far beyond the γ and δ scales.)

$$\begin{vmatrix} \dfrac{\alpha}{(1+m)\alpha - m} & \dfrac{-m\beta}{(1+m)\alpha - m} & 1 \\ 0 & \gamma & 1 \\ 1 & -m\delta & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{\alpha}{(1+m)\alpha - m} & \dfrac{-m\beta + n\alpha}{(1+m)\alpha - m} & 1 \\ 0 & \gamma & 1 \\ 1 & -m\delta + n & 1 \end{vmatrix} = 0$$

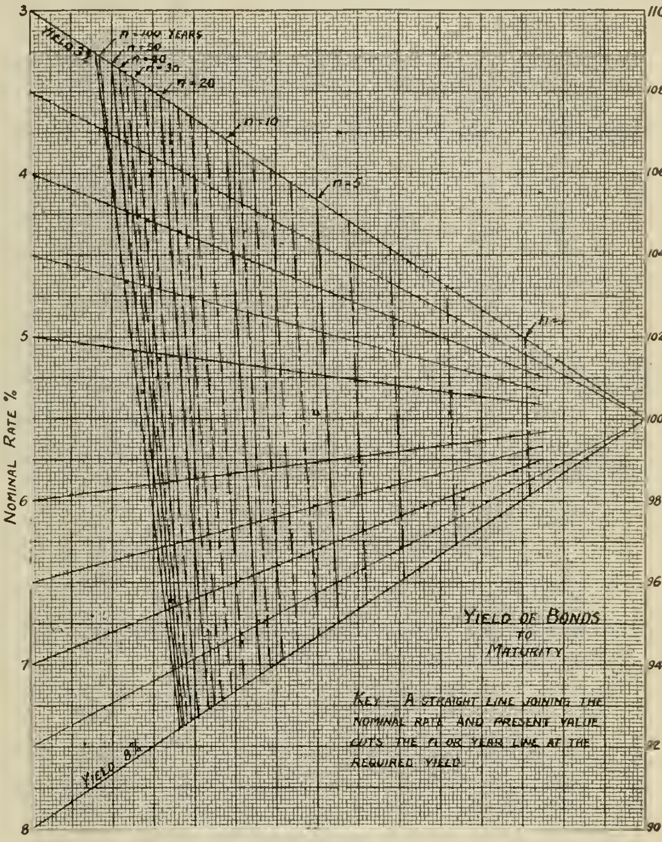

Figure No. 17.

or

$$\begin{vmatrix} \dfrac{-m\alpha}{1-(m+1)\alpha} & \dfrac{-m\beta}{1-(m+1)\alpha} & 1 \\ 0 & -m\gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} \dfrac{-m\alpha}{1-(m+1)\alpha} & \dfrac{-m(\beta + n\alpha)}{1-(m+1)\alpha} & 1 \\ 0 & -m\gamma & 1 \\ 1 & \delta + n & 1 \end{vmatrix} = 0$$

(Suitable for other cases of α.) See also appendix B.

Example. Yield to maturity of bonds given by the equation

$$R\frac{I^n - 1}{I - 1} - PI^n + 100 = 0,$$

where P = present value of \$100 bond.
R = Nominal rate of interest per cent, or yearly dividend on the bond.
n = Number of years to maturity.
I = $1 + \text{yield} = 1 + Y$.

(See figure No. 17)

The yield Y is the interest bearing value of the bond as an investment.

If for instance the returns from the initial investment of P dollars are equivalent to a yield of 6% on this investment, then $I = 1.06$.

Let us first use the analytical method of transforming the given equation to the form

$$f_1(\alpha, \beta)(\gamma - \delta) + f_2(\alpha, \beta) - \gamma = 0.$$

We first obtain:

$$\frac{I^n - 1}{I - 1}(R + P) - P\left(\frac{I^n - 1}{I - 1} + I^n\right) + 100 = 0$$

or

$$\frac{I^n - 1}{I - 1}(R + P) - P\frac{I^{n+1} - 1}{I - 1} + 100 = 0.$$

This gives directly

$$\frac{I^n - 1}{I^{n+1} - 1}(R + P) - P + \frac{100\,(I - 1)}{I^{n+1} - 1} = 0,$$

so that we have the substitutions

$$f_1(\alpha, \beta) = \frac{I^n - 1}{I^{n+1} - 1};\quad f_2(\alpha, \beta) = \frac{100\,(I - 1)}{I^{n+1} - 1};$$

$$\gamma = P\,;\quad \delta = -R;$$

giving the determinant

$$\begin{vmatrix} \dfrac{I^{n-1}}{I^{n+1} + 1} & \dfrac{100\,(I - 1)}{I^{n+1} - 1} & 1 \\ 0 & P & 1 \\ 1 & -R & 1 \end{vmatrix} = 0.$$

Using the second method we may take as our first trial determinant

$$\begin{vmatrix} R & 1 & 0 \\ -100 & \dfrac{I^n - 1}{I - 1} & I^n \\ -P & 0 & 1 \end{vmatrix} = 0$$

We can divide the three rows by R, -100, and $-P$ respectively, and obtain the new form

$$\begin{vmatrix} \dfrac{I^n - 1}{100\,(I - 1)} & \dfrac{I^n}{100} & 1 \\ -\dfrac{1}{R} & 0 & 1 \\ 0 & \dfrac{1}{P} & 1 \end{vmatrix} = 0$$

This would give us the two scales $-\frac{1}{R}$ and $\frac{1}{P}$ perpendicular to each other. It is evident from previous discussion that this may be transformed to give two parallel scales of $-R$ and P. There are two ways of doing this. (1) The first is by comparing the two forms

$$\begin{vmatrix} f_1 & f_2 & 1 \\ 0 & \beta & 1 \\ 1 & \gamma & 1 \end{vmatrix} \quad \text{and} \quad \begin{vmatrix} \dfrac{f_1}{f_2} & \dfrac{1 - f_1}{f_2} & 1 \\ 0 & \dfrac{1}{\beta} & 1 \\ \dfrac{1}{\gamma} & 0 & 1 \end{vmatrix}$$

Here we must solve for

$$\frac{f_1}{f_2} = \frac{I^n - 1}{100\,(I - 1)};\quad \frac{1 - f_1}{f_2} = \frac{I^n}{100},$$

giving

$$f_1 = \frac{I^n - 1}{I^{n+1} - 1};\quad f_2 = \frac{100\,(I - 1)}{I^{n+1} - 1},$$

so that the required form is

$$\begin{vmatrix} \dfrac{I^n - 1}{I^{n+1} - 1} & \dfrac{100\,(I - 1)}{I^{n+1} - 1} & 1 \\ 0 & P & 1 \\ 1 & -R & 1 \end{vmatrix} = 0$$

as already obtained by the analytical method.

(ii) The second way is by determinant transformation which will not be carried out here.

It is found by inspection that the (I, n) network of lines lies between the scales of P and $-R$, i.e. that $(I^n - 1) \div (I^{n+1} - 1)$ is a positive proper fraction. It is therefore unnecessary to reverse the R scale in sign.

For the chart it is desired to show the following ranges of value:—

R from 3 to 8, P from 90 to 110, n and I to suit.

In its present form, the determinant gives the R scale 5 units in length and the P scale 20 units long. Therefore, we must multiply the R scale by the multiple $m = 4$ and the resulting $-4\,R$ scale has a range of values from -12 to -32. We must therefore raise the R scale a distance $n = 90 + 32 = 122$ in order to place the P and R scales on the same level.

The final determinant form becomes

$$\begin{vmatrix} \dfrac{f_1}{(1 - m)\,f_1 + m} & \dfrac{mf_2 + nf_1}{(1 - m)\,f_1 + m} & 1 \\ 0 & \gamma & 1 \\ 1 & m\delta + n & 1 \end{vmatrix} = 0$$

where

$$f_1 = \frac{I^n - 1}{I^{n+1} - 1};\quad f_2 = \frac{100\,(I - 1)}{I^{n+1} - 1};$$

$$\gamma = P\,;\quad \delta = -R\,;\quad m = 4\,;\quad n = 122.$$

After substituting and simplifying, this reduces to

$$\begin{vmatrix} \dfrac{I^n - 1}{4\,I^{n+1} - 3\,I^n - 1} & \dfrac{122\,I^n + 400\,I - 522}{4\,I^{n+1} - 3\,I^n - 1} & 1 \\ 0 & P & 1 \\ 1 & 122 - 4\,R & 1 \end{vmatrix} = 0$$

It is a good policy to expand this final form and check it with the original equation before proceeding with the actual plotting.

To obtain the I or yield lines we must eliminate n from the equations

$$x = \frac{I^n - 1}{4\,I^{n+1} - 3\,I^n - 1};\quad y = \frac{122\,I^n + 400\,I - 522}{4\,I^{n+1} - 3\,I^n - 1};$$

Denoting $(I^n - 1)$ by N, these relations become

$$x = \frac{N}{4\,IN - 3\,N + 4\,I - 4};\quad y = \frac{122\,N + 400\,(I - 1)}{4\,IN - 3\,N + 4\,I - 4};$$

Eliminating N from these equations, we obtain

$$\frac{y}{x} = \frac{122\,N + 400\,I - 400}{N} \quad \therefore \text{ giving } \quad N = \frac{400\,x\,(I - 1)}{y - 122\,x};$$

Substituting this for N in the equation in x above, we get

$$4\,x\,(I - 1) = N\,(1 + 3\,x - 4\,Ix);$$

i.e.,

$$\frac{4\,x\,(I - 1)}{1 + 3\,x - 4\,Ix} = \frac{400\,x\,(I - 1)}{y - 122\,x}$$

which reduces to

$$y = (422 - 400\,I)\,x + 100.$$

We have taken some trouble to effect this elimination of n but have been more than repaid in finding that I lines are straight. We could have plotted the I and n lines by substituting simultaneous values of I and n in the equations in x and y, and evaluating x and y for each case.

On inspecting the chart we see that there are eleven I lines and twenty-two n lines. This would require 242 separate determinations of x and y. However, we may with our present knowledge plot the I lines quite easily. All that remains is to determine a sufficient number of points on the n lines to obtain smooth curves. If we determine the value of x where each n line cuts the integral yield lines (i.e. at yields of 3, 4, 5, 6, 7, 8) we should have no difficulty in plotting. This means 6 × 22 or 132 separate determinations of x only, evidently a great saving in labour.

On inspection of the equation for the I lines.

$$y = (422 - 400\,I)\,x + 100,$$

it is seen that for $x = 0$, $y = 100$ irrespective of the value of I. Therefore all I lines meet on the P scale at $P = 100$.

Again putting $x = 1$, we find that

$$y = 522 - 400\, I = 522 - 400\,(1 + Y)$$
$$= 122 - 400\, Y = 122 - 4 \text{ times yield in percent.}$$

But the R scale is plotted according to this formula ($y = 122 - 4\,R$). Therefore our I linescut the R scale at the corresponding values of R and each I line passing through an R point may be arked as a yield line, with yield the same as the value of R.

For plotting the n lines, we must use the relation

$$x = \frac{I^n - 1}{4\,I^{n+1} - 3\,I^n - 1} = \frac{I^n - 1}{I^n(4\,I - 3) - 1}.$$

The work may be conveniently tabulated with columns for $I = 1.03$, 1.04 etc. and rows for values of n. Values of I^n may be determined and entered in this table, and coupled with each value, and directly underneath it. the corresponding value of $I^n\,(4\,I - 3)$. The value of x may then be read off a slide rule, or, if thought necessary, a table of logaritthms may be resorted to. If any value of x appears to be incorrect on plotting, the table affords a convenient method of checking.

There are some equations in four variables which permit a choice of the network variables α and β. In the example just illustrated this is not the case, as the I and n variables are practically inseparable, unless we are willing to deal with three-variable functions e.g.

$$n \log I = \log\,(R - 100\,I + 100) - \log\,(R - PI + P)$$

If we take the example

$$K^3 - 3\left(\frac{1}{2} - \frac{x_o}{t}\right)K^2 + 6\,np_o\frac{x_o}{t}K - 3\,np_o\left\{\frac{x_o}{t} + 2\left(\frac{1}{2} - \frac{d'}{t}\right)^2\right\} = 0$$

(From Hool and Johnson's Concrete Engineers' Handbook) where the variables are, $K\frac{x_o}{t}$, p_o, $\frac{d'}{t}$. This may be written

$$K^3 - \tfrac{3}{2}\,(1 - 2\,A)\,K^2 + 6\,nABK - 3\,nB\left\{A + \tfrac{1}{2}\left((1 - 2\,C)^2\right)\right\} = 0$$

where

$$A = \frac{x_o}{t};\; B = p_o\;;\; C = \frac{d'}{t}\;;$$

to give the determinant form

$$\begin{vmatrix} f_1\,(\alpha, \beta) & f_2\,(\alpha, \beta) & 1 \\ 0 & \gamma & 1 \\ 1 & \delta & 1 \end{vmatrix} = 0,$$

this equation must be expressed as

$$f_1\,(\alpha, \beta)\,(\gamma - \delta) + f_2\,(\alpha, \beta) - \gamma = 0.$$

We see that there is no term containing both γ and δ here, so that if we wish to have a network of $\alpha\;\beta$ lines, there must be no term containing both γ and δ.

(*a*) Suppose we wish to have a chart with a network for the variables K and B. Our given equation is in a suitable elementary form since it contains no term including both A and C. We therefore rearrange it

$$(K^3 - \tfrac{3}{2}\,K^2) + 3\,A\,(K^2 + 2\,nBK) - 3nAB - \tfrac{3}{2}\,nB\,(1 - 2\,C)^2 = 0$$

The desired form is

$$f_1\,(K, B)\,(A_1 - C_1) + f_2\,(K, B) - A_1 = 0.$$

Therefore we divide through by $\frac{3}{2}\,(K^2 + 2\,nBK)$ and obtain

$$\frac{nB}{K^2 + 2n\,BK}\left\{-\,2A - (1 - 2C)^2\right\} + \frac{2\,K^3 - 3\,K^2}{3\,(K^2 + 2\,nBK)} + 2\,A = 0$$

The determinant form of this is

$$\begin{vmatrix} \dfrac{nB}{K\,(K + 2\,nB)} & \dfrac{K\,(2\,K - 3)}{3\,(K + 2\,nB)} & 1 \\ 0 & -\,2\,A & 1 \\ 1 & (1 - 2\,C)^2 & 1 \end{vmatrix} = 0$$

(*b*) If we wish to have a chart with a network for K and A, we must eliminate the term containing B and C. Dividing through by $3\,nB$ we have

$$K^3 - \tfrac{3}{2}\,K^2 + 3\,AK^2)\,\frac{1}{3\,nB} + (2\,AK - A) - \tfrac{1}{2}\,(1 - 2\,C)^2 = 0$$

This must be of the form

$$f_1\,(K, A)\,(C_1 - B_1) + f_2\,(K, A) - C_1 = 0$$

Therefore we transform thus:—

$$K^2\,(K - \tfrac{3}{2} + 3\,A)\left\{\frac{1}{3\,nB} - \tfrac{1}{2}\,(1 - 2\,C)^2\right\}$$
$$+ \tfrac{1}{2}\,(1 - 2\,C)^2\left\{K^2\,(K - \tfrac{3}{2} + 3\,A) - 1\right\} + (2\,AK - A) = 0$$

or

$$\frac{K^2\,(K - \frac{3}{2} + 3\,A)}{K^2\,(K - \frac{3}{2} + 3\,A) - 1}\left\{-\,\tfrac{1}{2}\,(1 - 2\,C)^2 + \frac{1}{3\,nB}\right\} + \frac{2\,AK - A}{K^2\,(K - \frac{3}{2} + 3\,A) - 1} + \tfrac{1}{2}\,(1 - 2\,C)^2 = 0$$

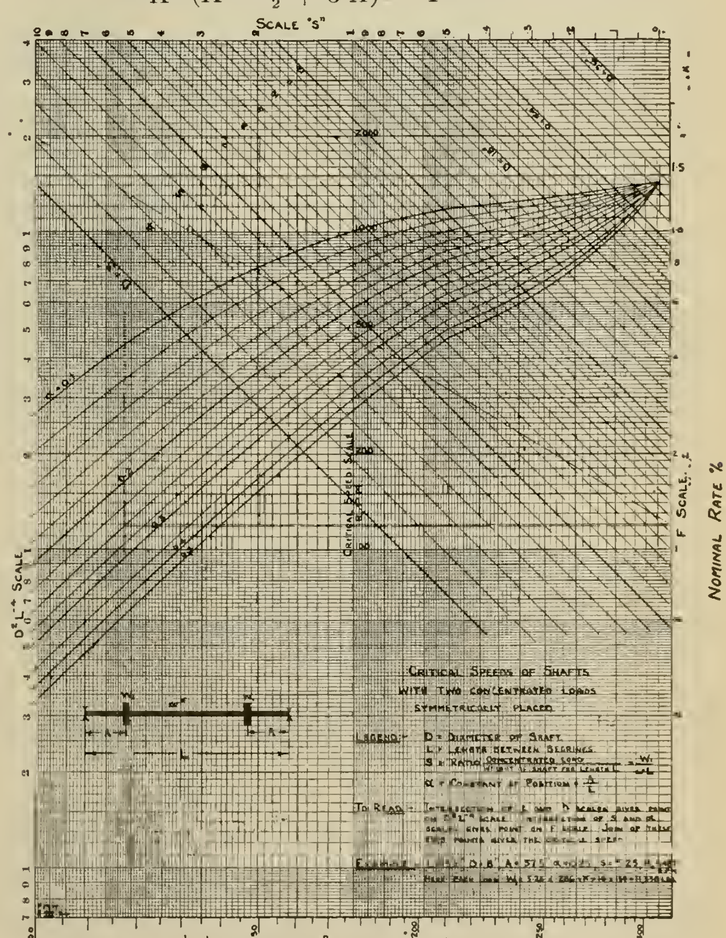

Figure No. 18.

This gives the determinant form

$$\begin{vmatrix} \dfrac{K^2(K-\frac{3}{2}+3A)}{K^2(K-\frac{3}{2}+3A)-1} & \dfrac{A(2K-1)}{K^2(K-\frac{3}{2}+3A)-1} & 1 \\ 0 & -\frac{1}{2}(1-2C)^2 & 1 \\ 1 & -\dfrac{1}{3nB} & 1 \end{vmatrix} = 0$$

which simplifies to

$$\begin{vmatrix} \dfrac{2}{K^2(2K-3+6A)+2} & \dfrac{-2A(2K-1)}{K^2(2K-3+6A)+2} & 1 \\ 0 & \dfrac{1}{3nB} & 1 \\ 1 & -\frac{1}{2}(1-2C)^2 & 1 \end{vmatrix} = 0$$

(c) If we try to use a network for the variables K and C we find it impossible to obtain a suitable form for charting after the terms containing A and B have been eliminated. The chart with the network of K and B lines does not appear as suitable as that with the network for K and A, because the (KB) network extends far beyond the space between the straight line scales for A and C. However, it is a good policy in any example to study with care each alternative in its elementary form before making a choice. No further discussion will be made of this example, since the actual chart does not differ essentially from that for the yield to maturity.

Binary Scales

In certain cases the equation may give a determinant form like

$$\begin{vmatrix} 0 & f(\alpha,\beta) & 1 \\ 1 & \gamma & 1 \\ 2 & \delta & 1 \end{vmatrix} = 0$$

Here the point given by the simultaneous values of α and β is on the line $x = 0$ and is not obtained by the intersection of an α and a β line. This scale along the $x = 0$ line is called a binary scale, and it is evident that every point on this scale will represent an infinite number of simultaneous values of α and β.

In order to facilitate the solution of these nomograms an auxiliary network of lines, made up of a set of α and a set of β lines, is chosen and drawn on the chart in a more or less arbitrary manner. This network must be arranged in such a way that the ordinate of the point of intersection of an α and a β line shall satisfy the relation $y = f(\alpha, \beta)$. Simultaneous values of α and β will thus give us the correct position on the $x = 0$ scale by simply projecting horizontally from this point of intersection of the α and β lines.

Speaking generally, what we have done is chosen arbitrarily two sets of lines

$$F_1(x, y) = \phi_1\alpha \quad \text{and} \quad F_2(x, y) = \phi_2\beta$$

which, on elimination of x, give us the relation $y = f(\alpha, \beta)$. An example should aid in the understanding of the above theoretical discussion. Let us take the formula which the writer has used in connection with some charts for critical speeds of shafts.

$$N_c^2 = K\frac{d^2}{l^4}\left(\frac{A+A_1+P.\,S+P_1S^2}{M+2N+P^2.\,S+M_1+2PP_1.\,S^2+P_1{}^2S^3}\right)$$

$$= K\frac{d^2}{l^4}F.$$

(See figure No. 18)

The expression F is a function of two variables, S and α, the symbols A, A_1, P, P_1, M, M_1, N, denoting various functions of α. Many of these α functions could not be determined easily except by graphical means, so that their functional relationship with α was not obtained algebraically.

The determinant for the equation was obtained by using its logarithmic form

$$2\log N_c = \log(Kd^2 \div l^4) + \log F,$$

which gives

$$\begin{vmatrix} 2 & \log F & 1 \\ 1 & \log N_c - 3 & 1 \\ 0 & \log\dfrac{Kd^2}{l^4 \times 10^6} & 1 \end{vmatrix} = 0$$

in the final form for plotting.

This is a parallel line nomogram with a ($\log N_c - 3$) scale in the centre, and two binary scales (one on each side) for $\log F$ and $\log\left(\dfrac{Kd^2}{10^6 l^4}\right)$.

Since the $\left(\dfrac{K\,d^2}{l^4}\right)$ scale is the simpler of the two, we will examine it first. The binary scale gives

$$y = \log\left(\frac{K}{10^6}\right) + \log(d^2) - \log(l^4)$$

In choosing the auxiliary network of d and l lines, the relation $x + y = \log(d^2)$ was chosen arbitrarily. In this way the d lines were a set of parallel lines inclined at 45° to the horizontal. It follows from this choice that the l lines must satisfy the relationship

$$x + \log\left(\frac{K}{10^6}\right) + \log(d^2) - \log(l^4) = \log(d^2),$$

or

$$x = \log(l^4) - \log\left(\frac{K}{10^6}\right).$$

The auxiliary network is thus made up of sets of d lines and l lines satisfying the equations

$$x + y = \log(d)^2 \quad \text{and} \quad x = \log(l^4) - \log\left(\frac{K}{10^6}\right).$$

The latter set of lines need not be drawn but may be represented by a scale along the bottom of the chart, marked off in accordance with the relation in x. To obtain a point on the binary $\left(\dfrac{d^2}{l^4}\right)$ scale, the point of intersection is obtained between the "d" line and the vertical "l" line. The ordinate of this point of intersection is projected horizontally across to the binary scale along $x = 0$.

Of course the binary scale is not marked in any way. It is simply a line on which points are obtained by the help of the network of "d" and "l" lines.

In order to have the "$l - d$" network within the boundaries of the chart, it may be necessary to modify slightly the arbitrary equations. The general form for these is

$$x = \log(l^4) - \log\frac{K}{10^6} + \text{constant } C$$

$$x + y = \log(d^2) \qquad + \text{constant } C$$

The scale along the X axis may be chosen arbitrarily, both as to its size and the position of the origin. The important point to bear in mind is that the Y scale must conform to the Y scales of the main determinant, and that the binary scale must be placed in conformity with the main determinant also; that is, along the line $x = 0$ in the main determinant.

Turning now to the binary scale for the function F, placed along the line $x = 2$ at the right border of the chart, the network of lines for the variables α and S was chosen as follows:—

An arbitrary scale for S was chosen and drawn along the top of the chart, so that the S lines are perpendicular to this scale, in the same way that the "l" lines are perpendicular to the "l" scale. In other words we have arbitrarily made S equal to some function of x.

To aid in plotting the (αS) network, the binary F scale has been marked off along the right side of the chart, and since our determinant tells us that $y = \log F$, the marking on the scale is logarithmic and similar to the marking of the N_c scale in the centre, with corresponding values reduced in the ratio $\frac{1}{1000}$, because the N_c scale has been plotted from the equation

$$y = \log N_c - 3.$$

The next step is to make a table of values for F for a set of fairly equally spaced values of S, and over a range of values of α required by the problem. The table may be arranged similarly to the table for the yield to maturity chart, with values of α marked along the top for the columns, and values of S marked down the side for the rows. The expression

$$F = \frac{A + (A_1 + P)\,S + P_1S^2}{M + (2\,N + P^2)\,S + (M_1 + 2\,PP_1)\,S^2 + P_1{}^2S^3}$$

is evaluated for each combination of S and α and entered in the table.

These values of F are now plotted as ordinates along the S lines and the points corresponding to each value of α joined by a curved line. We thus obtain a set of α lines and the intersection of any S and any α line will determine a point of intersection which must be projected horizontally across to the binary F scale.

To solve the original equation for N_c a straight line is drawn between the point on the binary $\left(\frac{d^2}{l^4}\right)$ scale and the point obtained on the binary F scale. This line will cut the N_c scale at the satisfying value of N_c.

It may be noted that the simple form of the given equation

$$\begin{vmatrix} 2 & \log F & 1 \\ 1 & \log N_c & 1 \\ 0 & \log\left(K\frac{d^2}{l^4}\right) & 1 \end{vmatrix} = 0$$

was modified slightly. The scale for N_c was dropped three units with respect to the scale for F because the range of values of N_c is between 100 and 4,000 and the range for F is in the neighbourhood of 0.05 to 1.5.

It is readily seen that there are an innumerable number of ways in which the auxiliary networks for the binary scales may be chosen. If possible, a mathematical choice is most suitable as in the case of the $\frac{d^2}{l^4}$ scale.

A choice giving straight lines for at least one of the variables should also be made. Sometimes, however, some arbitrary choice is necessary as in the case of the F scale above. In these cases it is generally possible to make one of the sets a set of parallel straight lines. Curved loci should be avoided because of the labour involved in their construction.

Cases With More Than Four Variables

The general type of determinant for the case of five variables is

$$\begin{vmatrix} f_1\,(\alpha\beta) & f_2\,(\alpha\beta) & 1 \\ \phi_1\,(\gamma\delta) & \phi_2\,(\gamma\delta) & 1 \\ \psi_1\rho & \psi_2\rho & 1 \end{vmatrix} = 0$$

in which the variables α and β form one network, γ and δ form a second network, and ρ is represented by a curved line. The line of collinearity in this case is between a point of intersection in the $(\alpha\beta)$ network, another point on intersection in the $(\gamma\delta)$ network, and a third point on the ρ scale.

The general type of determinant for the case of six variables may be written

$$\begin{vmatrix} f_1\,(\alpha\beta) & f_2\,(\alpha\beta) & 1 \\ \phi_1\,(\gamma\delta) & \phi_2\,(\gamma\delta) & 1 \\ \psi_1\,(\rho\mu) & \psi_2\,(\rho\mu) & 1 \end{vmatrix} = 0.$$

It is difficult to lay down a set of rules for the suitable treatment of these more complicated types of equations, or to codify and tabulate methods of procedure in the work of transformation for charting purposes. A good policy is to pair off the variables whenever possible and in this way make use of binary scales. It is evident, however, that these cases call for a certain amount of ingenuity in their successful treatment. Each new equation which the writer has investigated has opened up new vistas of thought and research, and he does not feel that he has as yet arrived at that happy condition of experience which would justify him in an attempt to assemble these different views into a complete and harmonious picture. He hopes that the picture which has been presented to cover the case of three variables will fulfil the hopes expressed at the outset, and not appear to the reader as too futuristic in design.

Appendix A.

Rule 6—for determinants was the basis of our discussion of alignment charts. This rule states that the area of the triangle between the three points (a_1b_1) (a_2b_2) and (a_3b_3) is

$$\frac{1}{2}\begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix}$$

and that if these three points are collinear the relation

$$\begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix} = 0$$

will be true.

In a similar manner Rule 5 may be studied and used as a basis for the discussion of "charts of concurrence." This rule states that when three lines

$$\left.\begin{array}{l} a_1x + b_1y + c_1 = 0 \\ a_2x + b_2y + c_2 = 0 \\ a_3x + b_3y + c_3 = 0 \end{array}\right\}$$

are concurrent, then the relation

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$$

will be true.

If therefore we can express a given equation or formula in three variables in this latter determinant form, and arrange the members in such a way that the top row are functions of one variable, the middle row functions of a second variable, and the bottom row functions of the third variable, it will be possible to construct a chart in which there will be a set of straight lines $a_1x + b_1y + c_1 = 0$ for the different values of the first variable, and similar sets of lines for the other two variables. These lines are easily plotted by evaluating a_1, b_1, c_1, for each of the values of the first variable; similarly for the others.

The condition of solution of the given equation is obtained when the lines corresponding to the particular values of the three variables are found to be concurrent. This, it is seen, is the procedure in the case of charts of intersection or concurrence.

It is an interesting fact that the alignment chart corresponding to the determinant form

$$\begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix} = 0$$

and the chart of concurrence corresponding to the same determinant form, bear a definite geometric relation to each other.

It may be shown that the polar of the point (a_1b_1) with respect to the circle with unit radius and centre at the origin, is the straight line $a_1x + b_1y - 1 = 0$.

Thus the unit circle has the equation $x^2 + y^2 = 1$ and the polar of any point (x_1y_1) is $xx_1 + yy_1 = 1$; therefore the point (a_1b_1) will have as its polar the line $a_1x + b_1y = 1$.

It is seen then, that the point (a_1b_1) on the scale representing the variable α in the alignment chart, will have as its polar the line $a_1x + b_1y - 1 = 0$. If we write the determinant for the intersection chart in the form

$$\begin{vmatrix} a_1 & b_1 & -1 \\ a_2 & b_2 & -1 \\ a_3 & b_3 & -1 \end{vmatrix} = 0.$$

we see that this polar is identical with the line on the intersection chart representing the first variable. A particular value of the first variable α will determine a point (a_1b_1) on the alignment chart scale, since a_1 and b_1 are functions of α.

The same value of α will determine the line

$$a_1x + b_1y - 1 = 0$$

in the set of α lines in the intersection chart, and the point in the alignment chart is the pole of the line in the intersection chart. It follows also from the theory of poles and polars that when the three points in the alignment chart are collinear the three lines in the intersection chart are concurrent. It is also true that the line of collinearity in the alignment chart is the polar of the point of concurrence in the intersection chart.

We will close with a simple illustration. Take the determinant form

$$\begin{vmatrix} 0 & \alpha & 1 \\ \beta & 0 & 1 \\ \gamma & \gamma & 1 \end{vmatrix} = 0$$

The alignment chart corresponding to this equation is composed of the α scale along the line $x = 0$, the β scale along the line $y = 0$, and the γ scale along the line $x = y$. The "concurrence" chart for this determinant form is made up of the set of α lines $\alpha y - 1 = 0$ or $y = \frac{1}{\alpha}$, the β lines $\beta x - 1 = 0$ or $x = \frac{1}{\beta}$, and the γ lines $\gamma x + \gamma y - 1 = 0$ or $x + y = \frac{1}{\gamma}$. Although this intersection chart is a common type, the corresponding alignment chart in this case is not very popular, because of the position of the scales.

Appendix B

Classification of formulae for the various types of alignment chart, and corresponding determinant forms with adjustments.

I. *Three Parallel Scales.*

General equation $\alpha + \beta + \gamma = 0$. α and γ scales on outside give the determinant form

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\beta & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0.$$

Transformations of this are

$$\begin{vmatrix} 0 & \alpha & 1 \\ \frac{2}{m+1} & \frac{-m\beta}{m+1} & 1 \\ 2 & m\gamma & 1 \end{vmatrix} \qquad \begin{vmatrix} 0 & \alpha & 1 \\ \frac{2}{m+1} & \frac{-m\beta+n}{m+1} & 1 \\ 2 & m\gamma+n & 1 \end{vmatrix}$$

(impossible when $m = -1$)

also

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\beta) & 1 \\ \frac{2}{2-m} & \frac{m\gamma}{2-m} & 1 \end{vmatrix} \qquad \begin{vmatrix} 0 & \alpha & 1 \\ 1 & m(-\frac{1}{2}\beta)+n & 1 \\ \frac{2}{2-m} & \frac{m\gamma+2n}{2-m} & 1 \end{vmatrix}$$

(impossible when $m = 2$).

If α and β are required on the outside scales, the determinant form used is

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & \beta & 1 \end{vmatrix} = 0$$

with its transformations. If β and γ are required on the outside scales, use

$$\begin{vmatrix} 0 & \beta & 1 \\ 1 & -\frac{1}{2}\alpha & 1 \\ 2 & \gamma & 1 \end{vmatrix} = 0$$

etc.

II. *Two Parallel Lines and a Diagonal Straight Line.*

General equation $\alpha + \beta\gamma = 0$.

The corresponding elementary determinant forms are

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \beta & 1 \\ \frac{\gamma}{1+\gamma} & 0 & 1 \end{vmatrix} = 0$$

and

$$\begin{vmatrix} 0 & \alpha & 1 \\ 1 & \gamma & 1 \\ \frac{\beta}{1+\beta} & 0 & 1 \end{vmatrix} = 0.$$

By using different forms of the given equation $\alpha + \beta\gamma = 0$ a set of six determinant forms may be obtained. The forms of the equation used are

$$\alpha + (-\beta)(-\gamma) = 0$$

$$\beta + \alpha\left(\frac{1}{\gamma}\right) = 0 \qquad \beta + (-\alpha)\left(-\frac{1}{\gamma}\right) = 0$$

$$\gamma + \alpha\left(\frac{1}{\beta}\right) = 0 \qquad \gamma + (-\alpha)\left(-\frac{1}{\beta}\right) = 0$$

$$\frac{1}{\beta} + \gamma\left(\frac{1}{\alpha}\right) = 0 \qquad \frac{1}{\beta} + (-\gamma)\left(-\frac{1}{\alpha}\right) = 0$$

$$\frac{1}{\gamma} + \beta\left(\frac{1}{\alpha}\right) = 0 \qquad \frac{1}{\gamma} + (-\beta)\left(-\frac{1}{\alpha}\right) = 0$$

$$\frac{1}{\alpha} + \left(\frac{1}{\beta}\right)\left(\frac{1}{\gamma}\right) = 0 \qquad \frac{1}{\alpha} + \left(-\frac{1}{\beta}\right)\left(-\frac{1}{\gamma}\right) = 0$$

The corresponding elementary determinant forms, with their transformations, may be arranged thus:

$$\begin{vmatrix} 0 & \beta & 1 \\ 1 & \alpha & 1 \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & m\beta & 1 \\ 1 & \alpha & 1 \\ \frac{m}{m+\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & m\beta+n & 1 \\ 1 & \alpha & 1 \\ \frac{m}{m+\gamma} & \frac{n\gamma}{m+\gamma} & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & \beta & 1 \\ 1 & -\alpha & 1 \\ \frac{1}{1-\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & m\beta & 1 \\ 1 & -\alpha & 1 \\ \frac{m}{m-\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & m\beta+n & 1 \\ 1 & -\alpha & 1 \\ \frac{m}{m-\gamma} & -\frac{n\gamma}{m-\gamma} & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & \frac{1}{\alpha} & 1 \\ 1 & \frac{1}{\beta} & 1 \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\alpha} & 1 \\ 1 & \frac{1}{\beta} & 1 \\ \frac{m}{m+\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\alpha}+n & 1 \\ 1 & \frac{1}{\beta} & 1 \\ \frac{m}{m+\gamma} & \frac{n\gamma}{m+\gamma} & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & \frac{1}{\alpha} & 1 \\ 1 & -\frac{1}{\beta} & 1 \\ \frac{1}{1-\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\alpha} & 1 \\ 1 & -\frac{1}{\beta} & 1 \\ \frac{m}{m-\gamma} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\alpha}+n & 1 \\ 1 & -\frac{1}{\beta} & 1 \\ \frac{m}{m-\gamma} & -\frac{n\gamma}{m-\gamma} & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & \frac{1}{\gamma} & 1 \\ 1 & \beta & 1 \\ \frac{1}{1+\alpha} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\gamma} & 1 \\ 1 & \beta & 1 \\ \frac{m}{m+\alpha} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\gamma}+n & 1 \\ 1 & \beta & 1 \\ \frac{m}{m+\alpha} & \frac{n\alpha}{m+\alpha} & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & \frac{1}{\gamma} & 1 \\ 1 & -\beta & 1 \\ \frac{1}{1-\alpha} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\gamma} & 1 \\ 1 & -\beta & 1 \\ \frac{m}{m-\alpha} & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} 0 & \frac{m}{\gamma}+n & 1 \\ 1 & -\beta & 1 \\ \frac{m}{m-\alpha} & -\frac{n\alpha}{m-\alpha} & 1 \end{vmatrix}$$

NOTE: If the variable α or β, or both, have values extending through zero, the determinants containing reciprocal fuctions $\frac{1}{\alpha}$ and $\frac{1}{\beta}$ may be used after a slight modification.

Thus

$$\begin{vmatrix} 0 & \frac{1}{\alpha} & 1 \\ 1 & \frac{1}{\beta} & 1 \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & 1 & \alpha \\ \beta & 1 & \beta \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 0 & 1 & (\alpha+n) \\ \beta & 1 & (\beta+n) \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & \frac{1}{\alpha+n} & 1 \\ \frac{\beta}{\beta+n} & \frac{1}{\beta+n} & 1 \\ \frac{1}{1+\gamma} & 0 & 1 \end{vmatrix} = 0$$

If the α and γ scales are required on the parallel lines, this may be accomplished by writing the equation $\alpha + \gamma\beta = 0$, and interchanging the β and γ in the first four forms. In a similar manner may the β and γ variables be interchanged in the last two forms. If the parallel scales are running in the wrong direction the signs of both may be changed.

Thus

$$\begin{vmatrix} 0 & \beta & 1 \\ 1 & -\alpha & 1 \\ \frac{1}{1-\gamma} & 0 & 1 \end{vmatrix} \rightarrow \begin{vmatrix} 0 & -\beta & 0 \\ 1 & \alpha & 1 \\ \frac{1}{1-\gamma} & 0 & 1 \end{vmatrix}$$

It is evident that any pair of the variables may be chosen for the parallel scales. If it is found that a given choice places the diagonal scale outside the parallel scales, this condition may be remedied by using the determinant form having the sign of one of these variables changed.

III. Collinearity of the origin, a point on a straight line scale for one variable, and a point given by the intersection of two sets of lines for the other two variables.

General equation $\alpha + \beta\gamma = 0$; more general equation is

$$f_1(\alpha\beta) + \gamma f_2(\alpha\beta) = 0.$$

Determinant forms are given for $\alpha + \beta\gamma = 0$ only. Some of these (in which γ appears in the top row) are unsuitable for the more general form

$$f_1(\alpha\beta) + \gamma f_2(\alpha\beta) = 0.$$

$$\begin{vmatrix} \alpha & \beta & 1 \\ -\gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \alpha & -\beta & 1 \\ \gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \beta & \alpha & 1 \\ -\frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \beta & -\alpha & 1 \\ \frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

$$\begin{vmatrix} \frac{1}{\alpha} & \frac{1}{\beta} & 1 \\ -\frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\alpha} & -\frac{1}{\beta} & 1 \\ \frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\beta} & \frac{1}{\alpha} & 1 \\ -\gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\beta} & -\frac{1}{\alpha} & 1 \\ \gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

These all have the straight scale for the γ variable. The β variable may be placed on this scale by interchanging the two variables, or by using the original equation $\alpha + \gamma\beta = 0$.

$$\begin{vmatrix} \beta & \frac{1}{\gamma} & 1 \\ -\alpha & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \beta & -\frac{1}{\gamma} & 1 \\ \alpha & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\beta} & \gamma & 1 \\ -\frac{1}{\alpha} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\beta} & -\gamma & 1 \\ \frac{1}{\alpha} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

In these forms the straight line represents the α variable. In making a choice of one of the above forms it is advisable to decide first which two of the three variables will be given, and which one solved for. One of the given variables should then be assigned to the straight line scale along $y = 1$, and the other given variable assigned to the ordinate (for the point of intersection). Thus if the given variables are β and γ, we may choose one of the forms

$$\begin{vmatrix} \alpha & \beta & 1 \\ -\gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \alpha & -\beta & 1 \\ \gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\alpha} & \frac{1}{\beta} & 1 \\ -\frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} \frac{1}{\alpha} & -\frac{1}{\beta} & 1 \\ \frac{1}{\gamma} & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

In this way the third variable is made to fit within the bounds of the chart.

The vertical and horizontal scales may be chosen independently as regards their size. In addition to this adjustment, the variable along the ordinate may be expanded or contracted (to fit in between the origin and the line $y = 1$) and the straight line scale may also be moved laterally any desired amount. These transformations are given for one determinant form only. The other forms may be developed as desired, by symmetry.

$$\begin{vmatrix} \alpha & \beta & 1 \\ -\gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} m\alpha & m\beta & 1 \\ -\gamma & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} \quad \begin{vmatrix} m(\alpha+n\beta) & m\beta & 1 \\ -\gamma+n & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

IV. *Two Perpendicular scales and an Inclined Straight Scale.*
General equation $\alpha + \beta + \gamma = 0$. The variables may be interchanged as in the case of type I (three parallel scales). Elementary form of determinant

$$\begin{vmatrix} -\frac{1}{\alpha} & -\frac{1}{\alpha} & 1 \\ 0 & \frac{1}{\beta} & 1 \\ \frac{1}{\gamma} & 0 & 1 \end{vmatrix} = 0.$$

Transformations to alter the position and size of the scales are:

$$\begin{vmatrix} \frac{-1}{\alpha-m-n} & \frac{-1}{\alpha-m-n} & 1 \\ 0 & \frac{1}{\beta+m} & 1 \\ \frac{1}{\gamma+n} & 0 & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{-k}{\alpha-m-n} & \frac{-l}{\alpha-m-n} & 1 \\ 0 & \frac{l}{\beta+m} & 1 \\ \frac{k}{\gamma+n} & 0 & 1 \end{vmatrix}$$

$$\begin{vmatrix} \frac{1}{\alpha+m+n} & \frac{1}{\alpha+m+n} & 1 \\ 0 & \frac{1}{m-\beta} & 1 \\ \frac{1}{n-\gamma} & 0 & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{k}{\alpha+m+n} & \frac{l}{\alpha+m+n} & 1 \\ 0 & \frac{l}{m-\beta} & 1 \\ \frac{k}{n-\gamma} & 0 & 1 \end{vmatrix}$$

The perpendicular scales may be altered in inclination to each other thus:

$$\begin{vmatrix} \frac{1+k}{\alpha-m-n} & \frac{-1}{\alpha-m-n} & 1 \\ \frac{k}{\beta+m} & \frac{1}{\beta+m} & 1 \\ \frac{1}{\gamma+n} & 0 & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{1+k}{\alpha+m+n} & \frac{1}{\alpha+m+n} & 1 \\ \frac{k}{m-\beta} & \frac{1}{m-\beta} & 1 \\ \frac{1}{n-\gamma} & 0 & 1 \end{vmatrix}$$

The horizontal and vertical scales may be adjusted as before.

V. *Two Parallel Scales and One Curved Scale.*
General equation $\alpha_1 + \beta + \alpha_2\gamma = 0$.
The corresponding determinants for this are

$$\begin{vmatrix} \frac{1}{1+\alpha_2} & \frac{-\alpha_1}{1+\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & \beta & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{1}{1-\alpha_2} & \frac{\alpha_1}{1-\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & -\beta & 1 \end{vmatrix}$$

The transformation for these are

$$\begin{vmatrix} \frac{1}{1+m\alpha_2} & \frac{-m\alpha_1}{1+m\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & m\beta & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{1}{1+m\alpha_2} & \frac{n-m\alpha_1}{1+m\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & m\beta+n & 1 \end{vmatrix}$$

$$\begin{vmatrix} \frac{1}{1-m\alpha_2} & \frac{m\alpha_1}{1-m\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & -m\beta & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{1}{1-m\alpha_2} & \frac{m\alpha_1+n}{1-m\alpha_2} & 1 \\ 0 & \gamma & 1 \\ 1 & -m\beta+n & 1 \end{vmatrix}$$

VI. *Two Perpendicular Scales and One Curved Scale.*
General equation $\alpha_1 + \beta + \alpha_2\gamma = 0$.
The corresponding elementary forms are

$$\begin{vmatrix} -\frac{\alpha_2}{\alpha_1} & -\frac{1}{\alpha_1} & 1 \\ 0 & \frac{1}{\beta} & 1 \\ \frac{1}{\gamma} & 0 & 1 \end{vmatrix} \qquad \begin{vmatrix} \frac{\alpha_2}{\alpha_1} & -\frac{1}{\alpha_1} & 1 \\ 0 & \frac{1}{\beta} & 1 \\ -\frac{1}{\gamma} & 0 & 1 \end{vmatrix}$$

These are really identical when plotted except that they are in different quadrants of the co-ordinate plane.
Transformations are

$$\begin{vmatrix} \frac{-\alpha_2}{\alpha_1-n\alpha_2-m} & \frac{-1}{\alpha_1-n\alpha_2-m} & 1 \\ 0 & \frac{1}{\beta+m} & 1 \\ \frac{1}{\gamma+n} & 0 & 1 \end{vmatrix}$$

Here n or m may be chosen to translate the γ or β scale across the origin in cases where the α scale lies outside the quadrant for β and γ. m and n may also be chosen to eliminate zero values in the denominators.

$$\begin{vmatrix} \frac{-(\alpha_2+k)}{\alpha_1-n\alpha_2-m} & \frac{-1}{\alpha_1-n\alpha_2-m} & 1 \\ \frac{k}{\beta+m} & \frac{1}{\beta+m} & 1 \\ \frac{1}{\gamma+n} & 0 & 1 \end{vmatrix}$$

This form may be used when it is desired to incline the β and γ scales at any required angle with each other. If the angle is made quite acute the scales may be translated some distance from the origin (the origin not necessarily shown on the paper). In this way the chart may be made to resemble the charts of type V.

VII. *Two Parallel Scales and a Network for Two More Variables.*
General equation $f_1(\alpha\beta) + \gamma + f_2(\alpha\beta) \cdot \delta = 0$.
Corresponding determinant is

$$\begin{vmatrix} \frac{1}{1+f_2(\alpha\beta)} & \frac{-f_1(\alpha\beta)}{1+f_2(\alpha\beta)} & 1 \\ 0 & \delta & 1 \\ 1 & \gamma & 1 \end{vmatrix}$$

Treatment for this type is the same as for type V, by substituting

$f_1(\alpha\beta)$ for α_1; $f_2(\alpha\beta)$ for α_2; γ for β; and δ for γ;

VIII. *Two Perpendicular Scales and a Network for Two More Variables.*
Similar treatment to that of type VI.

IX. *Two Parallel Scales and a Third Parallel (Binary) Scale.*
General equation $f(\alpha\beta) + \gamma + \delta = 0$.
Corresponding determinant form

$$\begin{vmatrix} 0 & f(\alpha\beta) & 1 \\ 1 & -\frac{1}{2}\gamma & 1 \\ 2 & \delta & 1 \end{vmatrix}$$

The treatment of this type is similar to that of type I.
All cases containing binary scales may be treated similarly to the corresponding types with single scales.

Cross Index for Classifying Equations

Equation Form	*Type of Chart*
$\alpha + \beta + \gamma = 0$	I, IV.
$\alpha + \beta\gamma = 0$	II, III, I after taking logarithms.
$\alpha_1 + \beta + \alpha_2\gamma = 0$	V, VI.
$f_1(\alpha\beta) + \gamma + f_2(\alpha\beta) \cdot \delta = 0$	VII, VIII.
$f(\alpha\beta) + \gamma + \delta = 0$	IX (similar to type I).
$f(\alpha\beta) + \phi(\gamma\delta) + \psi(\mu\nu) = 0$	Similar to type I.

Exponential equations reduced to logarithmic form.
Equations containing products also reduced to logarithmic form whenever possible.

Determination of the Constituents of Concrete

A. K. Light, B.Sc.,
Chemist, Testing Laboratories, Department of Public Works, Ottawa.

Paper read before the Ottawa Branch of the Society of Chemical Industry, November 21st, 1929.

The importance underlying the following method is that it places in the hands of the engineer a means whereby he can have a check made on any concrete mix in order to ascertain whether it was made according to specifications. Likewise, it may be used for the purpose of investigating causes of failure in concrete.

It is frequently of great interest, especially in the case of failures, to know the type and proportions of the various constituents, viz. cement, sand, gravel or broken stone, entering into the composition of the concrete. At present in our department records are kept of all this data, but unfortunately in past years, and even at present in works not under our jurisdiction, no records are kept. Thus when it is desirable to know the mixture in any given specimen of concrete, mechanical and chemical examinations are resorted to in an endeavour to arrive at the necessary data.

The examination and separation of a piece of concrete into its various constituents, at first thought, seems comparatively simple, but upon consideration proves to be extremely difficult. In the first place, the sample may not truly represent the mass of the concrete, for due to segregation of aggregates, non-uniformity of batches or variations in placing, the homogeneity of the mass may vary greatly. However, examination, as far as practicable, of the mass, and a careful selection of a large composite sample taken from the various parts of the concrete, may obviate this variation to a great extent. The next problem is in the actual chemical composition of the constituents themselves, for they all contain silica, ferric oxide, alumina, lime, magnesia, the alkalies and small amounts of other substances, in varying proportions, and though it is easy to determine the amount of these compounds "in toto" in the concrete, it is very difficult to apportion them to the cement and aggregates constituting the concrete.

The method given in Bulletin 61 of the Iowa State College, "Estimation of the Constituents of Portland Cement Concrete," by Geo. W. Burke, goes a long way towards solving the problem, but offers many pit-falls, and is only accurate under certain well-defined conditions. It is however, well worthy of consideration and gives results which are at least approximate.

An outline of the method is as follows:—

The original large representative sample is carefully broken into 2 inch or smaller pieces and reduced to one of about 1,000 to 1,500 grams, which is heated in a muffle furnace for about 3 hours at a temperature of about 600 to 700°C. Dehydration of the cement takes place at this temperature allowing the coarse aggregate to be separated by hand from the sand and cement, and cleaned by brushing and scraping. Separation is then made on the ¼-inch sieve, the portion passing being classified as the "sand-cement mixture." Part of this mixture is analysed for silica and lime, while the balance is used to obtain, as nearly as possible, a representative sample of the original sand. This is obtained by rubbing the mixture in a mortar with a rubber-faced pestle and sieving until the sand portion is free of cement. This sand is then analysed for silica, and lime, and by making calculations with the percentages of either of these constituents in the sand-cement mixture, and also the assumed percentages in the cement, the proportions of sand and cement in the mixture may be arrived at.

The pitfalls and possible sources of error in the method as found by ourselves, and borne out by H. F. Kreige of the State Highway Commission, Jefferson City, Mo., and L. G. Carmick of the Division of Tests, U. S. Bureau of Public Roads, may now be discussed.

In breaking down the original sample to 2-inch size it is difficult to prevent the breaking of the aggregate also, especially if it is soft. At a temperature of 600 to 700°C. limestone and dolomite are liable to be partially calcined, become friable, and thus break down readily with the rubbing, going into the sand-cement mixture or even into the discarded cement portion, and thus impairing the results. Similarly, gravels of other origins may disintegrate somewhat at this temperature due to expansion stresses, expulsion of water or unsoundness due to weathering. If a lower temperature is used the cement is not completely dehydrated and is difficult to separate from the aggregate. The complete separation of the sand, especially in the fine particles, is difficult to achieve and is another source of error. The presence of rotten or weathered aggregate is a very common occurrence and the percentage often runs high. This material is very friable, as a rule, especially after heating at the temperature used here.

Where the sand is non-calcareous and little affected by dilute hydrochloric acid, great improvement in the results is obtained by washing the separated sand with dilute acid in order to remove any adhering cement.

To sum up: In order to obtain accurate results by this method the aggregates, both coarse and fine, must be resistant to the temperature used, must be sound and not easily crumbled, and not appreciably affected by hydrochloric acid, otherwise the results will be vitiated in proportion to the extent that these requirements are not fulfilled. In any case it is most necessary to use every care and precaution in carrying out the method in order to obtain the best results.

A method which gives the ratio of cement to aggregates, but does not give a separation of the aggregates has been proposed by H. F. Kriege, already mentioned. We have checked this method in many ways by the use of known mixtures of cement and aggregates of different types and have found it to give very good results. We have also used it in checking the cement content of some concretes which showed signs of disintegration in a very short time after being placed, in order to ascertain whether the contractor made the mix as rich in cement as specified.

This method is based on the difference in the state of combination of the silica in the cement and in the aggregate. In the former it is present as mono-, di-, and tri-calcium silicates, while in the latter it is present either free or combined as some impure aluminium silicate. The silica may therefore be separated from the calcium silicates by chemical treatment which will have little or no effect on it either in the free state or combined in the aluminium silicates. The only types of Portland cement concrete we found that failed to give us dependable results under this method where those which contained either diatomite or basic slag or similar materials. The bulk of the silica in diatomite is readily soluble in alkali, while the basic slags liberate silicic acid upon treatment with dilute hydrochloric acid.

Strict precautions must be taken in the procuring and preparation of the sample as with the method already described. The ultimate sample taken for analysis should be ground to pass at least a 100 mesh sieve, and care should be taken that none is lost during the grinding.

The method of analysis is as follows:—

Weigh triplicate samples of 10 grams into 250 c.c. beakers, moisten with hot water and stir to prevent the formation of lumps. Add slowly, with thorough stirring, 100 c.c. of 1:3 hydrochloric acid, and after all effervescence has ceased, allow the mixture to settle until the supernatent liquid is clear. Decant through a prepared Gooch crucible, retaining as much of the residue as possible in the beaker, and wash the residue with hot water, twice by decantation. Add 75 c.c. of a 4 per cent solution of sodium hydroxide to the residue and heat to about 75 or 80°C., stirring constantly. Hold the mixture at this temperature for 10 to 15 minutes and then allow to settle. Filter and wash by decantation through the same Gooch crucible into the acid solution previously filtered. Finally transfer all the residue to the crucible and wash thoroughly with hot water. The suction on the Gooch crucible should be regulated so that filtration is not more rapid than a dropping rate. Quantitatively transfer the solution from the filter flask to a suitably sized beaker and evaporate the solution to dryness. After baking on the hot-plate, moisten the residue with concentrated hydrochloric acid, evaporate and bake again. Take up the residue with about 75 c.c. of 1:4 hydrochloric acid and boil until all soluble material is in solution. Filter, wash well with both hot dilute hydrochloric acid and hot water and finally ignite the residue in a platinum crucible and weigh. Moisten the residue with a few drops of concentrated sulphuric acid, and add 10 to 15 c.c. hydrofluoric acid. Evaporate to dryness, ignite and weigh again, the loss in weight representing the silica liberated from the cement in the original concrete mixture. This weight divided by the average silica content of Portland cement—about 21.5 per cent—gives the percentage of cement in the original concrete.

The first method described has the advantage of allowing an examination of the aggregate being made; its petrographic nature, granulometric analysis and other physical properties may be determined. The second method offers a means of determining the proportion of cement to aggregate. By combining these two methods it is possible to arrive at a fairly accurate means of making a thorough examination of a specimen of concrete and of determining fairly closely the proportions of the mix used in its making, subject, of course, to such vitiating circumstances as have already been described. One of the chief controlling factors in determining the strength of concrete, is the amount of water used in proportion to the quantity of cement, and it is unfortunate that there is no method of determining how much of this all important constituent was used in making the concrete. However, such data as the strength and density of the concrete, nature and grading of the aggregate, and quantity of cement should go a long way towards solving the problem of why the concrete failed.

Too much importance cannot be placed on the value of such information as may be acquired from these methods, not only from the point of view of checking up on the contractor, but from the fact that the knowledge of the causes of a failure may obviate a recurrence of the same conditions in future structures.

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The Fourth Plenary Meeting of Council

The fourth Plenary Meeting of Council will be held at Headquarters on Monday, Tuesday and Wednesday, September 22nd, 23rd and 24th, 1930. Facilities will be provided, as on previous occasions, for the attendance of Councillors from all parts of the Dominion, and it is expected that as heretofore the gathering will be attended by a large majority of the members of Council.

The Plenary meetings of Council have, in the past, proved to be a most powerful influence in welding together The Institute's Branches and the membership at large, since they afford a most favourable opportunity for the expression of different points of view and result in the working out of Institute policies on the basis of the greatest possible benefit to the membership at large. They are of particular advantage in promoting the formation and renewal of personal acquaintanceships between members of Council. They permit of personal discussion, and in many cases enable Councillors who cannot attend other Council meetings to familiarize themselves with the work of the Headquarters' staff, and with the activities of Council, in a way which would otherwise be impossible. While all members of Council receive the minutes of Council meetings, there are always a considerable number for whom the Plenary meeting is the only occasion on which they can get first-hand acquaintance with the Council's business, so as to realize the extent and complexity of the many questions on which Council has to render decisions.

Among the topics to be dealt with at the forthcoming meeting may be named the financial problems before The Institute; the policy to be adopted regarding specialized branches of engineering and the formation of professional sections of branches; the relations between The Institute and the Provincial Professional Associations; the publications of The Institute, and the work of the various special committees which are studying questions of importance. A period will naturally be allotted for general business, at which time Councillors will be at liberty to bring up matters which they consider should be dealt with by Council, but which have not already been included in the agenda. It is thought that individual members of The Institute can render a service by suggesting to the Councillors of their respective Branches questions of importance which they think should receive consideration at the Plenary meeting.

There is every reason to believe that the Plenary meeting of 1930 will be as well attended and as fruitful of results as those held in 1927, 1928, and 1929.

Notes on Education, Employment and Remuneration

Discussions regarding engineering education, professional employment and the resulting remuneration are always of interest to an engineer, whatever the branch of the profession in which he may be engaged. Such matters form an important part of The Institute's activities, as is evidenced by the work of our Employment Service Bureau, and the enquiries which are being conducted by The Institute's committees on Engineering Education and on Classification and Remuneration.

The recent successful meeting held in Montreal by the Society for the Promotion of Engineering Education, a body with which The Institute has always had cordial relations, is a reminder of the admirable work done by that Society in collecting and discussing information on its special subject and in the preparation of the reports contained in its proceedings. The findings of the Society's committees during the past six years have just been published in the form of a comprehensive report* collecting the bulletins issued during the progress of its investigations. These deal primarily with engineering education, but include incidentally a mass of interesting particulars regarding the career of the young engineer after graduation.

The reports are of course based on conditions existing in the United States, although many comparative data are given in respect to European and Canadian conditions. The attitude of practising engineers and industrial managers towards the younger members of the profession and the opinions of engineering graduates and non-graduates on the present situation have been carefully studied.

The results of the present system of engineering education and training have been examined in detail as regards the careers and earnings of certain typical groups of engineering graduates. The resulting information has increasing value, for as time goes on the proportion of non-graduate to graduate engineers tends steadily to diminish.

It will be interesting to see how far the results of the enquiry now being made by The Institute's Committee on Remuneration will bear out the figures shown by the Society for the Promotion of Engineering Education

*Report of the Investigation of Engineering Education 1923-29. Vol. I. Pittsburgh. Office of the Secretary S.P.E.E., University of Pittsburgh, 1930.

reports. These were based on about five thousand replies, and indicate that the median rate for engineering graduates one year out of college was about $1,800 per annum, rising in five years to about $2,800 and at ten years to some $4,000 per annum. Individual replies naturally showed a wide range above and below these figures.

The Institute's questionnaire, if replies are received from a sufficient proportion of the members, will afford material for another valuable report, outlining Canadian conditions, and will contribute considerably to our knowledge of the reasons for the alleged migration of young engineers to other countries.

It is noteworthy that many members of The Institute now resident in the United States are desirous of returning to Canada. Recent investigations have shown that the percentage of technical graduates of Canadian universities now living in the United States is by no means so large as had been supposed, and the number is gradually being reduced, largely through the activities of such bodies as The Engineering Institute and the Technical Service Council.

It must be remembered, however, that the compensation of engineers is mainly controlled by supply and demand. Favourable conditions as regards engineering employment existed during 1928 and 1929, as is shown by the reports of our Employment Service Bureau. While this satisfactory activity has not been continued during 1930, and opportunities are less numerous now than then, it does not appear from the information on hand that any considerable number of our members are at present looking for positions. It is somewhat remarkable that the number of non-members who desire to apply for employment through The Institute's Service Bureau is just now larger than the number of Institute members who are enquiring. It would thus seem that unemployment in Canada as regards our members is not at this time a really serious factor.

It is, however, well to realize that under present conditions there is but little work available for engineers arriving in Canada from outside of the country. During the past few years the publicity given to engineering and industrial achievements in Canada has resulted in a considerable influx of young engineers from Britain and the continent of Europe, and this still continues. It has been found desirable, therefore, to take steps to bring this situation to the attention of the European representatives of the Dominion and Provincial governments, the colonization departments of the Canadian railways and other authorities from whom information is asked by intending immigrants. These officers have been requested to state that at present the prospects in Canada for the employment of engineers from other countries are not favourable, since the supply of our own men is, just now, more than adequate to meet the demand.

The cutting down of industrial activities in Canada, while quite marked, has been less serious than in Britain or the United States, and has led to the present situation as regards employment, of which engineers in Canada are fully aware. Employers naturally take the very reasonable view that in such opportunities as do occur, preference should be given to our own men.

The work of The Institute's Service Bureau and the publication of the E–I–C News has been of great value in establishing and maintaining cordial relations with the managers of industrial concerns and others interested in the employment of engineers.

The task of our Employment Bureau would be greatly facilitated if members, whether looking for employment or not, would comply with the request made in the E–I–C News for July 24th, 1930, by obtaining, filling in and returning to Headquarters, the Institute's registration forms, thus placing Headquarters in possession of a definite record of their professional careers and experience. It is only in this way that the office can be enabled to reply adequately to enquiries received for men capable of undertaking special work or qualified for particularly responsible positions.

Publications of Other Engineering Societies

From time to time announcements have appeared in The Engineering Journal regarding the exchange arrangements which exist between The Engineering Institute of Canada and the founder engineering societies of the United States, whereby members of The Institute may secure the publications of the American societies at the same rate as charged to members of those societies. A list of these publications, with the amounts charged, is given below and subscriptions may either be sent direct to New York or through headquarters of The Institute.

	Rate to Members	*Rate to Non-Members*
American Institute of Electrical Engineers		
Journal, single copies	$0.50	$ 1.00
" per year	5.50	10.50
Transactions, per year:—		
Paper	5.00	10.00
Cloth	5.00	10.00
Year Book	1.00	2.00
Pamphlets	.25	.50
American Institute of Mining and Metallurgical Engineers		
Magazine, single copies	0.50	1.00
" per year	5.00	10.00
Transactions, per volume, with pamphlets, paper	2.50	5.00
(Other publications, same rate E.I.C. members as to A.I.M.M.E. members)		
American Society of Civil Engineers		
Proceedings,, single copies	0.50	1.00
" per year	4.00	8.00*
Transactions, per year	6.00	12.00†
Year Book	1.00	2.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
**If subscription is received before January 1st, otherwise $10.00.*		
†If received before February 1st, otherwise price $16.00.		
American Society of Mechanical Engineers		
Journal, single copies	0.50	0.60
" per year	4.00	5.00
Transactions, per year	6.00	8.00
Year Book	1.00	2.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		

OBITUARIES

Henry Alexander Bowman, M.E.I.C.

It is with deep regret that the death of Henry Alexander Bowman, M.E.I.C., which occurred on June 8th, 1930, at Winnipeg, Man., is reported.

Mr. Bowman was born in London, England, on August 13th, 1855, and received his education by private tuition, subsequently joining the Royal Artillery, London, in which he held the rank of captain.

Coming to Canada in 1895, Mr. Bowman settled on a farm in Petersfield, Man., but in 1902 he became a member of the engineering staff of the Manitoba Department of Public Works, and has been connected with the department since that time. In 1912 he was acting Deputy Minister of Public Works, and in 1918 he was made acting chief engineer. During the year 1918 Mr. Bowman was

H. A. BOWMAN, M.E.I.C.

made chief engineer of the Reclamation Branch of the department, which office he filled until his death.

Mr. Bowman was intensely interested in the education of young engineers, and particularly in the development of young men engaged in engineering work, who had not had the advantage of university training. To the end that such young men might be encouraged to study, he instituted a series of examinations for juniors in his department, and contributed substantial cash prizes to be awarded to those who took high standings in the examinations.

Mr. Bowman was for two years chairman of the Board of Examiners of the Association of Professional Engineers of Manitoba.

He joined The Engineering Institute as an Associate Member on May 2nd, 1907, becoming a full Member on May 6th, 1930. Mr. Bowman was a charter member of the Winnipeg Branch of The Institute, and from its inception until extreme pressure of public duties and failing health prohibited, was an active member and regular attendant at Branch meetings.

William Newton Ryerson, M.E.I.C.

Deep regret is expressed in recording the death of William Newton Ryerson, M.E.I.C., which occurred at New York on July 7th, 1930.

Mr. Ryerson was born in New York, N.Y. on December 7th, 1874, and attended the New York public schools and the Columbia Grammar school, where he was graduated in 1892. He entered the school of mines at Columbia University the following year, and graduated in 1896 with the degree of electrical engineer.

Following his graduation, Mr. Ryerson was employed by the Sprague Electric Elevator Company, Bloomfield, N.J., and later was with the Western Electric Company, New York. In October 1898, he became associated with the Metropolitan Street Railway Company of New York, on construction and power work and substation operation, remaining with that company until June 1901, when he left to form a connection with the Manhattan Company as chief operator of their steam electric generating station. Mr. Ryerson's chief interest at that time seemed to be on electric railways and subways, and in October 1901, he became superintendent of the substations for the Interborough Rapid Transit, with which concern he remained until April 1905. About that time, some of the big hydro developments on the Canadian side of Niagara Falls were started, and Mr. Ryerson became assistant superintendent of construction for the Niagara Construction Company, and later in the same year, superintendent of construction for the Ontario Power Company, Niagara Falls, Ont., which position he held until January 1909.

At that time Mr. Ryerson became general manager and chief engineer, and also a director of the Great Northern Power Company, Duluth, Minn., which position he held for over thirteen years, and it was here that he became well known among the light and power companies of the country, serving on several committees of the National Electric Light Association. In 1922 Mr. Ryerson joined the management department of Day and Zimmermann, Inc., engineers, of Philadelphia, Pa., and in January 1925 he became assistant to the vice-president in charge of operations and engineering of the United Gas Improvement Company of Philadelphia. When the Trojan Engineering Corporation was organized in September 1928 Mr. Ryerson became its president, which position he held at the time of his death.

Mr. Ryerson was a Fellow of the American Institute of Electrical Engineers, and a member of the American Society of Mechanical Engineers, the National Electric Light Association, the International World Power Conference, and the American Gas Association.

He joined The Engineering Institute of Canada as a Member on December 12th, 1907.

Edward Herbert Pense, A.M.E.I.C.

Members will learn with regret of the death at Welland, Ont., on June 6th, 1930, of Edward Herbert Pense, A.M.E.I.C.

Mr. Pense was born at Kingston, Ont., on June 16th, 1880. He graduated from the Royal Military College in 1900, and received the degree of B.Sc. in mining from Queen's University in 1903.

After some months spent on railway location and construction work, he entered the service of the Department of Public Works in 1904, as an assistant engineer, remaining with the Department until 1916, when he went overseas with the rank of company commander in the Canadian Engineers, and served in France until the end of the War. On his return to Canada, Mr. Pense was employed on the St. Lawrence Ship Canal survey from 1920 to 1923, when he was transferred to the staff of the Welland Ship Canal. Here he was employed as assistant engineer on sections 7 and 8 until his death.

Mr. Pense was a well-read scholarly man of varied attainments, and was also interested in athletics.

He joined the Canadian Society of Civil Engineers as a Student on October 11th, 1900, and became an Associate Member on December 10th, 1910.

PERSONALS

J. P. A. Laforest, A.M.E.I.C., has been appointed city engineer of Granby, Que. Mr. Laforest was formerly city engineer of Longueuil, Que.

C. G. Clark, S.E.I.C., is assistant to the chief engineer, Atlantic Sugar Refineries, Saint John, N.B. Mr. Clark graduated from the Nova Scotia Technical College in 1930 with the degree of B.Sc.

W. C. McLeod, S.E.I.C., is at present with the Canadian Westinghouse Company, Ltd. at Hamilton, Ont. Mr. McLeod graduated from the Nova Scotia Technical College in 1930 with the degree of B.Sc.

J. H. Parks Matheson, S.E.I.C., who graduated from McGill University this spring with the degree of B.Sc., is now in the employ of Shawinigan Chemicals, Ltd., at Shawinigan Falls, Que.

Geo. G. Reid, S.E.I.C., has joined the staff of the Canadian Consolidated Felt Company Ltd., at Kitchener, Ont. Mr. Reid graduated from the Nova Scotia Technical College in 1929 with the degree of B.Sc.

A. Holland, A.M.E.I.C., executive engineer, Public Works Department, Accra, Gold Coast Colony, West Africa, is at present in England on leave and is located at 10 St. John's Road, Queen's Park, Chester.

O. B. Bourne, A.M.E.I.C., formerly designer with the Department of Works, City Hall, Toronto, Ont., is now with the Beauharnois Construction Company, at Beauharnois, Que.

O. J. Frisken, S.E.I.C., has joined the staff of Babcock-Wilcox and Goldie-McCulloch, Ltd. at Galt, Ont. Mr. Frisken, who graduated from Queen's University in 1929 with the degree of B.Sc., was formerly heating engineer with the Trane Company of Canada, Toronto, Ont.

R. L. Weldon, A.M.E.I.C., who has for some time been manager of manufacturing and director of Newfoundland activities of the International Power and Paper Company, at Montreal and Corner Brook, Nfld., has been transferred by the company to New York, N.Y.

T. Linsey Crossley, A.M.E.I.C., is now making his headquarters in the laboratory of the Don Valley Paper Company, Toronto. While retaining his interest in the Industrial Laboratories, Ltd., Mr. Crossley will devote his time entirely to consultation and testing in the technology of pulp and paper.

E. V. Ahara, Jr.E.I.C., who was formerly with Ruths Steam Storage (Canada) in Toronto, is now connected with the Abitibi Power and Paper Company, Ltd., at Toronto. Mr. Ahara is a graduate of the University of Toronto of the year 1922, and was at one time mechanical engineer with the Combustion Engineering Corporation.

Ed. Prevost, Jr.E.I.C., has resigned as construction engineer for the Atlas Construction Company to accept a similar position with Ulric Boileau Ltd. and Damien Boileau Ltd. on their joint contract for the construction of the new University of Montreal. Mr. Prevost graduated from the Ecole Polytechnique, Montreal, with the degree of B.Sc., in 1921.

C. E. Potter, Jr.E.I.C., who was formerly with Roy H. Bishop, architect, at Oshawa and Toronto, Ont., is now on the staff of Robertson and Janin of Ontario, Ltd., Toronto. Mr. Potter, who graduated from the University of Toronto in 1925, was for a time with the engineering department of the Wayagamack Pulp and Paper Company, at Flamand, Que. and was later on the staff of the Toronto Transportation Commission.

T. R. Cooil, Jr.E.I.C., who for the past few years has been field engineer in charge of sewer and water maintenance and construction in the city engineer's department, Saskatoon, Sask., has been appointed city engineer for the city of North Battleford, Sask. Mr. Cooil graduated from the University of Saskatchewan in 1926, with the degree of B.Sc.

A. C. Brown, M.E.I.C., is now connected with Sir John Jackson (Singapore) Ltd., Singapore Naval Base, Singapore. Since 1926 Mr. Brown has been on the staff of Baldry, Yerburgh and Hutchinson (Roads) Ltd., At one time Mr. Brown was engineer and manager for the Hollinger Power Development at Cochrane, Ont., and in 1922 was engaged on the construction of the Welland Ship Canal at St. Catharines, Ont.

C. R. Townsend, Affil. E.I.C., who was formerly woods superintendent of the Laurentide Ottawa Company, Ottawa, and was later located at Grand'Mere, Que., is now connected with the forestry department of the Canada Power and Paper Corporation at Wayagamack Island, Three Rivers, Que. Mr. Townsend graduated from the University of New Brunswick, having secured the degree of B.Sc. in 1920 and that of M.Sc. in 1923.

Professor W. G. Worcester, M.E.I.C., professor of ceramic engineering at the University of Saskatchewan, and chairman of the Saskatchewan Branch of The Institute has been given an honorary degree by the University of Ohio, Columbus, O. from which college he graduated, in appreciation of his work in ceramics. Professor Worcester is on the staff of the Department of Labour and Industries and has been very active in the development of the clay industries of Saskatchewan.

J. K. Davidson, Jr.E.I.C., has resigned his position as assistant engineer with the Dominion Bridge Company, Ltd., Montreal, to take up duties as resident engineer on the construction of a filtration and pumping station for the Water Commissioners of Brantford, Ont. Mr. Davidson is a graduate of the University of St. Andrews, Dundee, Scotland, of the year 1926, and had been connected with the Dominion Bridge Company since his arrival in this country.

James Forgie, M.E.I.C., has been appointed by the Commissioners for the Port of New York Authority as consulting engineer for all future construction work, associated with Messrs. Robert Ridgway, chief engineer of the New York Board of Transportation and also Professor W. H. Burr and Mr. Daniel Moran, who served as consultants in the building of the Hudson river bridge. Mr. Forgie is an engineer of international repute, who has been identified with the construction of tunnels, particularly of the Pennsylvania tunnels between Manhattan and New Jersey.

Major G. W. F. Ridout-Evans, A.M.E.I.C., has joined the staff of Morrow and Beatty Limited, at Fitzroy Harbour, Ont. Prior to accepting his present position Major Ridout-Evans was with the Dominion Bridge Company, Ltd. He was at one time assistant engineer with Morrow and Beatty at Kapuskasing, Que. Major Ridout-Evans served overseas during the war from 1915 to 1919, and on his return to Canada he was with the Great Eastern Paper Company Ltd. at River Madeleine, Que. In 1922 he was in the employ of the Robert Reford Company, Ltd. at Quebec, Que.

W. H. Jones, M.E.I.C., presented a paper on the "Cracking of Petroleum Oils and Low Temperature Coal Tars" in April last before the Institute of Fuel, London, England.

W. H. JONES, M.E.I.C.

Mr. Jones is assistant chief engineer, London office of the Universal Oil Products Company of Chicago. He graduated from the University of Manitoba in 1914 with the degree of B.Sc., and served in the Canadian Engineers and the Royal Air Force from 1914 to 1919. On returning to Canada, Mr. Jones was variously engaged until the beginning of 1922, when he received an appointment with the Roxana Petroleum Corporation (Shell) at Wood River, Ill., as chief surveyor in charge of extensive oil refinery construction work and later as superintendent of "cracking" (method of oil refining). Towards the end of 1924 he was engaged by the M. W. Kellogg Company of New York to undertake the supervision of their cross cracking plant contracts in Europe with headquarters in London. On completion of these contracts he joined the Anglo-Persian Oil Company, Ltd. as senior assistant engineer and consultant, London office, in connection with their cracking plant developments and remained with them until 1927. Mr. Jones was subsequently engaged for a short time by the Medway Oil and Storage Company as assistant manager in charge of production and in 1928 received his present appointment with the Universal Oil Products Company. Mr. Jones was not only closely associated with cracking in its early commercial development in the United States, but has taken a prominent part in introducing and developing this method of gasoline production in Great Britain and other European countries. He represented the London office of his company at the World Power Conference, which was held in Berlin in June.

BOOK REVIEWS

Modern Bridge Construction

By F. Johnstone Taylor. Crosby Lockwood & Son, London, 1930, buckram, 5½ x 8¾ in., 235 pp., front., figs., $4.50.

The aim of the author as set forth in the preface is to deal with his subject in such a way that the work will serve the needs of the average civil engineer who requires some knowledge of bridge construction, and of those engineering students who, without intending to specialize in bridge work, also require a good grounding in the subject to add to their general knowledge and to meet the requirements of general examinations. The use of higher mathematics is avoided as much as possible.

In a very general way the elements of design and modern methods of construction are set forth. Masonry bridges, small steel bridges, trussed girders, steel arch bridges, swing bridges, bascules, drawbridges and vertical lift bridges, suspension bridges and concrete bridges are treated in twelve chapters comprising 231 pages of reading matter. To attempt to explain methods of design, construction and erection, even in a general way, covering such a wide field as outlined above, in such a small volume is a very difficult task indeed. The brevity with which the several types are treated is such, that unless one has a fair knowledge of the subject, he will have difficulty in following the discussion. The explanation of design methods is in general so concise that one wonders whether an engineer, with little knowledge of the subject, would be able to add any material knowledge to his store.

The book is written for English engineers. Although many of the typical examples illustrated are to be found in the British Isles, there are several noteworthy examples of United States and Canadian bridge construction. In some instances one notices symbols, used without explanation of their meaning, which are not familiar to Canadians accustomed to a somewhat different nomenclature.

The book is well printed on excellent paper with an attractive binding. It is remarkably free from typographical errors. The diagrams and cuts are, in general, not so well drawn as are those found in technical books published on this side of the Atlantic, nor do they show the same finish.

While the reviewer doubts whether the author has attained fully his purpose in writing the volume, he is of the opinion that it has value to the Canadian engineer interested in bridges, because it gives him a bird's eye view of practically all types, and, from experience, the reviewer knows that, over a period of years, many bridge engineers have actual experience with perhaps but two or three of these. To such therefore this volume will repay careful perusal.

W. P. Copp, M.E.I.C.,
Professor of Civil Engineering,
Dalhousie University,
Halifax, N.S.

Les sources de l'énergie calorifique et le chauffage industriel

Volume 1, by Emilio Damour. Librairie Polytechnique Ch. Béranger, Paris, 1930, buckram, 9¾ x 6 in., 477 pp., illus., figs., tables, 110 fr.

This is the third edition of a text-book prepared for the engineers following the post-graduate courses given at the Conservatoire National des Arts et Métiers, Paris, an institution which aims to give sound theoretical and specialized training to those already engaged with the different industries.

The complete text will be contained in two volumes and will be exhaustive, treating of all the different sources of heat and of its industrial utilization, including electrical heating. This first volume is devoted to the following subjects: the scientific basis of technical heating; the theory of industrial heating furnaces; the control of combustion.

The book is up to date, giving a special consideration to all the recent developments. It contains numerous figures, graphs, tables of technical data and several examples of numerical calculations.

The author, besides being a professor, is an engineer connected with one of the largest industrial concerns in France and his treatment of the subject is advantageously influenced. His book can be recommended to all those interested in heat engineering, whether they are students or engineers.

L. Brunotto,
Librarian,
Ecole Polytechnique,
Montreal.

Gauges and Fine Measurements

By F. H. Rolt. Macmillan and Company, London, 1929, buckram, 5¾ x 8¾ in., v. 1, 366 pp., v. 2, 357 pp., figs., tables, 2 vols., $13.00.

The development of mass production methods in mechanical engineering has been going on for more than twenty years, but its most rapid advance occurred during the War, when quantities of mechanical products had to be manufactured on an interchangeable basis by firms having no previous experience in this class of work. The production of the parts themselves, and that of the jigs and fixtures required for their manufacture, is entirely dependent on the provision of adequate gauges and methods of precision measurement. Means are, in fact, necessary by which the variations in the dimensions of parts due to wear of the cutting tools, drills, or dies, can be adequately controlled, and by which the variation in size of successive pieces can be held within any desired limits. During the War, the production of munitions was in many cases found to be dependent not on the capacity of the machine tool equipment of the manufacturing firms, but on the supply of the gauges required to measure and inspect the product during and after manufacture.

Engineers who are not familiar with this subject do not always realize the precision of measurement required in modern manufacturing processes. It is obvious that gauges must be made more closely to their nominal dimensions than the parts which they measure. Measurements made for the purpose of checking gauges, therefore require extreme accuracy, and for this purpose measurements have frequently to be made to within one-millionth of an inch. For example, in some instances it has been necessary to take account of the difference in length between the British inch, based on the Imperial standard yard, and the inch recognized in the United States by the Bureau of Standards, which is based on 39.37 inches, being equivalent to one meter. In fact, the length of a standard one-inch block made to United States requirements and measured at 62 degrees F. is thirty-three-millionths of an inch shorter than an inch based on the Imperial standard yard. It is interesting to note that gauge blocks wrung together are not actually in contact, but are separated by a grease or liquid film whose thickness has been determined as from two to three one-millionths of an inch, a thickness which seems to be independent of the nature of the liquid constituting the film. Blocks which are chemically clean can only be wrung together imperfectly or with difficulty.

The first steps in gauging and precision measurement as applied to engineering work were due to Sir Joseph Whitworth, who commenced his work about 1840 and subsequently developed a remarkable measuring machine and a system of gauging to promote interchangeability. The most striking advances in recent years were made possible by the introduction of the block and slip gauge system in 1908 by the Swedish firm of Johansson. Since that time, to name only a few of the leading features of the art, measurement with an accuracy of one one-millionth has become a practical necessity to meet the requirements of industry, the measurement and accurate manufacture of screw threads has been put upon an entirely new footing, optical projection has been applied to precision measurement, and methods and apparatus have been developed for the complete measurement of gear wheels, hobs and other similar objects.

Mr. Rolt was associated with Sir Richard T. Glazebrook and J. E. Sears, Jr., at the National Physical Laboratory at Teddington during the War and his experience gave him an intimate acquaintance with the needs of industry as regards the art of measuring both in the laboratory and in the field.

The first volume of his book deals with general machine gauging, standards of length, including measurement in terms of the wave lengths of light, methods of comparing line standards, the history of standards of length, both primary and secondary; the author then proceeds to the discussion of standard gauge blocks, end gauges, the stability of gauges, the preparation of flat surfaces, and measurement by optical interference methods.

The first volume closes with a chapter on end-measuring machines, comparators, and indicators as used in the laboratory and in the work shop.

The second volume discusses many types of limit gauges, micrometers and other types of workshop measuring instruments; deals with the manufacture of jigs and position gauges, and with the methods and difficulty of setting out angles. Internal measurements are considered, then tests for flatness and straightness, and there is an interesting chapter on the design of measuring instruments. The volume concludes with two chapters on the measurement of gears.

The knowledge of the principles and methods employed described in this book is of the first importance in every modern tool-room, and the author is to be congratulated upon the admirable way in which he has dealt with his subject. It is hoped that he will be able to complete this excellent treatise by the issue of a third volume on screw-thread measurement.

The work can be recommended as an authoritative text-book; its utility is increased by a copious list of references appended to each chapter, and an adequate index for each volume.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:

American Standards Association: American Standards Year Book, 1930.

American Institute of Electrical Engineers: Quarterly Transactions, Vol. 49, No. 2, April, 1930.

American Institute of Consulting Engineers, Inc.: Proceedings of a Special Meeting held April 21, 1930.

North-East Coast Institution of Engineers and Shipbuilders: Notes on the Progress in Transportation of Oil by Sea and Possible Future Developments.

The Institution of Mechanical Engineers: List of Members, 1st May, 1930.

Canadian Institute of Mining and Metallurgy and the Mining Society of Nova Scotia: Transactions, Volume 32, 1929.

The Engineering Profession in British Columbia: The Engineering Act of British Columbia; the Profession's Student System . . . 1930.

Reports, etc.

Department of Mines, Canada:

Program of Field Work of the Geological Survey, 1930.
Investigations of the Mines Branch, July, 1930.

Department of the Interior, Canada:

Publications of the Dominion Observatory, Ottawa. Vol. 10, Bibliography of Seismology, No. 4, Oct.-Dec., 1929.

Department of Mines, Ontario:

Thirty-eighth Annual Report, Vol. 38, Parts 6 and 7, 1929.

Hydro-Electric Power Commission, Ontario:

Supplement "C," List of Electrical Equipment approved by the Commission.

Geological Survey, United States:

Water-Supply Paper 621: Surface Water Supply of the United States, 1926, Part 1: North Atlantic Slope Drainage Basins.

" " 629: Surface Water Supply of the United States, 1926, Part 9: Colorado River Basin.

" " 632: Surface Water Supply of the United States, 1926, Part 12: North Pacific Slope Drainage Basins. (A) Pacific Slope Basins in Washington and Upper Columbia River Basin.

Bureau of Mines, United States:

Petroleum Refinery Statistics, 1928.

Bulletin 315: Construction and Operation of the Bureau of Mines Experimental Oil-Shale Plant, 1925-27.

" 321: Innovations in Copper Leaching Employing Sulphate-Sulphuric Acid.

Department of Commerce, United States:

List of Publications of the Department of Commerce, May 15, 1930.

Bureau of Standards, United States:

Misc. Pub'n 100: Plain and Thread Plug and Ring Gauge Blanks.

National Electric Light Asssociation:

Prime Movers Committee, Engineering National Section: Higher Steam Pressures and Temperatures. Treatment of Feedwater.

Hydraulic Power Committee, Engineering National Section: Draft Tube Tests.

Public Relations, National Section: Report of the Public Speaking Committee, May, 1930.

Meter Committee, Engineering National Section: Inspection, Retest and Use of Electricians' Rubber Gloves. New Developments in Electrical Measuring Devices.

Purchasing and Storeroom Committee, Accounting National Section: Stores Reports.

Budget Committee, Accounting National Section: Organization for Budgetary Control. Long Term Budget Forecasting.

The John Crerar Library:

Thirty-fifth Annual Report for the Year 1929.

Kenya and Uganda Railways and Harbours:

Report of the General Manager on the Administration of the Railways and Harbours, Year ended December 31, 1929.

Society for the Promotion of Engineering Education:

Report of the Investigation of Engineering Education, 1923-1929, Vol. 1.

Technical Books, etc.

Presented by Brig.-General C. H. Mitchell, c.b., c.m.g., d.s.o., m.e.i.c.:

Canada and the Engineer, (A Monograph Prepared on request for the Fiftieth Anniversary of the American Society of Mechanical Engineers, by Brig.-General C. H. Mitchell, April, 1930.

Presented by Crosby Lockwood & Son:

Modern Bridge Construction, by F. Johnstone Taylor.

Presented by Prentice-Hall, Inc.:

Electroplating with Chromium, Copper and Nickel, by Hoppe and Freeman.

Presented by John Wiley & Sons:

Diesel Engine Operation, Maintenance and Repair, by C. H. Bushnell.

Presented by Macmillan & Co.:

Gauges and Fine Measurements: Vol. 1: Standards of Length, Measuring Machines, Comparators; Vol. 2: Limit Gauges, Measuring Instruments, General Methods of Measurement, by F. H. Rolt.

Presented by Sir Isaac Pitman & Sons:

Photoelectric Cells, Their Properties, Use and Applications, by Campbell and Ritchie.

Presented by Northern Electric Company:

Reprints of Technical Papers, Bell Telephone Laboratories, Inc.

Presented by Chamber of Mines, Manitoba:

[Review], Mining, Power, Transportation.

Purchased:

National Research Council, United States: Bulletin No. 76: Handbook of Scientific and Technical Societies and Institutions of the United States and Canada, 2nd ed.

Cracking of Petroleum Oils and Low Temperature Coal Tars

Of interest to fuel technologists is a paper on the above subject by W. H. Jones, b.sc., m.e.i.c., which was presented by the author and discussed at meetings of The Institute of Fuel, held at The Chemical Societies' Rooms, Burlington House, Piccadilly, London, on April 9th and 30th of 1930.

The author reviews in his paper the application of "cracking" in the petroleum industry, for the production of gasoline and its remarkable development since the World War, when practically no gasoline was produced by this method. The gasoline production by cracking to-day is approximately one-third of the total world gasoline production.

With the increasing development of low temperature carbonization or distillation of coal for the production of coal tar oils, the necessity of devising some means of dealing with these oils to derive the greatest economic advantage is of increasing importance. The paper deals with the cracking of the tar oils into gasoline of exceptionally high "anti-knock" quality. In the addendum to the paper results are given of the successful cracking of coal tar oils in a commercial size Dubbs cracking plant built in Belgium especially for this purpose under the author's supervision. The plant is the first of its particular kind in the world.

The paper and full discussion was published in the journal of The Institute of Fuel in July.

BRANCH NEWS

Calgary Branch

A. W. P. Lowrie, A.M.E.I.C., Secretary-Treasurer.
W. H. Broughton, A.M.E.I.C., Branch News Editor.

The Calgary Power Company extended an invitation to members of the Calgary Branch of The Institute and their friends to visit the Ghost river development situated at the confluence of the Bow and Ghost rivers on Saturday, June 21st. The weather conditions were threatening but about 30 members and friends attended and, as the rain kept off, thoroughly enjoyed the 35-mile trip and hospitality of the Company.

Members of the staff of the Calgary Power Company conducted the visitors through the plant and explained the mode of operation which is fully modern and practically fully automatic.

After dinner, H. J. McLean, A.M.E.I.C., production manager of the Company, gave a talk on the construction and operation of the plant, pointing out the very efficient way in which it can be co-ordinated with the Kananaskis and Horseshoe plants further up the river so as to make maximum use of the flow and the storage still further upstream. The dam proper is of concrete in the bed of the Bow river, 928 feet long, flanked on the north by a blanket fill 740 feet long along the face of the Ghost Hill, and by an hydraulic fill 2,020 feet long on the south. At the extreme south is the spillway which also is of concrete construction.

In addition to the average daily flow down the two rivers there is a storage lake immediately above the dam of 74,000 acre-feet at an available head of 108 feet. The plant was designed and all the concrete work is constructed for three turbines of 18,000 h.p. each, of which two are installed and are delivering power to practically all the towns of southern Alberta and as far north as Edmonton. There is also a house turbine of 1,450 h.p. installed and in operation. The third main turbine will be installed when load conditions warrant.

The power house is incorporated in the dam and the penstocks, immediately on the face of the dam, lead directly from the reservoir to the turbines which obviates much trouble due to objectionable ice conditions during our crisp and bracing winter months.

That those present had thoroughly enjoyed their trip and the hospitality of the Calgary Power Company was evidenced by the enthusiasm with which they responded to a vote of thanks to the Company and to Mr. McLean, proposed by F. K. Beach, A.M.E.I.C., and seconded by Mr. B. S. Smith.

Quebec Branch

Philippe Méthé, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Quebec Branch was held on May 26th, under the presidency of A. B. Normandin, A.M.E.I.C., president of the Branch.

The Council members were elected as follows:—

President (Honorary for life)	A. R. Décary, D.A.Sc., M.E.I.C.
President	S. L. de Carteret, M.E.I.C.
Vice-President	Hector Cimon, A.M.E.I.C.
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" *(Past-President)*	A. B. Normandin, A.M.E.I.C.
" " "	A. E. Doucet, M.E.I.C.

BRANCH ACTIVITIES

Four meetings were held during the year:—

1929

Oct. 28.—The Quebec Branch had the privilege to welcome as guest of honour, at a luncheon at the Chateau Frontenac, Brigadier-General C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C., president of The Institute.

1930

Jan. 27.—Noulan Cauchon, A.M.E.I.C., president of the Ottawa Town Planning Commission, on "Hexagonal Planning."

Mar. 24.—H. R. Wake, A.M.E.I.C., property engineer for the Aluminum Company of Canada, at Arvida; the buildings of the company at Arvida.

May 7.—A. A. MacDiarmid, M.E.I.C., and J. S. Bates, A.M.E.I.C., of Price Bros Co. Ltd.; the properties and process of manufacturing of the Donnacona Insulating Board, and the mill required to produce it.

FINANCIAL STATEMENT

Revenues

Cash in Bank, June 30th, 1929	$203.28	
Interest on bank deposit	5.53	
Rebates from Headquarters	232.20	
		$441.01

Expenditures

Stamps, telephones, telegrams, convocation cards	$ 36.17	
Luncheons and meetings	109.24	
Gratuity to the secretary	100.00	
		$245.41
Cash in bank June 1st, 1930		$195.60

PHILIPPE MÉTHÉ, A.M.E.I.C.,
Sec.-Treasurer.

RAPPORT DES ACTIVITÉS DE LA SECTION (1929-30)

La saison s'ouvre le 28 octobre par la visite du président de l'Institut, le Brigadier-Général C. H. Mitchell, C.B., C.M.G., C.E., D.Eng., M.E.I.C. A cette occasion, les membres se réunissent à un déjeuner intime au Château Frontenac.

Le 27 janvier, causerie sur l'urbanisme et le lotissement hexagonal par monsieur N. Cauchon, A.M.E.I.C., président de la Commission d'Urbanisme d'Ottawa.

Le 24 mars, causerie par monsieur H. R. Wake, A.M.E.I.C., ingénieur de la Aluminum Co. of Canada, Arvida; la construction des usines de la Compagnie, à Arvida.

Le 7 mai, Messieurs J. S. Bates, A.M.E.I.C., et A. A. MacDiarmid, M.E.I.C., tous deux de la Cie Price exposent aux membres de la section de Québec, les procédés de fabrication de leur nouveau produit isolant, le Donnacona Insulating Board, ainsi que les différentes caractéristiques de ce produit.

RAPPORT FINANCIER (1929-30)

Recettes

En caisse au 30 juin 1929	$203.28	
Intérêts sur dépôt	5.53	
Remises du Bureau-Chef	232.20	
		$441.01

Déboursés

Timbres, téléphones, invitations	$ 36.17	
Dépenses pour déjeuners-causeries, réunions	109.24	
Allocation au secrétaire	100.00	
		$245.41
En caisse, le 1er juin 1930		$195.60

PHILIPPE MÉTHÉ, A.M.E.I.C.,
Secrétaire-trésorier.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

On April 17th a paper was given before the Montreal Branch by Mr. F. W. Skinner, consulting engineer of New York City, describing the new Hudson River Bridge. This bridge when completed will be the longest span in the world.

Mr. Skinner introduced his paper by describing the three different types of bridges, namely, arch, cantilever and suspension. Two examples of the first were the Hellgate and the Staten Island bridges, having spans of 1,016 and 1,050 feet respectively. In the second class were the Quebec and Forth bridges with spans of about 1,800 feet each, while the third class was exemplified by the Brooklyn and Detroit-Windsor Ambassador bridges.

The economic length of span for cantilever bridges was stated by the speaker to be 2,500 feet, but suspension bridges were in his opinion competitive for all spans over 1,000 feet and moreover these could be built in places where it would be impossible to erect any other type of bridge.

Tribute was paid by Mr. Skinner to Messrs. John A. Roebling and Successors of Trenton, N.J., to whose skill in the perfection of wire and cable manufacture, the suspension bridge largely owed its development. It was for this reason that they were awarded the contract for the four 36-inch cables for the Hudson River Bridge, at a cost of approximately $13,000,000.

The bridge will have a span of 3,600 feet and will cost a total of $75,000,000. There will be eight traffic lanes capable of handling 30,000,000 vehicles annually, on the main roadway, and later on a second lower roadway can be added which will practically double the original capacity. The cables are supported at either bank by two steel towers 650 feet high and containing 20,000 tons of steel each. These supporting towers are very carefully anchored; that on the New Jersey side being in solid rock while that on the New York side is in concrete, weighing in all some 260,000 tons. Each cable is a mile long between anchorages and is made up of 62 strands of 432 wires each. The wires are 0.196 inch in diameter and are cold drawn from acid open hearth carbon steel having an ultimate strength of 288,000 pounds per square inch.

Temporary working platforms are carried just below the cables and the wires are drawn over the anchorages at the rate of nearly 123 tons a day, so that it is expected the bridge will be opened to traffic on scheduled time in 1932.

D. C. Tennant, M.E.I.C., occupied the chair.

GHOST RIVER POWER DEVELOPMENT

W. H. Abbott, A.M.E.I.C., addressed the Montreal Branch on April 24th on the problems encountered in connection with two large hydraulic earth-fills on the Ghost River Power Development.

As Mr. Abbott's paper was printed in full in the June issue of the Journal, no further account of it will be given here.

H. Massue, A.M.E.I.C., occupied the chair.

ELECTRICITY IN THE EIGHTEENTH CENTURY

On May 1st Dr. L. E. Pariseau gave another of his most interesting addresses to a crowded hall, his subject on this occasion being "Electricity in the Eighteenth Century."

The Doctor traced the development of the early investigations in the science of electricity and described at some length the work of some of the outstanding investigators of this early period. The lecture was illustrated by a number of slides which were reproductions of the illustrations and text of some of the earliest books on the subject, selected from Dr. Pariseau's own collection.

On a motion by J. L. Busfield, M.E.I.C., the thanks of the meeting were conveyed to the speaker by the chairman, D. C. Tennant, M.E.I.C.

COTTRELL PROCESS

A paper was presented by Mr. P. E. Landolt, of New York city, on May 8th describing the electric precipitation of finely divided particles by means of the "Cottrell Process."

Mr. Landolt explained that this process resulted from experiments conducted by Sir Oliver Lodge and Dr. Frederick Cottrell. More than a century ago attempts were made to precipitate particles after the same manner as is found in nature but without any marked success. Finally, however, Sir Oliver Lodge applied the present process to the manufacture of sulphuric acid and Dr. Cottrell followed by applying the method to a number of other uses such as the cleaning of gases, recovery of by-products, etc.

Mechanical means had been tried without success for the removal of finely divided foreign bodies from gases. Up to a certain point it was found economical to allow dust to settle but after that it was found that the falling speed of very fine particles was disappearingly small. The other mechanical process was by the use of the inertia of the suspended matter by such means as centrifugal force. When, however, this was applied to gases containing very finely divided matter the process either failed or became prohibitively costly due to the size and power of the required apparatus.

Sir Oliver Lodge's experiments on flue dust and sulphuric acid, from 1904-05, laid down the principles of electric precipitation. By this process electrodes are introduced into the gas and the particles charged by the discharge electrode are collected by the other.

Mr. Landolt told of the many practical applications which had been made in various industries and mentioned a number in Quebec, such as Brown Corporation, La Tuque, Noranda Mines Ltd., Noranda, and Aluminum Company, Arvida, etc.

THE QUEST OF THE UNKNOWN

Professor Harold B. Smith, President of the American Institute of Electrical Engineers, addressed the Montreal Branch and local members of the A.I.E.E. at a special meeting held on May 21st.

Professor Smith took as his title "The Quest of the Unknown" and in this connection outlined his experiences in a lifelong study of dielectrics. A number of slides were shown illustrating various transformers and other experimental equipment developed or built by the speaker in the course of his researches and culminating in a unit of 1,000,000-volt capacity recently completed.

In the course of his talk Professor Smith drew a parallel between his expeditions to southern Thibet and other little known parts of the world, and his experiments in the field of scientific research, conveying to his audience something of the thrill of "high adventure" to be derived from the latter. Finally, in closing the speaker advised every engineer to "find some problem and then stick to it."

The chairman of the meeting was D. C. Tennant, M.E.I.C., and a vote of thanks to the speaker was proposed by Julian C. Smith, M.E.I.C., after a most interesting discussion.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.
C. G. Moon, A.M.E.I.C., Branch News Editor.

The elections were quiet this year. Three new members won their seats by acclamation and the Executive Committee stands as follows for the coming year:—

Walter Jackson, M.E.I.C., Chairman
E. P. Murphy, A.M.E.I.C., Vice-Chairman
R. W. Downie, A.M.E.I.C., Secretary-Treasurer

C. W. West, A.M.E.I.C.	F. L. Haviland, M.E.I.C.
J. K. Wyman, A.M.E.I.C.	*J. C. Moyer,
W. R. Manock, A.M.E.I.C.	*C. G. Cline, A.M.E.I.C.
N. Bates, A.M.E.I.C.	*H. D. Davison, A.M.E.I.C.

Ex-officio
A. J. Grant, M.E.I.C.
E. G. Cameron, A.M.E.I.C.
C. H. Scheman, M.E.I.C.
M. B. Atkinson, M.E.I.C.

*New members.

Following a very pleasant custom, which was instigated by our late Chairman, E. G. Cameron, A.M.E.I.C., the members of the "old" and "new" executive met at the Lookout Golf course on May 22nd to discuss and elect the officers for the coming year. Truth to tell there was little discussion as the majority was more than eager for a game and matters pertaining to chairman and vice-chairman seemed to be of secondary importance. Both Walter Jackson and Harbour Master Murphy are prime workers besides being acknowledged good fellows so that there was very little question as to the shoulders upon which the mantle of authority and responsibility would fall. As for our secretary-treasurer, fortunately for us, he is a perennial.

It may be of interest to the Branch members to note that this year we have four members on the executive who ten years ago were signatories to the Charter, namely Messrs. Jackson, Grant, Moyer, and Davison.

The chief excitement of the golf game centred around two sets, a foursome composed of Messrs. Grant, Redfern, Atkinson and Beattie who were settling an old grudge, and a twosome containing the famous "Pro" Johnny Sears and an hitherto unknown player from the west.

Nobody knows yet who won the foursome but, to everyone's surprise, the twosome went to the dark horse. Having played at St. Andrews and at many of the other famous clubs Johnny was loud in his praises of "Lookout," frankly admitting that the hazards were too much for him and he was not up to his usual form when he turned in a score of 141. At St. Andrews he had made an 83 but being two up on his opponent he rested on his laurels and retired at the fourth hole.

ANNUAL MEETING

The annual meeting was held on June 4th at the Welland house, St. Catharines. Owing to the sultry weather the attendance was not large but the 150 guests who did brave the heat enjoyed themselves immensely. From Bridgeburg, nearly forty miles away, came a contingent of twenty-eight members, probably the best percentage from any section of this district. Following the dinner a brief interval was allowed for speakers and the introduction of new officers.

Then Dr. A. P. Coleman, Professor Emeritus of the University of Toronto, explained some very beautiful lantern views taken during one of his trips when he "forded" the continent. After which the younger members had their innings and danced until the early hours of the morning.

E. G. Cameron, A.M.E.I.C., was in charge of proceedings and the Branch is rather proud of the manner in which he handled a difficult situation when, for a short period, the lantern behaved as though it were endowed with long ears. Now that Walter Jackson has taken over the reins, other Branches will be asked to submit bids for a fully developed chairman (the highest or any tender not necessarily accepted).

Before commencing the programme the ladies were ably represented by a speaker in the person of Mrs. A. J. Grant who desired to express her opinion that making the annual meeting into a mixed gathering was a happy thought and one that should appeal to the wife of every engineer. She had been wrestling with Mr. Grant for a good many years to find out just what he did at these meetings and now she was satisfied that they were innocuous.

First of all Mayor McCordick welcomed the gathering to St. Catharines and spoke warmly of the friendships he had made with many of the engineers in the surrounding district. The Welland ship canal was responsible for the presence of many and, now that the great work of construction was practically complete, he felt keen sorrow that some of them would be forced to leave for other parts and other activities.

President A. J. Grant spoke of Institute affairs and deplored the fact that the recent ballot for increased dues was lost by a narrow margin. Many proposed activities will be impaired by the result and he trusted that members will realize that the situation is serious and will derive fresh impetus to canvass all possible prospects for new members. A determined effort in this direction would go far in offsetting the ill effect. In closing he desired to pay tribute to Mr. Cameron for the untiring energy which had been given to Branch and Institute affairs and wished every success to the new Chairman, Mr. Walter Jackson.

Mr. Cameron immediately took up the gauntlet and with a burst of unexpected eloquence paid Mr. Grant back right handsomely, ending with the quotation "We the Branch bask in the reflected glory of your position."

A somewhat pleasant feature of the gathering was the re-union between Mr. and Mrs. Brodie Atkinson who had not seen each other for several months. Of course there is an explanation for this state of affairs, namely that Mrs. Atkinson had been visiting her parents in California and had just returned a few hours previously whereas

Brodie had been over to England giving expert testimony before a Parliamentary Commission concerning a proposed vertical lift bridge across the River Tees near Stockton.

Most of the Branch Members had met Mr. Durley at previous annual meetings but never before had an assistant secretary been permitted to travel thus far from home. Mr. J. F. Plow has just entered upon the duties of this office and, much to the credit of Headquarters, was allowed to visit us and introduce himself.

Introducing Dr. Coleman, Mr. Cameron explained that he was a "realistic" speaker. On a similarly hot night in 1914, at the Engineering Club at Thorold, Dr. Coleman had chosen for his subject the "glacial age" and before very long most of the guests were calling for their wraps. Tonight, advised Mr. Cameron, if the subject was mentioned it might be as well to limit the thickness of ice to about a quarter of a mile instead of the previously mentioned two miles.

Dr. Coleman then took the floor and, after the lantern had been sufficiently humoured, entertained the gathering with his very acute and pertinent observations while travelling through seventeen states and five provinces. Most of the views were coloured by his own brush and some were original sketches, for he is not only an eminent geologist and naturalist but also an artist in water colour and word painting.

He took us through the south and showed us how the darkies lived, to the prairies where Indians roamed around in Packards purchased with profits from oil lands, and to the Yellowstone where the tints in the rocks vied with the beautiful colouring in the waterfalls and streams. Then with never a stop at cities which hold little interest for the naturalist he led us to the beauties of the coast, the sunken gardens and the gorge near Victoria, the Seven Sisters at Vancouver and back by way of the Okanagan and Kootenay Lake to Lake Louise and Banff. There he showed us tame "wild" animals, mule deer that came right up to the car and bears which grew so friendly that they had to be enticed in the opposite direction before the party could move ahead.

Again Mr. Cameron rose to the occasion and referred to the applause as a "conservative measure of our appreciation." Then thanking Dr. Coleman for himself and on behalf of the Branch he declared an adjournment before going ahead with the dance.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Vacant

DRAUGHTSMEN—One or two draughtsmen experienced in general pulp and paper mill work and construction, for a company in the province of Quebec. Apply at once to Box No. 554-V.

MECHANICAL ENGINEERS. Two young graduate engineers with sales ability wanted by a well-known Canadian company. Apply, giving full particulars, to Box No. 562-V.

TOWN ENGINEER, for a town in Maritime Provinces. Electrical and civil engineer, or electrical engineer with sufficient knowledge of civil engineering to take charge of water and sewerage system, building of roads and sidewalks, etc. Must be able to speak French. Apply to Box No. 565-V.

SALES ENGINEER. Canadian stoker manufacturers desire services of experienced mechanical engineer to take charge of distribution. Location Montreal. Apply at once to Box No. 580-V.

DRAUGHTSMAN—Young man with some experience for about fourteen months work for city engineer's office in northern Ontario. Apply at once to Box No. 584-V.

RADIO ENGINEER—Canadian manufacturer of broadcast receivers requires development engineer. University degree or equivalent experience required. Give full details of qualifications in application. Apply to Box No. 591-V.

ENGINEERS—A large electrical manufacturing concern requires several young engineering graduates, Mechanical, Electrical or Chemical, for work on factory and inspection methods, manufacturing problems and cost reduction. Men who have graduated within the last two or three years preferred. Please state in first instance, education, full qualifications, experience, references, salary required, kind of engineering work particularly desired, age and when available. A snapshot or photograph is desirable. Apply to Box No. 594-V.

DRAUGHTSMEN.—Preferably familiar with cruising, flotation and cyanide mill work. Men experienced in concrete, structural steel and plant layouts considered. Only Canadian citizens need apply. Work will be about eight months. Apply by letter. Location, Canada. Apply to Box No. 595-V.

ELECTRICAL ENGINEER, preferably with sales experience, to handle engineering equipment in Montreal and vicinity. Apply to Box No. 596-V.

ESTIMATOR OR QUANTITY SURVEYOR, required for a large building construction company. Must be experienced in this particular work and acquainted with Canadian methods of taking off and extending building quantities in detail. Apply giving age, experience and references to Box No. 597-V.

DRAUGHTSMAN wanted, experienced in industrial plant layout and equipment and in details of modern factory construction. Location Montreal in office of architectural engineer. State in detail age, education, experience, salary, etc. Apply to Box No. 598-V.

Situations Wanted

ELECTRICAL ENGINEER, M.Sc., A.M.E.I.C., graduate, seven years' experience in high tension calculation design and construction, seeks connection. Location immaterial. Age 30. Married. Apply to Box No. 7-W.

CIVIL ENGINEER, A.M.E.I.C., experience: highways, railways, drainage projects, stream diversion, earth, timber and concrete dams, laying large and small pipe, timber structures, concrete walls and pavements. Location, construction or maintenance. Desires position as engineer or superintendent. Location immaterial. Apply to Box No. 34-W.

CIVIL AND MECHANICAL ENGINEER, aggressive practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mill, desires change. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years' experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal engineering, construction work, inspection, estimating. Apply to Box No. 107-W.

COLLEGE GRADUATE, age 34, with over ten years' experience in power developments and pulp and paper mill construction and maintenance, largely in direct charge of design or construction; desires new connection as chief or assistant engineer or construction superintendent. Apply to Box No. 167-W.

ENGINEER—Sales executive, A.M.E.I.C., age 37, presently employed as district representative, desires change in wider field. Experience (Canada and abroad), covers structural steel and iron foundry work as chief draughtsman, designer, etc. Available on reasonable notice. Apply to Box No. 227-W.

MACHINE DESIGNER. Experienced machine designer and draughtsman, shortly open for position. A.M.E.I.C. Considerable experience in mining and winding machinery. Well up in steam power house equipment layouts and piping. Own design in successful operation. Accustomed to structural work. References good. Present location Montreal. Interview easily arranged. Apply to Box No. 329-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years' experience in this country, twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Provinces. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, graduate '29, desires engineering position with possibilities of forming connections. Willing to learn. Work in construction preferred, water power, or municipal suggested. Past experience consists chiefly of survey work in charge of party. Location in B.C. or western provinces preferred. Apply to Box No. 338-W.

CONSTRUCTION ENGINEER, Canadian, speaking and writing French and English, A.M.E.I.C., P.E.Q. Twenty years' experience in water power development, roadway, water and sewer works, as engineer in charge or superintendent, desires position. Available on short notice. Apply to Box No. 380-W.

GRADUATE ENGINEER, N.S. Tech. Coll., age 25, desires permanent position with industrial concern. Since graduation has spent two years' apprenticeship with Can. Westinghouse Co. Apply to Box No. 382-W.

CIVIL ENGINEER, B.Sc., '24, Jr.E.I.C., C.P.E.Q., Canadian, age 30, married. Experience: Construction power developments, railways, highways, pulp and paper mills, maintenance pulp and paper mills, railways, desires permanent position with opportunity for advancement. Apply to Box No. 402-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), graduate. Eighteen years' experience in survey and construction, railway, hydro-electric and buildings. Experience comprises both office and outside work. Desires responsible position. Would consider position with commercial or manufacturing firm. Available about August 15th. Apply to Box No. 425-W.

ELECTRICAL ENGINEER, B.A.Sc., age 25 years, single; two five-month summer vacation periods on electrical construction and maintenance; three years and three months with large electrical manufacturing company, including twelve months' standard test course, twenty-one months' machine design, six months' commercial experience. Apply to Box No. 426-W.

CIVIL ENGINEER, S.E.I.C., 1930 graduate of Nova Scotia Tech. with experience as plane table topographer, instrumentman and draughtsman and particularly interested in hydro-electric power development and reinforced concrete design, desires position. Willing to go to foreign fields. Available at a few weeks' notice. Apply to Box No. 431-W.

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Radio Inductive Interference

Methods Employed to Locate and Suppress the Interference at its Source

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Paper read before the Montreal Branch of The Engineering Institute of Canada, November 21st, 1929.

Co-operation of Public Utilities

The Dominion government is the only government, as far as the author knows, which provides a regular service to broadcast listeners for the suppression of inductive interference. The situation in other countries varies considerably. In Europe the noise level from interference in the cities tends to be lower than in this country on account of the extensive use of the underground wiring system. Radio engineers who have recently returned from Europe tell, however, that the inductive interference is considerable when listening on the receiver to distant or weak stations.

There is a tendency in Europe and in the United States to increase the power of the broadcasting stations and, thereby, increase the signal strength, so that the receivers do not require to be set for extreme sensitivity and, in this way, the inductive interference is not so noticeable.

Many of the public utilities in the United States have a well organized inductive interference investigation section and spend a considerable amount of money along this line, for the purpose of increasing the good will of their consumers.

An increase in the electric load, of some 10 or 20 per cent, is attributed, by some public utilities in the United States, to be a direct result of the introduction of radio receivers into the homes. The increased load due to radio includes, besides the actual power consumed by the radio receivers and battery chargers, an extra light and heating load, which meter readings have proved to follow the installation of a radio receiver in the home.

In Canada the public utilities are, generally, co-operating in a very satisfactory manner with the Radio Branch in the suppression of interference. The Bell Telephone Company and the telegraph companies besides assisting the Radio Branch, have developed their own methods of suppressing interference from the normal operation of their equipment and are installing the necessary devices wherever the apparatus is found to be causing interference.

The British Columbia Electric Railway Company has, for some time, been employing an electrician for the investigation and suppression of interference from their lines, and this electrician has been working in conjunction with the radio inspector in Vancouver and accompanying the radio investigators on tours in the surrounding district.

The Toronto Hydro-Electric Commission, besides assisting the radio inspectors, maintains a number of inspection gangs, independent of the emergency, construction, or repair gangs, who devote their entire time to periodic inspections of their overhead system. In this way, the distribution system is maintained in such a condition as to give very little interference to radio reception.

Interference Carried on Power Lines

All electrical conductors carrying current are surrounded by three types of fields, which may influence radio receivers having aerials within these fields of influence.

These fields are:—

(1) *Electromagnetic*—which varies according to the current in the conductor.

(2) *Electrostatic*—which varies according to the voltage.

Under normal conditions on electric power lines, these electromagnetic and electrostatic fields, surrounding the conductor, do not extend for more than a few yards from the power line. In some cases, however, the third type of field, called the

(3) *Field of electric radiation*, which is produced by a very sudden change in voltage, called an electrical surge, may radiate and cause interference to radio receivers whose aerials are a considerable distance from the power lines. An electric surge may travel many miles along a power line and produce a radiation which may be picked up on radio receivers. A surge, due to a spark on the power line, may be induced from one line to another and be carried a greater distance on the secondary system than on the one on which the spark occurred.

The amount of interference caused by an electrical surge to a radio receiver depends not only on the characteristic of the surge, but on the characteristic of the wires carrying the surge. Sometimes, telegraph interference, produced by the breaking of a 100-volt battery, will cause greater radio interference than the switching of high voltage power lines. It is often found that radio interference caused by a fault on the distribution system may be carried a greater distance on the electric railway feeders, which run parallel to the distribution system near the fault, than on the

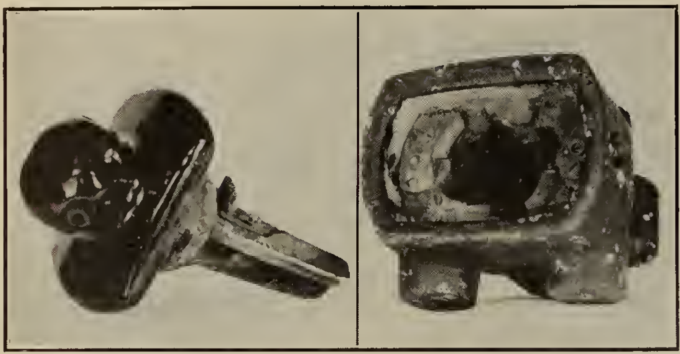


Figure No. 1—Defective Cutout Plug—2,200-Volt Circuit.

wires connected directly to the fault. This is probably due to the fact that the capacity from the distribution primary to ground is considerable, as the transformers act as condensers to drain off the interference from the distribution system, while the capacity of electric railroad feeders to ground is very much less.

Summary of Sources of Inductive Interference Investigated During Fiscal Year 1928-1929 by the Radio Branch

Domestic and commercial apparatus	1,650
Distribution systems and power lines	4,271
Total Sources (other than radio)	5,921

Summary of Sources Found on Distribution Systems and Power Lines, Listed Above

Cutouts (transformer fuses)	3,186
Lightning arresters	194
Loose series connections ((other than cutouts)	182
Contacts with ungrounded metal (such as guy-wires, brackets, transformer cases, etc.)	441
Contacts with grounded material (other than lightning arresters)—(such as trees, poles, grounded metal, etc.)	126
Defective insulators or bushings	24
Sources unknown	8
Faults on lines over 8,000 volts	110
Total	4,271

In dealing with radio inductive interference, the sources are divided into two general classes, that is those originating on power lines and distribution systems, and those caused by electrical machinery and apparatus.

As so many sources handled by the Radio Branch are caused by power lines and distribution systems, this class of interference will be dealt with first.

It will be seen from the summary, that, of a total of 5,921 cases of inductive interference investigated during the year, 4,271, or about 72 per cent of the total, were found on the power lines and distribution systems. These 4,271 cases are referred to again in the latter part of the summary, and it is worthy of note that 2,186 sources were caused by defective cutouts or transformer fuses.

Although defective transformer cutouts cause very considerable radio interference (in some cases, a single defective cutout may practically destroy all radio reception throughout an entire city), as a general rule the interference is intermittent and does not seriously interfere with radio reception for a greater distance than from one-quarter to one mile from the source.

While other sources of interference are not so numerous, they very often cause more serious interference. A fault on a high voltage power line in Quebec caused radio interference to all receivers along this line for a distance of thirty miles. This was actually caused by an unused power line picking up potential by induction and radio investigators found that a spark occurred from the grounding chain to a steel tower.

Transformer Fuses

The majority of the cases of interference are caused by the old type of porcelain fuse plugs having open fuses. Both the type which plugs straight in and that which closes with a quarter turn are equally bad from the interference point of view. Very few cases of interference have been found to be caused by oil immersed fuses, or the cartridge type, including the expulsion fuses.

On examination of the interfering fuse plugs, it is usually found that the copper jaws have lost their temper due to heat and the blades are corroded. It is very often found that the copper fuses, from the blade to the jaw, making a perfect metallic contact of very small area (not much more than a pin point). A defective transformer fuse is shown in figure No. 1. This probably accounts for the intermittent nature of the interference, as there will be no interference as long as this fuse contact holds, but the slightest vibration caused by wind or passing traffic will break this pin point of copper and the arcing from blade to jaw will recommence, causing interference. The test used, therefore, to locate defective cutouts, is what is known as the mallet test and consists of tapping the pole with a wooden mallet while an observer listens to the interference on a radio receiver. This test will, usually, show up the defect, whether the interference could be heard, or not, before the test, as the vibration will either start or stop the interference, or change its characteristic.

A great improvement in reception conditions has been noticed in some of the cities which are gradually discarding the old type of cutout and installing on all the larger types of transformers either the oil cutout or the expulsion fuse.

Another cause of interference has been noticed occasionally, particularly on high voltage, small current fuses, such as those used to protect potential transformers. In these cases interference was traced to an open wire fuse. which had burnt away for a short distance from the fuse terminal, and was arcing from the end of the fuse wire to the fuse terminal. The fuse wire had probably been damaged when being connected under the head of the terminal screw and had burnt off for a short distance but due to the limited current, there was not enough heat to

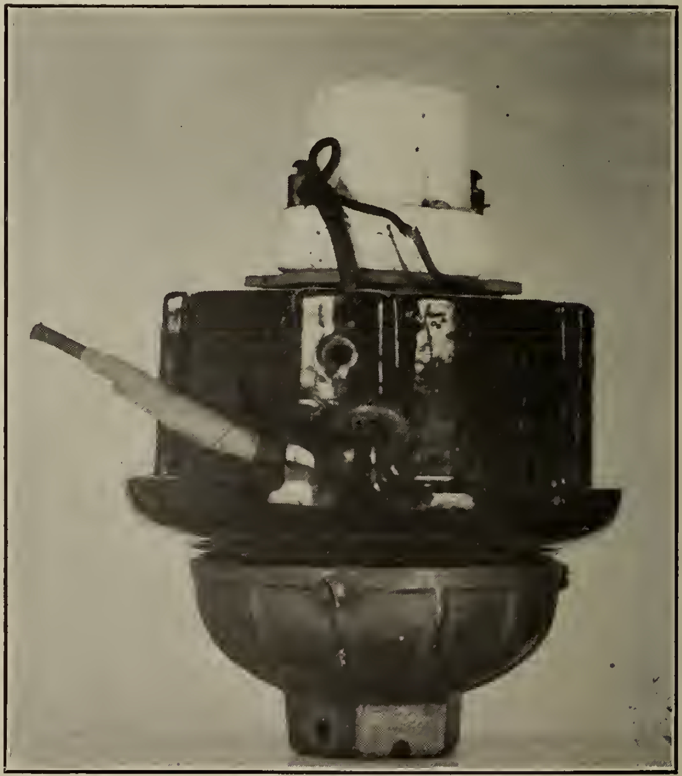


Figure No. 2—Street Light Fixture Causing Interference.

Figure No. 3—Super Heterodyne Receiver installed in Car.

blow the fuse completely, and the transformer continued to operate as the primary current arced steadily across the gap.

Lightning Arresters

It will be seen by the summary that 194 lightning arresters were found to cause radio interference. Most of these cases were caused by the old type of lightning arrester, consisting of a resistance and series gaps from line to ground. In most cases, the electrodes of the gaps were corroded, or some of them short-circuited, causing an unbalance of the electrostatic field and sparking across some or all of the series gaps. The newer type of arresters enclosed in porcelain gives very little radio interference.

Loose Series Connections

Loose series connections on circuits of 220 volts, or less, usually do not cause very widespread interference.

Loose connections to 500-volt motors, where they are kept in continual vibration, have caused very considerable interference. Greater interference, however, is caused by the loose connections on higher voltage, particularly where the current flowing through the loose connection is small.

Some of the most far reaching cases of interference have been traced to loose series connections, including poor contacts at disconnecting switches on overhead lines carrying little or no power current. A case of this kind was traced along an 11,000-volt line, about fifteen miles from the broadcast listener's receiver, and was found to be caused by a poor contact in an open air disconnecting switch connected to about a mile of line, which was under potential but carrying no load.

Contacts With Ungrounded Metal

Four hundred and forty-one sources of interference were dealt with under the heading: "Contacts with Ungrounded Metal," including power wires in contact with insulated guy-wires, loose tie-wires on insulators, power wires in contact with pole line hardware, transformer cases, etc., and, also, parts of series street lighting fixtures within sparking distance of the conductor.

Many of these sources of radio interference have been found, also, to create hazardous conditions for the linemen or the general public. A case of interference was recently traced, along the 2,200-volt primary, a distance of three-quarters of a mile from the receiver affected, and it was found that an unused radio aerial was in contact with the 2,200-volt primary. The owner of the aerial informed the investigator that a radio dealer had arranged to connect a set to this aerial the following day.

A common fault found on series street lighting fixtures was caused by the leads from the auto-transformer to the lamp sparking to some insulated metal in the lamp fixture. These leads were insulated to withstand only the low voltage of the lamp and the fault did not cause any trouble with the lighting systems on account of the fact that the metal in contact with the leads was insulated from line and ground. Although these leads were only required to withstand 50 volts, or less, which is the voltage across the lamp, from the point of view of lighting and power, they were subject to the full voltage of the line as far as radio interference was concerned, as the iron of the fixture formed an intermediate plate of series condensers from line to ground and a spark occurred, through the poor insulation of the lead, to the iron. Figure No. 2 shows a street light fixture with iron ring removed to show defective wiring. This matter was brought to the attention of the manufacturers, who were pleased to alter the design of their fixtures, insulating all conductors connected to the lines to withstand the high voltage test.

Tie-Wires

Loose tie-wires on power wires are believed to be the cause of much interference from high voltage power lines. Practically all high voltage power lines cause a certain amount of interference which is usually referred to as normal high tension fry, but the amount of this interference varies very greatly. The interference from lines

Figure No. 4—Radio Investigator and Lineman locating Fault.

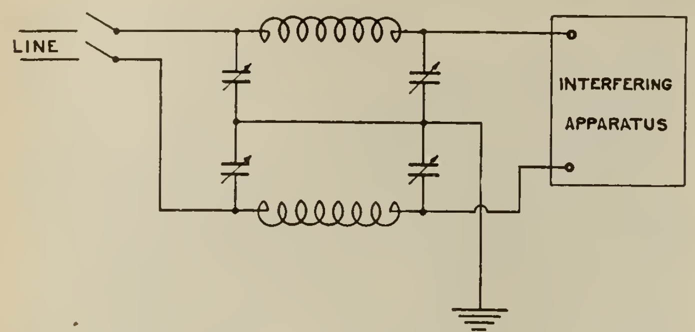


Figure No. 5.—Diagram of Tuned Radio Frequency Rejector Circuit.

using the suspension type of insulator is practically always less than that caused by lines of similar voltage using the pin type of insulator.

Some new 13,000-volt insulated lines, using insulated tie-wires, have been found to be very quiet, while, as a general rule, the bare lines of this voltage give less radio interference than insulated lines after the insulation becomes old.

A number of cases have actually been found, where the tie-wire was loose on the insulator, and a great deal of the interference was eliminated when this fault was repaired. Usually, however, the interference from an individual tie-wire is so small, compared with the total interference from the line, that such definite results cannot be obtained.

Interference Less in Wet Weather

It is often found that interference from high voltage power wires, having pin type insulators, is less in wet weather. An experiment was carried out on a tie-wire, which was found to be loose and causing radio interference; it was found that the spitting sound ceased as well as the radio interference, when a few drops of water were placed on the tie-wire.

It has, also, been found that considerable radio interference may be caused by a power wire in loose contact with an insulator (the tie-wire having been completely removed), and the interference ceased when the power wire was pressed hard against the top of the insulator.

The Ohio Brass Company have developed an insulator having a metal top and, also, one having a metallized surface on the top, in order to eliminate interference of this kind, but the Radio Branch has had no experience in connection with this new type of insulator in actual practice.

Effect of Reduced Voltage

Experiments were conducted with the co-operation of the Hydro-Electric Power Commission of Ontario on a 90,000-volt pin type line between Niagara Falls and Toronto. The voltage of this line was gradually reduced from 90,000 volts to zero, and it was found that the radio interference gradually reduced from the maximum at 90,000 volts to about one-half the intensity at 20,000 volts. The investigators expected to find that there would be a critical value of the voltage below which the interference would materially reduce, but such was not the case.

Methods of Locating Interference

The investigation usually starts from a report of interference made by a broadcast listener.

Numerous methods have been tried to obtain useful information from the broadcast listener, which might assist the investigator. Questionnaire forms have been used for the purpose of ascertaining from the broadcast listener the characteristics of the interference, but it has been found that the broadcast listener usually finds difficulty in describing the interference in a way that would prove helpful to the investigator, so that this form is seldom used. It has been found that more useful information can be obtained by a few minutes talk on the telephone, and using a simple card.

Investigators in different cities use different methods of handling and filing these cards, as conditions in the large cities call for a different system from that used in smaller towns.

General Patrol

In order to locate the interference it is first necessary to determine the area affected and the points at which the interference is greatest. A general patrol of the district is, therefore, made, using a superheterodyne radio receiver with a loop antenna, in an automobile. The loop antenna is turned parallel to the various wires and an endeavour is made to determine which system of wires radiates interference with greatest intensity. The directional effect of the loop is used solely for this purpose, as it is found that, in less than 1 per cent of the cases will the loop point directly to the source of interference, but gives greatest intensity when the loop parallels the wires carrying the interfering surge.

The volume control of the receiver is, also, used to determine the location where the interference is greatest. Although the greatest interference is not always heard near the source, in many cases the source is found somewhere in that vicinity.

Mallet Test

A more detailed investigation is then made in the location where the source of interference is suspected. If it is suspected that the interference is caused by some wires or apparatus on the poles of the distribution system, these poles are struck a moderate blow with a five-pound wooden mallet, while the interference is noted on the radio receiver. The blow of the mallet will cause a vibration corresponding to that produced by passing traffic and, if a loose connection or faulty contact exists on the pole, it will cause the radio interference to start, stop or change its character. In the case of loose transformer cutouts and other similar faults, a very slight vibration will sometimes affect the interference, such as tapping the pole with the hand, or tapping a pole several spans away with a mallet.

Shaking Guy-Wires

Some types of interference, such as caused by a power wire lying on a guy-wire, may be located by shaking the guy-wires, thus causing all the wires in the vicinity to swing as they would in windy weather. Very often, shaking the guy-wire will start or stop radio interference from a fault, up to a distance of half a mile from the guy-wire being shaken. If the interference starts and stops instantaneously with the shaking of the wire, the immediate vicinity is investigated for the fault. If, however, a second or two elapses after the guy-wire is shaken, a search is made a considerable distance from this point for the fault.

Bamboo Pole

A jointed pole, consisting of three five-foot sections of bamboo about one inch in diameter, has been found very useful for shaking individual wires while listening to the interference from the radio receiver. This bamboo pole may, sometimes, be used to temporarily remove wires which are in contact with other wires or pole line hardware, without the necessity of a lineman climbing the pole.

Portable Receiver

A portable receiver has been found very useful in addition to the receiver carried in the automobile. Frequently, it is desired to patrol a power line away from the highway, or carry the receiver into buildings. This portable receiver should be as light as possible and does not require to be as sensitive as the receiver in the car. To atone for the lack of sensitivity, the portable receiver may be placed with the loop near some wire connected to the power systems under investigation. The ground wire on the pole will conduct the interfering surge from the power wire to the radio receiver. This portable receiver may be used with a probe antenna or a radio frequency exploring coil, for pick-up, in place of the loop, where it is desired to determine which of a number of wires carries the interfering surge with the greatest intensity. The receiver with the loop is intended to determine the field of radiation within several yards, while the exploring coil and probe antenna are intended to determine this field within a few inches.

Radio Frequency Exploring Coil

The radio frequency exploring coil consists of a honeycomb coil of approximately 75 turns. This must be thoroughly insulated, so that it can be used with safety near high voltage bus-bars in a power house. It is used in the same way as the loop antenna, but, being small, has the advantage of determining which bus-bar carries the interference, when these bus-bars are in close proximity. It possesses the same directional characteristics as the loop.

The use of the radio frequency exploring coil, is, however, limited to places where the receiver can be carried within a few feet of the power wires or bus-bars, as the radio frequency exploring coil cannot be used with a long lead. The capacity between the wires of a long lead would by-pass the pick-up from the coil.

The Probe Antenna

The probe antenna is used in place of the radio frequency exploring coil where it is not convenient to place the radio receiver within a few feet of the power wires. The probe antenna consists of an insulated conductor enclosed in a tubular metallic shield extending to within 6 inches of the upper end. The centre conductor is connected to the aerial binding post of the receiver, while the shielding is connected to the ground terminal of the receiver. This probe antenna will only pick up radio signals by the 6 inches which are unshielded and is, therefore, very useful for probing between wires. The shielding should be insulated, as contact from the shield to any metal or ground will cause noise in the radio receiver. An additional insulation, such as a fibre tube, may be placed over the upper end of the probe antenna for protection when working among high voltage wires.

It is useful to have the portable receiver thoroughly shielded when it is desired to work in a power house or other place where the intensity of the radiating field is so great than an unshielded receiver would pick up stray fields.

Switching Test

The switching test is only resorted to in the investigation of interference when it is convenient to switch the suspected circuits on and off without inconveniencing the power consumers, or where other methods of investigation fail.

Many sources of interference do not start immediately the circuit is closed. It is, therefore, more reliable to consider the results when opening a circuit during the time that the interference is continuous. Usually, the switching test should be repeated several times, to avoid misleading results from a coincidence in which the interference starts and stops, at the instant of switching, from some independent cause.

Surge Traps

Surge traps are usually installed in the power lines which supply the apparatus, in order to stop the flow of the surge which causes the radio interference. In exceptional cases, however, when it is not practical to do this, a surge trap can sometimes be effectively installed in the electric service wiring in the vicinity of the receiver.

Surge traps may be divided into two classes:—

(1) The tuned radio frequency rejector circuit,
(2) The untuned surge trap.

Tuned Radio Frequency Rejector Circuit

The tuned radio frequency rejector circuit, shown in figure No. 5, consists of an inductance in the power line, with a condenser connected in parallel with the inductance, the value of the inductance and the condenser being such that the impedance of the line is extremely high at the particular radio frequency which the rejector is designed to stop. This type of surge trap is seldom used as it only stops the interference to a receiver which is tuned to one particular wave length.

Surge Trap Untuned

The untuned surge trap is the type most frequently used as it is designed to stop the interfering surge, no matter what form this surge may take. The surge may consist of radio frequency oscillations either continuous or damped, or may consist of series of extremely sudden changes in voltage. These surge traps are made up of condensers, or choke coils, or both. The purpose of the condenser is to by-pass the surge, by providing a path of low impedance, but which will not conduct the power current. The choke coil is placed in the line so that it will carry the power current without any material loss and introduce a high impedance to the interfering surge. By a suitable combination of condensers and choke coils it is usually possible to prevent the surge from passing the surge

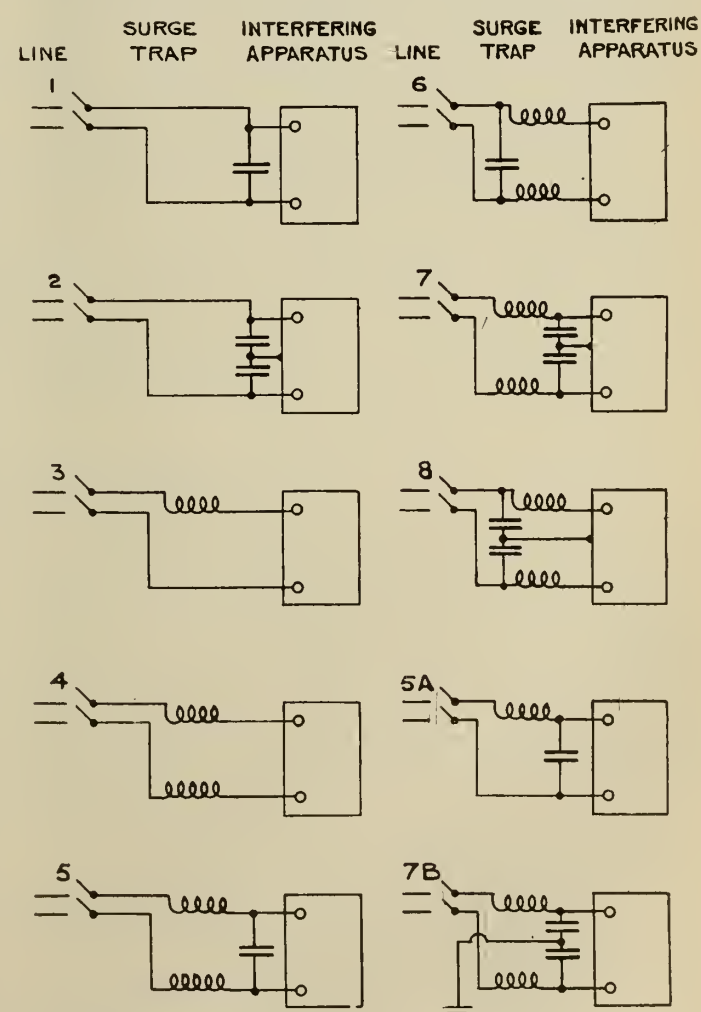
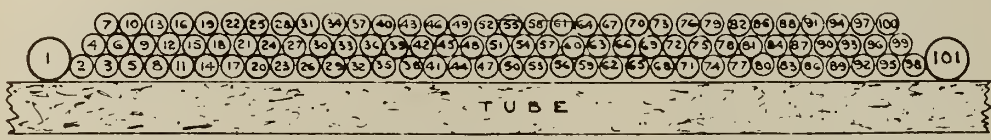


Figure No. 6.—Diagram of Surge Traps, Standard Types.

trap with sufficient intensity to cause material interference to radio reception.

As the requirements of a surge trap are dependent not only on the type of apparatus causing the interference, but also on the characteristics of the wiring supplying the apparatus, and other nearby wiring, it is not possible to recommend a definite surge trap for any given class of electrical apparatus. In order to find the most economical surge trap to eliminate the interference, it is usually necessary to conduct a few simple experiments. When conducting these experiments particular attention must be given to all details, as a slight change in the arrange-



Detail - Three Layer Bank Winding.

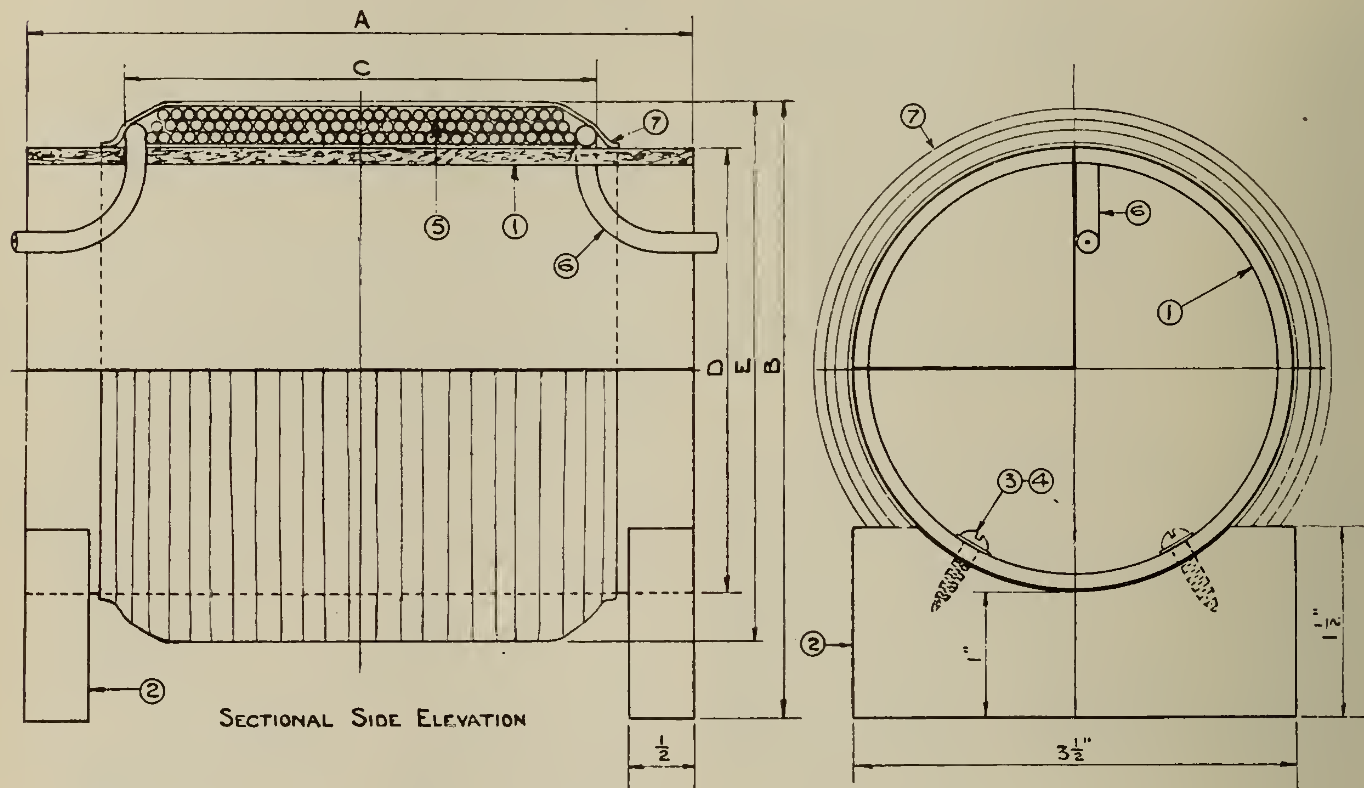


Figure No. 7.—Diagram of Choke Coils, Bank Wound.

Type	Current Rating Amps.	Size of Wire B. & S.	No. of Turns	No. of Layers	Size of Leads	DIMENSIONS				
						A	B	C	D	E
BM 18	2.75	18	100	6	14	2¾″	5″	1¼″	3½″	4⅜″
BM 14	5.5	14	100	3	14	5¼″	5″	3¼″	3½″	4½″
BM 12	8	12	100	3	12	5¾″	5″	3¾″	3½″	4½″
BM 10	12	10	100	3	10	6¾″	5″	4¾″	3½″	4⅝″
BM 8	16	8	100	3	8	7½″	5¼″	5½″	3½″	4¾″
BM 6	20	6	100	3	6	8¾″	5¼″	6¾″	3½″	4¾″
BM 8S	16	8	150	3	8	10½″	5¼″	8½″	3½″	4¾″

Pt. 1.—Fibre Tube, 3¼″ inside, 3½″ outside dia.
2.—Fibre Supports, 2 off.
3.—Brass wood screws, No. 5, round head, ⅝″ long, 4 off.
4.—Brass washers, ⅛″ hole, 4 off.
5.—Winding, d.c.c. solid copper wire.
6.—Leads, rubber insulated braid covered stranded copper wire, one turn around tube and 18″ long outside, soldered and taped to winding.
7. Five layers Empire cloth and two layers friction tape, varnished.

ments, which would seem insignificant to those without experience in the matter, might make all the difference between success and failure.

Figure No. 6 shows the types of surge traps most frequently used for the prevention of interference.

All surge traps should be installed according to the regulations of the Canadian Electrical Code, as most of the provinces have accepted this code as their standard.

Condensers

Condensers used for surge traps are supplied in capacities of 1/10, ½, 1 and 2 mf., according to requirements. The value of the capacity is not critical and, if it is found that 1 mf. condenser does not reduce the interference whatever, it is seldom possible to entirely eliminate the interference by using condensers of other capacities. As a general rule, the smaller capacity is suitable for the elimination of interference in which there is a very small current surge, such as in the case of telegraph interference. Condensers of larger capacity are required, however, for such cases as battery chargers and moderately-sized motors and generators, in which there is a considerable current surge which causes the interference.

The condensers should be made to withstand a test voltage of several times the voltage of the line, as the surge which causes the radio interference very often has instantaneous values of voltage very much in excess of the line; for example, the surge on a telegraph line supplied from a fifty-volt battery will, in some cases, exceed two hundred volts.

Choke Coils

The inductance of choke coils for use in surge traps varies from ¼ to 15 millihenries, according to the special requirements. Choke coils for this purpose are designed so as to have very low distributed capacity. The distributed capacity of a choke coil is the property of a choke coil which is equivalent to a condenser connected in parallel with an ideal choke coil having no distributed capacity. This distributed capacity forms a by-pass which will conduct the surge, causing interference, to the line. It is, therefore, necessary to keep the distributed capacity as low as possible and in no case should it exceed 75 micro-microfarads (0.000075 mf.). The ideal choke coil is made by winding insulated wire in a single layer, on an insulated cylinder. As this type of construction, however, takes up considerable space, the coils may be wound according to the method known as bank winding, shown in figure No. 7.

Ordinary multiple layer winding is practically useless for construction of choke coils, as the distributed capacity between adjacent layers is excessive. Another type of choke coil, frequently used, may be described as the pancake type, in which there are a few turns per layer and many layers. In this way, the distributed capacity is kept low, as in bank winding, on account of the fact that the many layers are equivalent to condensers in series.

Choke coils should not be impregnated with wax or other dielectric, as the dielectric constant of those substances is greater than air, and, thus, increases the distributed capacity. As a general rule, no iron is required for choke coils, as the inductance of the choke coil does not require to be great and the permeability of most iron at radio frequency being very low would, thus, not materially increase the inductance of the choke coil with regard to the interfering surge but it would tend to increase the distributed capacity, and, in this way, reduce the effectiveness of the coil.

In exceptional cases, however, iron is used in the construction of "absorption type choke coils," in order to absorb the energy of the interfering surge.

Size of Choke Coil

The size of wire used in choke coils must be sufficient to carry the maximum load of the apparatus without overheating, which would cause a fire risk; or without causing excessive voltage drop, which would interfere with the operation of the apparatus. The maximum voltage drop in most of the choke coils is usually from one to three volts. This voltage drop, is, therefore, usually negligible on circuits of 110 volts or more, but must be considered when dealing with low voltage apparatus such as that supplied from 6-volt batteries.

The insulation of the choke coil to ground or between lines must withstand the voltage of the line with the necessary factor of safety. The insulation of the wire between turns is practically independent of the voltage of the line and ordinary cotton covered wire is usually sufficient for the winding, provided the choke coil as a whole is well insulated from ground and wires of different voltage. Care must be taken, however, in constructing bank wound choke coils, not to damage the insulation of the wire when the wires of the choke coil are required to cross, and double cotton covered wire is recommended in this case.

Engineering Education

Abstracts of the Seven Papers Submitted for the Past-Presidents' Prize, 1929.

The following are abstracts of the seven papers submitted for the Past-Presidents' Prize during the prize year 1928-1929.

Paper No. 1.

The first problem of the educator is to select the fundamentals from the vast store of human knowledge, that shall best fit the student for further progress.

The greatest difficulty in organizing engineering education is in providing teachers who will command respect, enforce discipline, inspire a love of study and train their students to be seekers after knowledge.

It is essential to teach only that number of subjects that can be given with thoroughness and to point out in all courses that successful application rests on good business methods, good ethics and sound economics.

It is thought that the technical student should be drilled in the use of clear forcible English, when speaking as well as when writing.

The mind trained to the proper use and definition of words and further trained to memorize and classify data and principles is fitted to show power and originality in dealing with the problems set before it.

It is desirable to weed out of the technical school and university the unfitted, the uninterested and the indifferent students.

It is desirable to encourage by scholarships and loan funds those who are anxious to learn but who have no one to pay their way. It is most unwise to allow students to spend more money than is actually required by the necessities of their college life.

The head of a school has a preponderating influence on its standards and success and great executive ability brings a school forward just as a great business concern is built by the energy and ability of its head.

If the teachers in our technical schools spend part of their lives in outside work it will enable them to be more independent to command higher salaries and be worth more in particular as educators.

Paper No. 2.

No event in recent years has signalized more clearly the growth of public esteem for the ability of engineers than the election of Herbert Hoover as President of the United States.

Engineering training is likely to develop qualities of exceptional social value in the business man or statesman of the present day.

"On what are we prospering in Canada at present? We are mining our prairie land for export wheat, and we are mining our forests for export pulpwood. We are mining our nickel, our gold and our copper for a foreign market."

A system of regular apprenticeship for the training of skilled workers is needed in every province in Canada. (Ontario passed an Apprenticeship Act in 1928.)

Canada also needs technical schools sufficient to produce 5,000 trained workers of the foreman grade annually.

For young men of exceptional ability the avenue should be direct from the shop and the technical school through the university to the job requiring executive capacity.

Paper No. 3.

The considerations covered by the title are so wide that only broad principles can be discussed.

The influence of the teacher on the student is a very important factor in education, and for this reason it is desirable that young engineers, after preliminary learning in school or college, should continue their studies in positions in actual engineering work under a practising engineer; this practise of master and pupil to be encouraged by employing corporations.

The education of an engineer is incomplete when he leaves college, and he is only commencing its more practical phase.

The Engineering Institute of Canada has shown a regrettable tendency to pay more attention to ethical professional standards and to rates of pay for members, than to the more important duty to enlarge the technical knowledge of its members.

Engineering societies could have a deciding influence on the progress of the engineering student after completion of college work and entrance into his life's work.

Engineering students for continuance of their education should attend engineering society meetings, where papers on engineering subjects are read and discussed.

There should be the closest possible co-operation between the engineering society and engineering schools.

The future of education for engineering lies with engineers, whose judgment in any educational matters should prevail over that of professional educationalists.

There is a lack of connection between prescribed courses of study and practical engineering work, only partly made up by employment of students on engineering work during summer vacations.

A more definite and systematic co-operation of large employment corporations in affording employment for engineering students during summer vacation periods is desirable. The present system is too haphazard. The Engineering Institute of Canada is the logical body in Canada to grapple with this situation.

The apprentice system combining, for students between sixteen and eighteen, field and shop work with applied study (such as engaged in by General Electric Company and Westinghouse Lamp Company) is commended.

A study of the Latin and Greek languages, as languages, is not necessary for an engineer and cannot the cultural tradition desired be obtained from translation? The ability to write and speak both English and French is necessary in Canada.

It is not possible for the engineer to know too much mathematics (including accounting), and of natural science.

The dead languages, psychology, political economy, English literature should not be included in an engineering curriculum.

The chief weakness of engineering education is the lack of relation in the student's mind of things read or heard, or supposedly learned, to practical work.

There is a lack of connection between school studies and the daily life and work of the engineer. Some engineering executives, who have achieved great material success, have become almost obsessed with the unpracticality of college education.

The greatest engineer will always be the man whose brain power would have made him great in any walk of life.

Training for executive positions is outside the scope of educational institutions.

Education for engineering research may be properly left with the colleges, with some intelligent assistance from the operating companies who benefit from the results of research.

Paper No. 4.

There are three stages in engineering education; selecting the raw material, teaching the student, and placing the graduate so that he shall be of maximum use to the world and shall make the most of his own life. A possible fourth function is to co-operate with employers in the process of absorption.

Preparatory schools are too closely supervised, with studies to be done in a set way, do too much "spoon feeding," and tend to kill the imagination and initiative of the student.

Engineering graduates in non-engineering work should have been advised by some method of selection not to enter on an engineering course.

Learning alone does not make an engineer, nor an educated man of any sort; just as necessary are those peculiarities of mind and temperament lumped under the term "personality."

A suggestion is made that a psychological or intelligence test and a personal interview might be useful in determining whether or not a prospective student should take an engineering course, the membership of The Engineering Institute of Canada to assist in this movement by acting on boards of inquiry.

The engineering professors must maintain professional contacts outside of teaching, necessary both to supplement their incomes and to keep in touch with the ever-progressing world of engineering.

Too many teachers are graduates of the institutions they serve, with limited knowledge and experience. No one should be permitted to teach in a school from which he has graduated, until he has spent an apprenticeship in teaching elsewhere. No one should be allowed to serve as an engineering teacher who has not had some years of practical experience. The Scottish practise, whereby assistant professors have greater chances of advancement by transferring to other colleges is recommended.

The main job of a college is to teach, and research should take a secondary place. Research should be in the hands of a special staff with only limited assistance from the teaching staff.

Small classes where something approaching individual teaching is given are preferred to large classes.

The abolition of "cramming" for examinations is desirable, as cramming does not give time to think quietly and "digest" one's information. The passing of examinations should be given minor importance rather than the prominence it now has. Examinations give some indication of how much knowledge a student possesses but little as to his ability to use it.

Examinations might perhaps follow more closely the system of English universities and be held say twice during the entire course and on general questions rather than detailed for each specific subject. Some combination of written and oral examinations is desirable, showing both a student's knowledge and his ability to think.

Engineering courses generally appear to deal mostly with fundamentals with only enough specialization to give the student an idea of their extent. English and economics are generally included in an engineering course.

Roughly it costs about $4,000.00 to give a student four years' engineering training, of which he pays perhaps $1,000.00, leaving a deficit of about $3,000.00 to be met out of endowments, etc. The cost of tuition should be raised to the actual cost of education, neglecting the benefits of endowments and other assistance, the fees charged to students to be graded according to their scholarship with proportionately greater discounts given the best scholars. There would then be more incentive to the student to work and the school's income would be increased. (One of the oldest technical schools in U.S.A. is adopting above plan in 1929-30.)

The engineering graduate is only the raw material from which successful engineers are made, with a substantial plus handicap on account of the training received.

A placement or employment service conducted by the school for the purpose of securing employment for its graduates is a useful link between industry and the young graduate. This necessary work is now neglected by some schools. Industrial firms should also have their own placement bureaus and should pass on to the engineering schools their suggestions for engineering courses as evident from the work of the engineering graduates.

The scheme of giving students vocational or co-operative employment early in their college courses, to be continued throughout them, appears the best method for giving the student practical experience.

The "settling-down" period of a graduate, extending over from perhaps one to five years, should be carefully checked up by the engineering school and any necessary assistance given, the graduate meanwhile to keep the school informed of his whereabouts and circumstances.

The absorption of graduates is of great importance and has been neglected by the schools; improvements have been forced by industry rather than the schools, but the present indication is that the schools are assuming their responsibilities.

The quality of those entering our schools is probably better than formerly; our teaching is improving; industry and the schools are co-operating more closely than formerly; the engineering profession is taking more interest than formerly in educational matter.

Paper No. 5.

The graduate who is trained how to think, rather than what to think, normally is the more useful in his profession, and the more capable of expansion and personal success.

The successful engineer must express and convey his thoughts to others. During his school course much opportunity should be given for debate and discussion before class or larger groups.

More attention to be given to the student during school and high school days with departments or agencies to advise with parents and children regarding suitable careers for the young student.

If a youth has little or no facility in mathematics, poor reasoning power, and lacks initiative, he would not succeed as an engineer.

More attention to be given to the school covering the period of the student from eight to sixteen years. The following are suggested:—

(1) Each school to have a person as a co-ordinating element or visitor between home and school;
(2) More care taken in electing school trustees;
(3) Assistance to teachers by an increased number of teachers who shall be receiving greater remuneration, and also be encouraged to show more initiative and individuality in teaching;
(4) Competent teachers who can arouse interest especially in mathematics, physics and chemistry; and teachers of these subjects to visit rural schools. Ability to arouse and stimulate interest to be rated as high as mastery of the subject.
(5) Facilities to be provided for more individual and less mass school work.

The conference method in class is advisable rather than the set lecture method.

After high school graduation, a year in some industrial plant as a labourer or mechanic is suggested, with one or two evenings per week at pre-university studies.

It is desirable to present to the university men with better preparation than is now the case.

Mathematics, physics and mechanics should have first consideration in an engineering course.

During college course, basic or elementary principles to be given throughout the course; from two-thirds to three-quarters of the entire time of college work is suggested in studying basic principles.

During the fourth year at college, visits to chemical, industrial and engineering works are suggested.

The National Industrial Conference Board of the United States investigating training in industry in questionnaires sent to men in pulp and paper industry received replies that subjects requiring more attention in college courses were economics, business administration, accounting, public speaking and psychology.

Attention to be given to debate and to English composition so that a student may state a case clearly before a public meeting, or state matters concisely in writing.

Close co-operation to exist between universities and industry in providing occupation for the student during vacations.

The young graduate to take an active interest in an engineering society, and such societies to make co-operation with him a definite part of their activities.

Requirements for matriculation should be more scientific and less academic.

Post graduate occupation should be regarded for at least five years as a part of training and education.

Paper No. 6.

The paper starts with a description of the Junior Technical School in Great Britain.

British engineering authorities agree that a practical training in an engineering works or industrial plant must be taken along with an engineering course.

The same year, 1824, that saw the opening of the Birkbeck Institution in London, England, produced the Rensselaer Polytechnic Institute at Troy, New York.

The American General Electric Company maintains a "testing course" absorbing about 400 engineering graduates per year on pay for a training in practical work on graduation, this "testing course" extending over from one to three years, depending on the ability and preference of the student.

In recent years modern society has come to realize that men with a solid foundation in science and engineering must be capable of taking a leading part in matters of policy and government.

The value of an arts course before the engineering course may be over-rated, unless there is a definite programme of study and objective throughout the courses.

The fundamentals that an engineer requires are founded on a knowledge of chemistry, physics, mathematics and mechanics.

Prof. George Swaine's advice in "The Young Man and Civil Engineering" is that he should enter an engineering school as soon as he can, that he should select courses that call for his most serious effort, and that he should not aim for culture, as that will come.

The ability to write and speak English well is essential.

Findings at convention of American Institute of Electrical Engineers at Niagara Falls in 1922, on engineering education as follows:—

(1) A more careful sifting of those not suited to the work;
(2) The selected group to be thoroughly drilled in mathematics;
(3) Specialization to be secondary to fundamentals;
(4) Specialization to be left until after graduation or at least until late in the course.

Adaptability to engineering is an inherent trait, and the college cannot create it, but only develop it.

The intelligence or psychology or other tests to be applied to students wishing to enter college.

There should be a point in the intelligence scale (obtained by comparison of school achievement and intelligence tests) below which students should be discouraged from entering a university.

Special provision to be made for brilliant pupils in selected classes, rather than mass instruction for students of different abilities.

The necessity of training for technical education in the trades being available to all workers.

The Engineering Institute of Canada, comprising all branches of professional engineering, to take an aggressive stand in educational matters in Canada. Suggestions made include:—Institute members to be on advisory boards of universities and have more to say regarding courses and subjects; students to be encouraged by scholarships to obtain training in industries with the co-operation of the industries; more interest in technical education for the masses; The Institute should go on record as to its educational requirements.

Paper No. 7.

The remarks affecting engineering education mentioned in this article, as well as other general statements, may well be summarized in the form of a number of suggestions or conclusions. In order that these may have definite application to specific cases they are assumed to apply in Canada and as sponsored by an engineering society such as The Engineering Institute of Canada. Statements are made at random and not necessarily in order of importance.

(1) The present facilities for engineering education in Canada insofar as number of universities are concerned are centrally located throughout the different provinces in Canada and are sufficient for present population, and equipment may be enlarged on demand rather than new universities adopting engineering courses.
(2) The general standard of engineering education in Canada is of a high grade and sufficient for the development of the country.
(3) With a higher standard of engineering education in Canada as and when insisted on by The Engineering Institute of Canada and the Provincial licensing bodies of the Professional Associations of Engineers the standards of personnel must improve.
(4) With improved personnel in the engineering profession a higher standard of appreciation from the public would be created and more remuneration obtained.
(5) The professors in engineering subjects to be granted adequate compensation on a par with practising engineers.
(6) Insistence of a more intensive infiltration of engineers into all positions,—in parliament, on commissions, in executive positions generally, in industry, in city manager and town planning positions, etc.
(7) Recognition of the fact that engineering education is bound up in an economic cycle with employment and remuneration. For fullest efficiency of engineering education public regard must be such that engineers are employed at adequate compensation in all possible variety of engineering positions and that engineering graduates are generally employed in industry. If the engineering profession is in the doldrums, engineering education must also suffer.
(8) Employing engineers and senior engineers to see that adequate salaries and chances for promotion are given where possible to junior engineers. The result of this may provide an opening for a man leaving college.
(9) An engineering society such as The Engineering Institute of Canada to assume the proper responsibility of an engineering society in educational matters and to keep all matters affecting engineering education in Canada constantly under review. This is to be in the nature of suggestions or criticisms from the entire membership of The Institute.
(10) The Engineering Institute of Canada to also have a live Educational Committee to make a study of specific cases and make recommendations. More is required than a more or less honorary list of members who bring in a more or less stereotyped report once a year but without producing results.
(11) The investigations and findings of such bodies as the Carnegie Foundation and Society for the Promotion of Engineering Education to be studied as these may have a bearing on problems of engineering education in Canada.
(12) A more active interest in research work by Canadian universities and by industry with close co-operation between the two.
(13) The employment of both professors and students in engineering during the summer vacations. The possibility of some of these being engaged on research work to be considered.
(14) An insistence on the part of employers of labour and practising engineers that all work of an engineering nature be given only to engineers or those in training for engineering courses. This is a very important requirement as many engineering students may be deprived of necessary experience in shop or on survey, particularly during the summer vacations, if this is not insisted on.
(15) Continuous training for practising engineers to be considered. These to include engineering society membership, engineer's clubs, periodicals, trade magazines.
(16) Engineering professors to attend engineering society annual meetings as the representative of their university, the expenses to be provided for annually in the budget of the university.
(17) The subject of vocational education as a preparation course for future engineering students to be studied.
(18) Attention to be given to some training for all persons in engineering works, in engineering construction, and in industry generally, so that the finished product may be as perfect as possible. Universities, schools and engineering societies to lend any possible assistance in this training.

An Economic Study of Motor Roads for Pulpwood Operations

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Chief Engineer, Lands and Woods Engineering, Canada Power and Paper Corporation, Three Rivers, Que.

Paper read before the St. Maurice Valley Branch of The Engineering Institute of Canada, June 21st, 1930.

Introduction

To obtain wood supplies for manufacturing pulp and paper many agencies exist which, while simple in themselves, are extremely sensitive to management owing to the quantities involved. As a result of the management of these agencies large sums may be saved or spent to secure identical results for it is easy to realize, when dealing in units of one hundred thousand cords that a difference of one dollar per cord represents large sums, yet the variations of unit costs are often far greater than this.

The writer has in mind several such features of management in which losses or gains can be effected by comparatively slight changes in planning and of these the subject of transport offers aspects most interesting to engineers. In this field alone we may observe factors among which roads are of great importance whether in their classification or routing.

In the following paper it has been endeavoured to show the economic principles influencing or which might influence the decision of engineers in their final choice of roads and methods for the transport of supplies and personnel in pulpwood operations. The conclusions obtained may of course apply to other forms of forest exploitation by the use of proper conversion factors.

The Necessity of Roads for Pulpwood Operations

In planning the yearly cut of pulpwood or any lumber, we have to deal with hundreds of square miles of comparatively unknown territory. These large areas known as "limits" or "freehold" lands, are generally based on some stream or streams which furnish routes of penetration and extraction. They consist of a vast tangle of thick forest, swamps, streams and lakes penetrable only by rough tote roads or to light parties along stream routes in summer and by snowshoe trails in winter.

To introduce into these forest lands the necessary personnel and horses to cut and take out the wood, to carry in the food and supplies for these, to protect the forest, to build structures whether buildings or river improvements, to supervise and keep in touch with the manifold phases of the work, are some of the problems to be solved before a supply of logs reach the block-pile. It is, therefore, obvious that some form of roads must always be organized before cutting can begin.

Whether much or little study and expenditure be given to the matter, at all times the transport of supplies and personnel has been the foremost reason for the construction of roads in woods operations and has been the main factor in the determination of routes. In this paper we will show how vitally the cost of the transport of these supplies and men is affected by the principal methods followed on land routes.

By the term "supplies" we mean all classes of food for man or beast, clothing, construction material, medical supplies, tools of every description, in short all that will be needed to shelter, feed and permit the work of the small population necessary to cut and bring to the mill its raw material, pulpwood.

The weight of these supplies varies directly with the number of cords cut and may be assumed to be forty pounds per cord as stated by Mr. G. E. Lamothe, A.M.E.I.C., in his paper read to the Annual General Meeting in 1927.

The total yearly cut of pulpwood in Canada is about 6,000,000 cords. To cut this, therefore, requires the movement of about 240 million pounds of supplies yearly or 120,000 tons. If we consider the total cut including saw lumber, firewood, poles, ties, etc., we would greatly increase this tonnage. If we think in terms of organized communications, the movement of these supplies would not appear so great but when we take into account that this amount is finally distributed by horses to the cut areas, we can easily understand that this is indeed a problem of some magnitude.

If we consider further that a good part of this horse transport moves over roads roughly hewn into the bush, we realize that the expenditure of effort and money to carry supplies merits much attention, lacking which it is easy to lose or make large sums without being aware of it.

Closer utilization and competition with foreign wood make it necessary to obtain pulpwood at a reasonable figure. Of the several factors known to the writer which would improve present methods of exploitation, selection has been made of those which show how profits may be derived from good roads and motor transport as against the old tote roads and horse transport, when long hauls and large quantities of supplies are concerned.

General Process of Transportation of Supplies

As stated before most limits are based on streams. These streams flow along irregularly curved lines, but for the purpose of this discussion we will assume figuratively that a stream has been straightened out, giving a limit of an undetermined number of miles in length by ten miles in width. In the centre of this limit flows the stream in question, as in figure No. 1, line A-Ax. Along this stream we may assume a road to be built, while point A represents a railhead or port to which all supplies for one season's cut are first freighted by land or water.

Let us now assume that an area is selected in this limit to furnish some required amount of wood. To cut this area, camps will be distributed to house a varying number of men and horses.

To these camps, (indicated by letters $b1$, $b2$, $b3$, etc., or by letters $c1$, $c2$, $c3$, etc.), supplies are transported from the railhead A or cache $A3$ as follows:—

(1) Either they are distributed directly from A to camps $b1$, $b2$, $b3$, $b4$, etc.

(2) Or they are transported to a secondary point of distribution generally called cache or depot, such as $A3$, whence distribution takes place to camps $c1$, $c2$, $c3$, etc.

In other words we have (a) primary transport to port or railhead, which is effected by ships or trains; (b) intermediate transport from port or railhead A to a cache $A3$ by ship, motor or horses; (c) secondary transport from this cache which is effected in small quantities by horsehaul.

For areas like that in figure No. 1, intermediate transport takes place as soon as secondary or retail distribution becomes uneconomical from A. The distance at which this occurs varies. Five miles seems a good figure to adopt for the distance at which retail hauling may stop, and this explains the width of ten miles for our theoretical limit, five miles on each side of the main stream route.

Based on this principle the last cache should be at Ax, five miles from the farthest extremity of the limit.

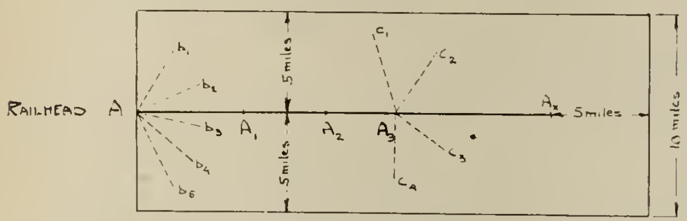

Figure No. 1.

In other words, in the limit of figure No. 1, intermediate transport will take place along line *A-Ax* of which the length equals the length of the limit less five miles.

The distance of intermediate hauling will vary from year to year. If we consider a progressive cut along divisions rectangularly placed along the route *A-Ax* as in figure No. 2, we will see that the minimum intermediate hauling is zero miles at *A* and the maximum distance is the scaled length of the line from *A* to *Ax*.

Average Haul

In planning the construction of roads in large forest areas it has been too often the practice of considering intermediate haul from railhead to cache as it occurs from year to year. Naturally, when we are close to the railhead the effect of the good or bad qualities of a road are less strongly felt. It is where exploitation goes beyond the half way point of a region that expenses multiply. For this reason, an engineer should not plan out his roads for one small section alone but for the whole region to be exploited over a number of years. This general plan, however, may be carried out in small sections over several seasons. As the cut advances and his road becomes built he may modify his views but he should not allow the permanent interests of the whole to be sacrificed for the temporary interests of a part. Hence, the first consideration in making his plans is not the distance of haul of the first year, but the average haul for the whole region. To permit such planning, however, he should be informed fully of the localities where the cuts are to take place and of the quantities to be cut, as well as any other facts applying to a cut programme. Moreover, to permit cheap transport it is obvious that regions should be progressively and fully exploited to permit the full use of all improvements put in.

With an evenly distributed timber supply, the average haul in figure No. 2 will be one half of the scaled distance from point *A* to point *Ax*. Should the distance from *A* to *Ax* be forty miles for example, the average haul would be twenty miles.

Variations from figures Nos. 1 and 2 are naturally the rule but the basic principles are always the same in solving transport problems connected with supply distribution in the forest. The deductions obtained in the above abstract figure will apply to any variations in the shape of limits since one of the principal factors is the area of the territory in question as we shall see later.

Methods of Transportation Utilized

Primary transport by water or rail. To points along the north shore of the St. Lawrence for instance, or in large streams, supplies will be carried by ships, while along the St. Maurice valley as another instance, the railroad will bring supplies to various stations on the Canadian National system. This transport is carried out mostly by various public carriers and follows the most economical routes.

Intermediate Transport

Intermediate transport is generally effected by means of:—

(a) Waterways,
(b) Horses with rough winter tote roads,
(c) Motor transport (including tractors and motor trucks).

Water Transport

From the port or railhead it may be possible to carry supplies to the "cache" by water. As mentioned by Mr. Lamothe, water transport is most desirable but, we will add, if it does not involve too much handling and if distances are sufficiently long. When it is combined with land transport, however, it has not always been found practical for short distances as the handling and re-handling of goods becomes a very costly item, as the usual way is to unload the freight car into wagons which take their load a short distance to the landing whence the boat is loaded. The reverse process is gone through at the cache where goods may be stored temporarily to permit immediately unloading the boat. If the waterway is only a portion of the route to be followed the combination of the water and land transport may become as, if not more, expensive than if a good road were used throughout. Moreover, when waterways are utilized a period occurs in the fall and spring when all communications are blocked owing to the freeze-up and the break-up. Under such conditions serious risks are taken by personnel and horses, who are reluctantly compelled to travel at such times.

Horses with Winter Tote Roads

When horses are used to transport provisions, tote roads are prepared roughly in the fall. When snow comes, the unevenness due to stumps, rocks and soft places disappears, and the road becomes passable. Sleighs are then used to carry provisions to central points of distribution. The large rough buildings called "caches" in this province, are built to shelter these provisions until the time when they are needed. It is obvious that with such an arrangement, the larger proportion of supplies needed in early fall must be put in place the previous winter to provision personnel and horses until snow roads are again in order. The roads are roughly reconnoitred and, as they are used, locations whether improved or not, are changed from a few feet to several miles from year to year. To avoid road making, frozen streams, lakes, and swamps are utilized. Side hills, which mean manual labour, are studiously avoided so that, in the effort to keep the sleighs on an even keel, it is preferred to climb steep hills, to building even such rough sidehill arrangements of sticks and logs as are constructed where unavoidable. Needless to say, spring, summer or fall travel on such roads is difficult when not impossible or ended by large sheets of water which were the best sections of the route in winter.

This method involves the necessity of halting places about every ten miles, as a total day's march is reckoned to be about twenty miles. Stables, a cook-house and rough bunkhouse are, therefore, placed at these approximate

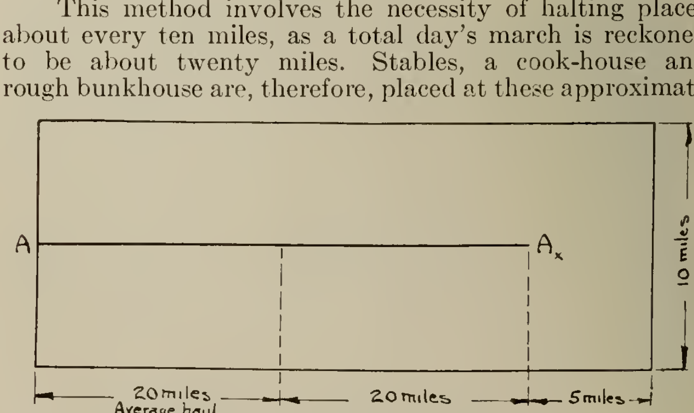

Figure No. 2.

intervals. These buildings are scarcely ever put up specially for the purpose, but are generally some old cache or contractor's building left from former years.

The principal advantage of this system is cheapness of initial road construction, but it must be fully remembered that it costs a sum which, added to yearly repair, is fully equal to the cost of maintanance of gravel roads. If these roads were used in winter only, things would be fairly tolerable, but jobbers or operating crews must be moved in during late summer and early fall before the snow comes which involves much trouble and suffering to the men and personnel involved. One particular stretch we have in mind was called by the Lake St. John men who travelled on it "Le Chemin des Larmes," the "Road of Tears." It was responsible for the loss of some fifty wagons and sleighs, the death of twenty horses and untold hardships to the men, all in one season.

Such roads do not make the forest areas accessible at all times of the year, and add considerably to the prices bid in tenders for the cut.

should be made and kept for the easier sliding of sleighs. A cost of $1,000.00 per mile may be assumed to be sufficient to build such roads in hilly country. The hauling season to be depended on is only sixty days per season.

For tractor hauling in summer the same type of gravel roads as for trucks are necessary with the only difference that the grades must be kept lower and bridges made stronger.

As in the case of hauling by horses, tractor haul in winter means filling a cache almost a year ahead of requirements, which again means disbursements of interest and insurance.

(*b*) *Trucks on Gravel Roads.*—In this instance no cache is filled the winter before. The provisions are motored into the area to be cut practically as cutting begins. The caches are filled while cutting proceeds and motor hauling can be carried on up to December if the season is good. The roads should be gravelled for a width of eight to ten feet. An extra width giving up to sixteen feet between ditches may be more roughly finished to

Figure No. 3.—Railhead Depot on Canadian National Railway.

When the cache is filled it is left, generally under guard of a watchman, until the next fall when cutting begins. It must, therefore, be insured against fire loss and involves also a capital sum, the use of which entails the loss or the payment of interest.

Motor Transport

(a) *Tractors.*—Motor transport may be effected by means of tractors or trucks. For distances of haul such as are commonly met with in the hauling of supplies from railhead to cache, tractors may be utilized on the snow in winter with trains of sleighs or on gravel or dirt in summer with trains of trailers. Needless to say the sleighs afford less resistance and permit cheaper hauling, thus making winter hauling less expensive than summer hauling.

Winter hauling also permits a much cheaper grade of tractor road to be built than for summer haul. The winter tractor road, however, is much more carefully made than the tote roads used for horse transport.

They require very careful location as grades must be kept much lower than for motor trucks. However, since frost is largely depended on to give a good bearing, the bottom is not so important as for gravel roads. The maintenance is an important item and some iced tracks

permit turnouts. The test of the quality of these roads is that they should be serviceable from spring to freeze-up in all weathers. Bridges and culverts should be substantially constructed with logs. We will not undertake here to give details of construction, but will limit ourselves to a statement of the actual cost of these roads as we have found it. In the St. Maurice region an average sum of thirty-five hundred dollars per mile should cover the first cost of stretches to be built in sections of say twenty miles more or less. The first cost above mentioned can be materially reduced in certain sections where topography permits or where stage construction is possible. This subject of stage construction was most thoroughly discussed by Mr. Alex Fraser, A.M.E.I.C., chief engineer of the Department of Roads, Province of Quebec, in his paper "A Few Economical and Technical Aspects of the Road Problem of the Province of Quebec" which appeared in the October 1929 number of The Engineering Journal. Other sections, however, demand a practically full expenditure at once, such as where rock or swamp are encountered.

It is necessary to state, however, that nothing but thoroughly supervised work will do as we have found that many disappointments are liable to be encountered through careless work.

Figure No. 4—Tote Road before the Snow.

It is also obvious that if the initial work is light, maintenance will be heavy at first, while if the initial work is heavy maintenance costs will be less. We have found grades of ten percent quite easily travelled over by motor trucks with full loads, although such grades are high for the use of tractors, the drawing power of which is much influenced by grades. The general location of these roads should be carefully made with reference to general route, cost and grades. As a rule stream valleys are followed and heights of land crossed only to reach other valleys. It is also to be carefully noted that choice of soil has a most important bearing on cost of roads, and this feature alone means close supervision and reconnoitering as building progresses since, owing to the tangled state of the forest, it is difficult to judge the ground properly until the brush and trees are cut. Needless to state, roads under heavy traffic need attention, and again it is well to emphasize the necessity of intelligent supervision, inspection and maintenance of roads during the open season.

Whether trucks or tractors are used in summer, a good gravel road must be built. It remains to prove if the extra expenditure involved justifies itself as against the method of stocking a cache a year ahead by horse transport or tractors in which initial road costs were small.

Distribution of Supplies from Caches, Secondary Transport

The distribution of supplies from the cache to the various camps scattered in an area to be operated is made by horse transport. In the early fall wagons or jumpers may be used; jumpers being rough sleds with wooden runners. The roads are merely trails with the bushes cut off. Their distance may vary owing to local conditions, but in general the hauling distance from cache to camps does not exceed five miles. The supplies are eked out as necessity arises and while the toting is bad until the freeze-up, the quantities involved do not cause too much hardship as the distances are short, the loads fairly light and the trips not too frequent.

A Comparison of Methods Outlined

It is obvious from the above enumerated facts that in comparing methods of transport we are practically fixed by geographical position in the matter of primary transport to port or railhead.

As to secondary transport, piecemeal quantities eked out through the winter for short hauls practically force us to adopt horses to accomplish this.

There now remains intermediate transport for which we may have water or land routes. We will confine the discussion to the case of land transport only and in this we have three alternatives.

Horses with cheap winter tote roads hauling provisions nearly one year before they are needed.

Tractors with more expensive winter roads to haul supplies also nearly one year ahead of requirements.

Tractors or motors with gravel roads hauling the provisions from the start of cutting operations.

In the first case we have expensive haul and cheap roads, in the second and third case cheap haul and more expensive roads. The total in each case will be analyzed to show which is the more advantageous.

Economic Factors forming a Basis for Planning Land Transport from Railhead to Cache

(1) Unit cost of horse transport for supplies (winter season).
(2) Expenses contingent to storing supplies in caches: Interest, insurance, wage of cache keeper.
(3) Unit cost of tractor transport of supplies (winter season).
(4) Unit cost of truck transport of supplies (summer season).
(5) Savings on labour costs by motor truck transport.
(6) Unit cost of roads.
(7) Area or areas to be cut and length of road from railhead to farthest cache.
(8) Density of wood.
(9) Yearly cut and weight of supplies necessary for this cut.

Unit Cost of Horse Transport

For the purpose of this discussion the unit weight will be one hundred pounds.

Our experience of the cost of horses has shown that the principal item in their cost is feeding, which varies according to the distance of haul. On the average, horses will feed every ten miles, which means that the railhead cost of their feed must be increased by the cost of road transport. We have found that the daily cost of feeding horses in the bush will run around $1.50 per day at present rates. With the horse's own daily rent this would make about $2.25 per day. For a team of two horses and teamster the cost may safely be taken to be $7.00 to $8.00 per day.

On any road the maximum return trip is twice the length of the road. Thus, for a twenty mile road the return trip is forty miles, taking two days and costing $16.00 to cover.

We have tabulated below the cost per 100 lbs. of transporting supplies by horses for distances to eighty

Figure No. 5—The Driller.

miles, the loads varying from 2,000 lbs. to 5,000 lbs. based on mileage only.

Table No. 1—Cost per 100 Lbs. for Hauling of Supplies by Horses, Winter Season

Load	Cost per 100 lbs.			
	20 Miles	40 Miles	60 Miles	80 Miles
2,000	$0.80	$1.60	$2.40	$3.20
3,000	0.53	1.07	1.60	2.14
4,000	0.40	0.80	1.20	1.60
5,000	0.32	0.64	0.96	1.28

In the following tables we have not shown the cost of horse haul on an increased scale due to greater cost of feed. In an average journey of fifty miles or one hundred miles return, five days rations are consumed, or 400 lbs. per team, some of which is used at the railhead and some along the route. When distances make necessary the hauling of horse feed to carry on the hauling itself, this factor is one which merits close attention and adds to the numerous troubles entailed by the use of animals.

We have not taken into consideration the item of loading and unloading which is fixed for all mileages.

Table No. 2—Diminution of Effective Load Due to Horse Feed, Based on Ration of 40 Lbs. per Day per Horse or 80 Lbs. per Day per Team.

Total Haul, Miles	Days for return trip	Average haul of horse rations, miles	Weight consumed for average haul of horse rations	Weight for total distance hauled lbs.	Percent of total load of 3,000 lbs.	Cents increase in haul per hundred owing to feed (from Table No. 1)
10	1	5	80 lbs.	40	1.3	0.3c
20	2	10	160 "	80	2.7	1.4c
30	3	15	240 "	120	4.0	3.2c
40	4	20	320 "	160	5.3	6.7c
50	5	25	400 "	200	6.6	8.8c
60	6	30	480 "	240	8.0	12.8c

The last two columns, in this instance, show the percentage of each load used in feeding and cost of hauling this percentage; it may also be taken as an indication of the increase in the rate per hundred pounds for an increase in distance.

This feature of a gradual increase in the cost of hauling by horses has been disregarded in our further development of this subject.

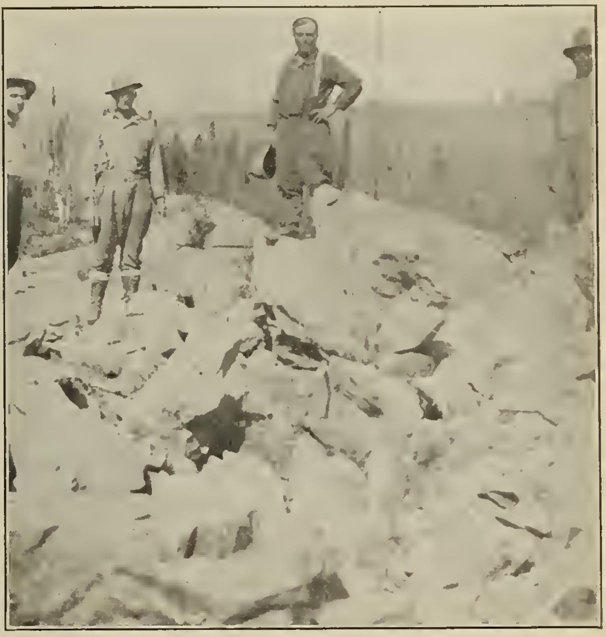

Figure No. 6—Rock Section after Blast.

It is well to state, however, that in our experience tender prices of 75 cents per hundred for a twenty mile haul seem to be a fairly representative bid by haul contractors, which it is difficult to better.

Expenses Contingent to Storing Supplies in Caches

A cache being filled almost one year ahead ties up capital for which interest must be paid. It must also be insured against the ever present danger of fire. For the latter reason mostly, it is usual to hire a cache keeper to watch the valuable supplies under his care, the more valuable because the whole next season's cut depends on the cache being carried intact through a dangerous fire season.

The value of the interest, insurance and wages to cover these expenses may be taken at 10 per cent of the total value of a cache.

The basis for this figure is the sum of interest, insurance rate, and wages expressed in percentage of the value of the cache as follows:—

Interest	7	per cent
Insurance	2½-5	" "
Wages and food	½	" "
say	10	" "

The actual value of a cache consists in the cost of goods plus transport, interest and insurance charges.

Figure No. 7—Cache and Outlying Buildings.

Figure No. 8—Gravel Road Newly Completed.

Interest and insurance form the extra expenses due to storing goods in a region one year ahead of the time needed.

The cost per hundred pounds of these expenses when the hauling is done by horses and tractors is indicated in table No. 3 below.

Table No. 3—Cache Expenses per 100 Lbs. at Varying Mileages

Average Mileage	Expense per 100 lbs.		Per 100,000 cords	
	Horsehaul	Tractors	Horsehaul	Tractors
10	$0.25	$0.23	$ 10,000	$ 9,380
20	0.27	0.24	11,000	9,590
30	0.30	0.24	12,000	9,810
40	0.32	0.25	13,000	10,030
50	0.35	0.25	14,000	10,240
60	0.37	0.26	15,000	10,460

Unit Costs of Motor Transport

For costs of motor truck transport it is well to quote the article on this subject in the Engineering News Record of August 2nd, 1928, by N. D. Douglas. In this article average costs of trucks were 7.74 cents per mile based on 1,000 trucks observed to run at speeds of 30-40 miles per hour on roads in California. Owing to the difference in roads in speed, climate and the fact that the dead season imposes a larger depreciation charge we can safely double the figures in this article. The tabulated values per 100 lbs. are as below.

Table No. 4—Motor Haul Cost per 100 Lbs. for Varying Distances Based on Varying Costs per Mile of Motor Transport of a Load of 4,000 Lbs.

Cost per Mile	Cost per Hundred in cents for haul of				
	20 Miles	30 Miles	40 Miles	50 Miles	60 Miles
15	0.15	0.22½	0.30	0.37½	0.45
16	0.16	0.24	0.32	0.40	0.48
17	0.17	0.25½	0.34	0.42½	0.51
18	0.18	0.27	0.36	0.45	0.54
19	0.19	0.28½	0.38	0.47½	0.57
20	0.20	0.30	0.40	0.50	0.60

Horse and Motor Truck Unit Costs Compared

In table No. 1, if we consider that the average load or two horses ranges around 3,000 lbs., the cost per 100 lbs. carried twenty miles is 53 cents. Comparing this with an average cost of motor transport of 17 to 18 cents per mile we find that the former costs about three times the cost of motor truck transport.

This figure is borne out by actual contract figures for filling caches, which vary from $1.50 to $2.00 per 100 pounds for horse transport and 50-60 cents for motor transport over distances of about forty miles. In other words we may safely assume that motor truck transport is ⅓ cost of horse transport (not including cache expenses).

The author's observations have led him to believe,when all is considered, that the contract figures are more reliable for practical purposes than those in the table, as they apply to actual regions similar to or actually those we exploit and take into full consideration all factors which might lead to losses, such as breakage, weather, repairs, temporary unemployment of plant, etc.

Again, if we compare winter tractor figures with summer motor truck hauling, we find from table No. 3 that the actual cost of hauling is about the same for both tractor and motor, but that other factors such as cache expenses and personnel hauling must be added to tractor costs.

Transport of Personnel

To calculate the value of the time saved in transporting personnel by motor trucks, we must remember that it is effected only in the fall when men are going in. If we calculate on a twenty-mile journey being accomplished in one day on foot and one hour by motor, the effective time saved is nine tenths of a day based on a ten-hour day.

In a labour season of 180 days this represents one half of one per cent of the total cost of labour.

Assuming a contract figure of $8.00 per cord, 100,000 cords would cost $800,000. Since 70 per cent of this amount, $560,000, goes in expenses due to labour, one half of one per cent of this sum is $2,800.00, the sum saved by motor transport, from which must be deducted the cost of transport. This difference is proportionate to mileage and may be tabulated as follows:—

Table No. 5—Savings Due to Motor Transport of Personnel on 100,000 Cords for Varying Mileage

Miles	Savings in Wages	Cost of Transport	Net Savings
10	$ 1,400.00	$ 250.00	$ 1,150.00
20	2,800.00	500.00	2,300.00
30	4,200.00	750.00	3,450.00
40	5,600.00	1,000.00	4,600.00
50	7,000.00	1,250.00	5,750.00
60	8,400.00	1,500.00	6,900.00

Unit Cost of Roads

The unit cost of a tote road may be disregarded. Its maintenance may be assumed the same as for motor roads, although Mr. Lamothe states in his article that it is higher.

The cost of a winter tractor road, as stated already, will be taken at $1,000.00 per mile, which should be deducted from savings effected over horses.

The unit cost of a road to permit motor haul may be taken to average $3,500.00 per mile in rough country as we now construct them. Some years ago we found this figure too low but by improved methods of construction we are satisfied that $3,500.00 per mile is sufficient for an average twenty miles in the Laurentian hills of the St. Maurice region, which is by no means the easiest country in which to build roads.

This $3,500.00 should also be deducted from the savings effected by motor transport, thus giving a profit or loss over horse transport.

Area or Areas to be Cut and Length of Road

This factor influences the length of road and, therefore, influences the total expenditure to be effected before the

Table No. 6—Savings Effected by Tractor Transport Over Horse Transport on Areas of Ten Square Miles Served by One Mile of Road — Average Haul 20 Miles

Cords per Acre	Total Cords per ten Square Miles	Weight of supplies for ten sq. miles in hundreds	Cost horse haul per ten sq. miles	Cost tractor haul per ten sq. miles	Difference	Cost per mile of road	Amount left over after road costs	Difference in carrying expenses of cache in favour of tractor	Net amount left over after building 1 mile of road at $1,000.00
1	6,400	2,560	$ 1,920	$ 560	$ 1,360	$1,000	$ 360	$ 75	$ 435
2	12,800	5,120	3,840	1,120	2,720	1,000	1,720	150	1,870
3	19,200	7,680	5,760	1,680	4,080	1,000	3,080	225	3,305
4	25,600	10,240	7,680	2,240	5,440	1,000	4,440	300	4,740
5	32,000	12,800	9,600	2,800	6,800	1,000	5,800	375	6,175
6	38,400	15,360	11,520	3,360	8,160	1,000	7,160	450	7,610
7	44,800	17,920	13,440	3,920	9,520	1,000	8,520	600	9,120
8	51,200	20,480	15,360	4,480	10,880	1,000	9,880	750	10,630
9	57,600	23,040	17,280	5,040	12,240	1,000	11,240	900	12,140
10	64,000	25,600	19,200	5,600	13,600	1,000	12,600	1,050	13,650

area can be completely organized for motor or horse transport. In our calculations we have assumed that a mile of road extends its influence five miles on either side which would give us a mile of road per ten square miles of area. In this connection it is well to remember that the average haul per mile of road is one half mile, as stated before. We may take, therefore, in the present discussion, that the average haul of a territory varies as one half its area. Furthermore, it is necessary to state here that in planning the cut of a yearly supply of wood several areas will be decided on. It is obvious that the engineer should be fully informed of what is to be done in this respect, not merely for one year but also as to the possibilities for future cuts so that he may plan intelligently his roads.

Density of Wood

Density of wood is generally expressed in cords per acre. The density of wood is an extremely important factor as it determines with what intensity supplies must be distributed on the area. For a fixed yearly cut, the heavier the wood crop the smaller the yearly cut area. This means a lesser mileage of road necessary to feed this cut area.

The density of wood is determined for various sections of a territory by cruises in which different methods may be used. The total number of cords for these sections is obtained, which divided by the number of acres, will give the density per acre.

Yearly Cut and Yearly Weight of Supplies Needed

The yearly cut is determined principally by mill requirements and the total growth on the forest properties of the mill.

It naturally influences the yearly weight of supplies by the ratio of forty pounds per cord already mentioned.

To obtain a comprehensive basis of comparison, all the factors above stated must be worked up together, and here it is again well to state the absolute necessity of the engineer being fully acquainted with all the features of a cut programme so that he may plan intelligently his construction programme. To permit this comparison and basing ourselves on the practically fixed ratios as between area, mileage of road, and weight of supplies, we will work out the net profit per mile for motor transport for various densities of wood on an area of 45 x 10 miles as in figure No. 10 which we can then apply to larger or smaller areas and to varying yearly cuts.

Such a regularly shaped area with an evenly distributed density of wood will not be met with in actual problems of course.

Actual timber areas will present irregularities of shape varying with the heights of land, and of density varying with the stands. The above problem will then become more complex and the determination of the distance of average haul could be solved by methods similar to those employed in finding the centre of gravity of an irregularly shaped figure.

This is especially the case when the railhead or port is not at the edge of or within the area under consideration, but outside of it by some miles.

In this case the distance of the railhead to the beginning of the limit should be added to the average haul within the limit.

It is obvious that the greater costs due to such a situation apply to horse haul as well as to motor haul. This is also the case when non productive areas must be crossed to reach productive areas.

Another caution to observe is that in filling the yearly mill requirements the cut is not concentrated in one place but is made up of quotas from various sections, giving us the required total. Such quotas are selected for various

Table No. 7—Savings Effected by Motor Truck Transport Over Horse Transport on Areas of Ten Square Miles, Based on One Mile of Road to Ten Square Miles of Forest and Average Haul of 20 Miles

Cords per Acre	Total cords per ten Sq. Miles	Weight of supplies needed for area expressed in hundreds	Cost by horse haul per ten square miles	Cost of motor haul for ten square miles	Difference	Interest and insurance of cache	Labour savings	Total amount available per mile of road	Amount left over after building one mile of road at $3,500.00
1	6,400	2,560	$ 1,920	$ 640	$ 1,280	$ 690	$ 150	$ 2,120	......
2	12,800	5,120	3,840	1,280	2,560	1,380	300	4,240	$ 740
3	19,200	7,680	5,760	1,920	3,840	2,110	440	6,390	2,890
4	25,600	10,240	7,680	2,560	5,120	2,820	590	8,530	5,030
5	32,000	12,800	9,600	3,200	6,400	3,520	740	10,660	7,160
6	38,400	15,360	11,520	3,840	7,680	4,220	880	12,780	9,280
7	44,800	17,920	13,440	4,480	8,960	4,930	1,030	14,920	11,420
8	51,200	20,480	15,360	5,120	10,240	5,630	1,180	17,050	13,550
9	57,600	23,040	17,280	5,760	11,520	6,340	1,320	19,180	15,680
10	64,000	25,600	19,200	6,400	12,800	7,040	1,470	21,310	17,810

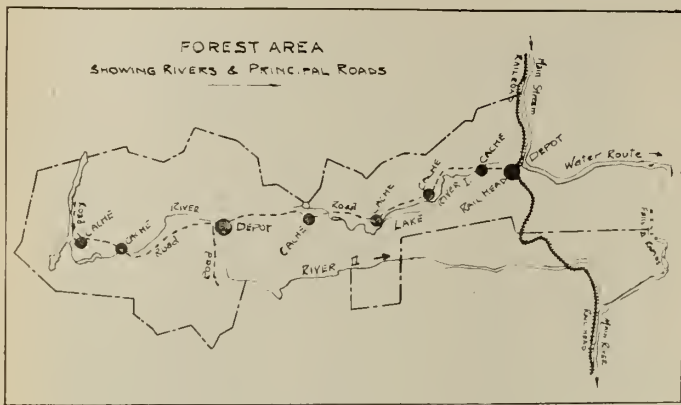

Figure No. 9.

reasons which we cannot discuss presently. Thus in the case under discussion, a mill requirement of 100,000 cords will be made up in lots ranging from 5,000 to say 30,000 cords. The supplies for each lot, however, are governed by all the principles to be developed further.

Comparison of Haul Costs as Applied to Timber Areas and Yearly Cuts

Having studied the basic costs it now remains to apply these costs to timber areas and yearly cuts.

To do this we will develop a problem on an ideal area of varying density on which we wish to cut:—

(a) a definite parcel of forest, in square miles;
(b) a definite cut, in cords.

In each case we wish to ascertain which is the most profitable: horse haul, tractor haul, or motor truck haul. This we will do in a tabulated form in each case.

Basic Data of Costs

From the preceding discussion we have secured the following facts:—

Cost horse transport . .	\$1.50 per 40 miles, \$0.75 per 20 miles.
Cost tote roads . . .	disregarded.
Cost tractor transport .	\$0.22 per 20 miles per 100 lbs.
Cost tractor roads . .	\$1,000.00 per mile.
Cost motor truck transport	\$0.25 per 20 miles per 100 lbs.
Cost motor truck road .	\$3,500.00 per mile.

We will now assume a timber area as in figure No. 3, which measures 45 by 10 miles or 450 square miles.

The full haul A to Ax is then $45-5=40$ miles.

The average haul is one half of 40 miles, that is 20 miles.

Carrying costs of caches are given in table No. 3 for tractors and for horses.

Density of wood: 1 to 10 cords per acre, each value being calculated for separately. It is well to note here that densities of less than two cords per acre can hardly be called commercial under present conditions.

Yearly cut: 100,000 cords.

Yearly weight of supplies: 4,000,000 lbs., or 40,000 hundreds.

Solution of Problem

We will first of all find the effect of density of wood on an area of ten square miles centred about the extremity of average haul $A1$. This small strip will extend one mile along the road and five miles on either side of it, giving us a section of average haul ten square miles in area.

In the case of a density of three cords per acre, the total cords per ten square miles will be 19,200 cords, as in column 2 of table No. 6.

At forty pounds per cord this means that 768,000 pounds or 7,680 hundreds will have to be hauled in to cut the ten square miles.

At 75 cents per 100 lbs. the cost to horsehaul this quantity of supplies will be \$5,760.00 as in column 4.

At 22 cents per 100 lbs. the cost to haul this quantity by tractors will be \$1,680.00 as in column 5.

The difference of \$4,080 in column 6 is, therefore, in favour of tractor haul.

This amount, however, must be lessened by the extra expenditure incurred in making a tractor road, \$1,000.00 given in column 7, which is subtracted from the value in column 6, giving us in column 8 the net sum gained for the average ten square miles, \$3,080. To this we add, (from table No. 3), the lessened carrying charges through tractor haul for caches in column 9, giving us the total advantage of tractors over horses in column 10, \$3,105.

It is true that the savings are less for areas near the railhead, but they are greater by the same amount for areas more distant than the average from the railhead.

Since the first fifty square miles can be supplied directly from the railhead, no road is necessary for their operation which explains why four hundred square miles only are controlled by the main haul road.

The same comparison has been worked out as between motor trucks and horses in table No. 7.

Effect of Wood Density on Possible Economies

If column 10 of table No. 6 be compared with column 10 of table No. 7, we note that for densities of three cords per acre and over, the motor truck is cheaper than the tractor in spite of the higher initial cost of road. This only takes the factor of supply and personnel transport and disregards those of fire protection, permanent availability, capital value, etc. For this reason and other advantages we have continued our comparisons of costs only as between horses and motor trucks.

It is to be noted that areas of one and two cords per acre are hardly commercial. More often than not they are old "cut over" stands leading to denser stands, which bring up the average density when a whole limit is considered.

Using table No. 7 which gives the difference in favour of motor transport per mile of road, we have applied this difference to a yearly cut of 100,000 cords in table No. 8.

Table No. 8—Profit Accruing from Good Roads for Total Cut of 100,000 Cords, Based on Varying Densities of Wood per Acre, and Average Haul of Twenty Miles

Cords of Wood per Acre	Square miles necessary to cut 100,000 cords	Average lineal miles of road necessary for cut of 100,000 cords	Total time to cut 400 square miles served by road	Profit or loss per mile of road from table No. 7	Profit per 100,000 cords after building road
1	156.0 sq.mls.	15.60	3 yrs.	\$ ..	\$ ..
2	78.0 "	7.80	5 "	740	5,770
3	52.0 "	5.20	8 "	2,890	15,030
4	39.0 "	3.90	11 "	5,030	19,620
5	31.2 "	3.12	13 "	7,160	22,340
6	26.0 "	2.60	16 "	9,280	24,130
7	22.3 "	2.23	18 "	11,420	25,470
8	19.5 "	1.95	20 "	13,550	26,420
9	17.3 "	1.73	24 "	15,680	27,130
10	15.6 "	1.56	26 "	17,810	27,780

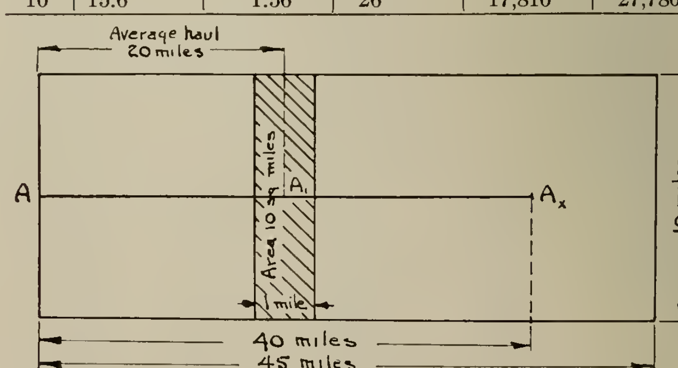

Figure No. 10.

These results are worth noting.

They show that after the road is built and the wood cut there is a surplus each year over the sums which would have been expended for transport by horses, this surplus being the greater as the density per acre increases.

Furthermore, this is done in one year's operation alone. This is not a far sighted policy which may or may not bring results in ten, twenty years or more, but immediately.

In other words, road building is not an uncertain factor. It pays now and yet this happens just in the one matter of hauling supplies and personnel for the cutting of each year's supply of wood. But it does other things. It is available and safe the year round. It brings supplies for the river drives, for building river improvements. It protects the forest, it has a capital value and it permits greater supervision and elasticity of operations, which matters have been totally ignored in computing results, having no sufficiently definite values as a base.

In the face of such facts, it is not surprising that up to date companies have departed from antiquated methods of transport, which are not only a spendthrift policy but leave no permanent benefit behind them.

Effect of Average Mileage on Possible Economies

As stated earlier, since costs vary practically directly with mileage, the figures obtained in table No. 8 may again be applied to average hauls of ten miles and above. It will be seen that the economy per mile increases as the average haul increases, as shown in table No. 9.

Table No. 9—Economy per Lineal Mile of Road Due to Motor Roads and Transport for Average Mileages Ten to Sixty Miles, Based on Cords per Acre Evenly Distributed

Cords Per Acre	Average Mileage					
	10 Miles	20 Miles	30 Miles	40 Miles	50 Miles	60 Miles
1	$ ..	$ ..	$ ..	$ ..	$ ..	$ ..
2	370	740	1,110	1,480	1,850	2,220
3	1,440	2,890	4,330	5,780	7,220	8,670
4	2,520	5,030	7,550	10,060	12,580	15,090
5	3,580	7,160	10,740	14,320	17,900	21,480
6	4,640	9,280	13,920	18,560	23,200	27,840
7	5,710	11,420	17,130	22,840	28,550	34,260
8	6,780	13,550	20,330	27,100	33,880	40,650
9	7,840	15,680	23,520	31,360	39,200	47,040
10	8,900	17,810	26,710	35,620	44,520	53,430

Finally, in table No. 10 these factors are applied to a yearly cut of 100,000 cords.

Table No. 10—Economy per 100,000 Cords Due to Motor Roads and Transport for Average Haul of Ten to Sixty Miles, Based on Cords per Acre Evenly Distributed (after deducting cost of road.)

Cords Per Acre	Average Haul					
	10 Miles	20 Miles	30 Miles	40 Miles	50 Miles	60 Miles
1	$ ..	$ ..	$ ..	$ ..	$ ..	$ ..
2	2,880	5,770	8,650	11,540	14,420	17,310
3	7,520	15,030	22,550	30,060	37,580	45,100
4	9,810	19,620	29,430	39,240	49,050	58,860
5	11,170	22,340	33,510	44,680	55,850	67,020
6	12,060	24,130	36,190	48,260	60,320	72,390
7	12,740	25,470	38,210	50,940	63,680	76,410
8	13,210	26,420	39,630	52,840	66,050	79,260
9	13,560	27,130	40,690	54,260	67,820	81,390
10	13,890	27,780	41,670	55,560	69,450	83,340

We see from the above tabulation that the further the distance, the greater the difference in favour of motor haul, to such an extent in fact, that the original cost of building a good road becomes insignificant.

From tables Nos. 7, 8, 9 and 10, we can, therefore, enunciate the principle with reference to motor transport on gravel roads that "the longer the mileage, the greater the effective economy per mile of road and per cord of wood cut" and "the greater the density, the greater the economy per mile of road and per cord of wood cut."

Mileage of Road Permissible for Varying Average Hauls and Mileage Cost of Construction

The total mileage of road possible per year is proportionate to the sums available by economies on horse transport.

For, if we consider a yearly cut of 100,000 cords, we will note that, regardless of density or distance, we need 4,000,000 pounds of supplies. For an average haul of twenty miles the expenditure to haul this by horses will be $30,000, by motor $10,000. This gives us a fixed difference of $20,000 per year in favour of motor haul.

To this we must add interest and insurance on caches, $11,000 from table No. 3, and savings on labour $2,300 from table No 5, giving us a total of $33,300, total available sum for roads.

In table No. 11 we have calculated these total available sums for roads for 100,000 cords and for average mileages ten to sixty.

Table No. 11—Sums Available for Road Building for Mileages Ten to Sixty for Each Cut of 100,000 Cords

Average haul Miles	Savings by motor transport of supplies	Interest and Insurance of Caches	Saving in time of labour	Total sum available for roads
10	$10,000	$10,000	$ 1,150	$21,150
20	20,000	11,000	2,300	33,300
30	30,000	12,000	3,450	45,450
40	40,000	13,000	4,600	57,600
50	50,000	14,000	5,750	69,750
60	60,000	15,000	6,900	81,900

If, for instance, we expend the sum of $21,150 for road building we will see that at $3,500 per mile we can build 7.05 miles of road per year and thereby complete our programme of road building quicker.

As this difference between costs of horse haul and motor haul increases with distance, however, the permissible expense per mile of road may be higher, thus reducing the mileage of road permissible but giving us a better road as shown in table No. 12.

Table No. 12—Mileage per Year Possible for Cut of 100,000 Cords for Varying Hauls and Varying Unit Costs per Mile of Road

Average Haul	Sum Available	Miles of road which can be built per year at unit prices listed						
		$3,000	$3,500	$4,000	$4,500	$5,000	$5,500	$6,000
10	$21,150	7.05	6.05	5.30	4.70	4.25	3.85	3.50
20	33,300	11.10	9.50	8.35	7.40	6.65	6.00	5.50
30	45,450	15.15	12.90	11.35	10.10	9.05	8.25	7.55
40	57,600	19.20	16.50	14.40	12.80	11.50	10.50	9.60
50	69,750	23.25	19.90	17.50	15.50	13.95	12.70	11.60
60	81,900	27.30	23.40	20.50	18.20	16.40	14.90	13.65

This enables us to state the economic principle that "The longer the average haul, the heavier may be the expenditure per mile of road," and also that based on one mile of road per ten square miles of forest, a programme of road building can be carried out ahead of actual requirements without extra expense until the whole area is covered. This means that within a limited number of years the full profit of motors can be finally secured without further expenses of construction.

Influence of Density of Wood on Number of Square Miles of Area to Permit Construction of One Mile of Road

In table No. 12 we have the maximum mileage of road permissible per 100,000 cords per year for varying average hauls and varying unit costs of road. It is now interesting to note how the total sum permissible for expenditure will affect the number of square miles to be served by one lineal mile of road. In other words we can determine the permissible density of road building.

In table No. 13, we have assumed a unit cost of $3,500.00 per mile.

The figures given are obtained as follows:—

Square miles per mile of road = square miles of stated density necessary for a cut of 100,000 cords, divided by the permissible mileage of road for 100,000 cords.

Thus, for a density of three cords per acre, an area of 52 miles is to be cut to obtain 100,000 cords and the permissible lineal mileage of road is 6.05.

The square miles of cut area per lineal mile of road for a density of three cords per acre is then $52 \div 6.05 = 8.6$ square miles per mile of road.

Table No. 13—Number of Square Miles Available to Permit Building One Mile of Road, Determined by Various Densities and Average Hauls. Road at $3,500.00 per Mile. Cut 100,000 Cords.

Density Cords	Area cut per year	Number of square miles per lineal mile of road Average Hauls					
		10	20	30	40	50	60
1	156.0	..	..	..	..	..	..
2	78.0	12.9	8.2	6.0	4.7	4.0	3.3
3	52.0	8.6	5.5	4.0	3.1	2.7	2.2
4	39.0	6.5	4.1	3.0	2.4	2.0	1.7
5	31.2	5.2	3.3	2.4	1.9	1.6	1.3
6	26.0	4.3	2.7	2.0	1.6	1.3	1.1
7	22.3	3.7	2.3	1.7	1.4	1.2	1.0
8	19.5	3.2	2.0	1.5	1.2	1.0	0.8
9	17.3	2.8	1.8	1.3	1.0	0.9	0.7
10	15.6	2.6	1.6	1.2	0.9	0.8	0.7

Table No. 13 shows us, therefore, that "As haul and density of wood increase, the number of square miles per allowable lineal mile of road diminishes."

That is, for a thick density and a long average haul we can make our routes economically closer to such an extent that, according to table No. 13, we reach such a closeness of road as one mile of road for less than a mile of limit which is almost absurd. This shows, however, that our figure of one mile of road per ten square miles of forest is well within the expendable sums.

These figures also convince us amply that executives need have no hesitancy at all to expend money in order to introduce good motor roadways into their limits where hauls of twenty and more miles are the common thing and where hauls are in fact increasing as close wood gets scarcer. This policy is a paying one, and in the end they must spend more money should they not follow it.

A road programme should be methodical and its expenditure based on the yearly mill requirements to come out of a region. As indicated previously the allowable expenditure will permit the immediate cut areas to be covered more rapidly than actual requirements. It is then that the programme should be pushed ahead with the sums available yearly for road construction. The territory to be exploited should be considered as a whole so that in cutting the cheap wood close to the railhead methods should not be such as to make the wood cut at the far extremities of a forest area more costly.

Summary and Conclusion

For a yearly mill requirement of wood a certain sum of money must be spent.

In the forest areas out of which this wood supply is to come, we have the option of making good roads for motor transport or not.

If we make good roads we will find our total expenditures for a yearly or total cut less than if we make no good roads.

If we do not make good roads we will fritter away greater sums of money on our wood and have nothing to show at the end of it.

In the latter case the area after the cut is left unorganized and unequipped to carry on cuts at greater distances, to which haul by motor eventually becomes not a matter of choice but of imperative necessity.

The fear of spending the necessary money for roads has already cost and is costing millions, for it is doubtful whether full advantage is now being taken of the possibilities of motor roads and motors for pulpwood or other forest operations.

It is not too much to say that through the neglect of the principles above enumerated, great sums of money have been and are probably being spent uselessly in using wrong methods of transport.

It is well to add, however, that the variety of problems in planning the haul of supplies and men is almost infinite and requires very careful study.

Moreover, in spending money to build gravel roads *results must be secured.* Disappointments are sure to occur unless competent location, building and maintenance are carried out. The mere installation of a good gravel road will not counteract carelessness in other directions: constant vigilance and care must be exercised to see that full use is made of the road while maintaining it in a high state of efficiency.

To the profits coming from hauling supplies and personnel on gravel roads, we may add the value of the improvement of the following features for which no determinate figures are available:—

(1) Communications available the whole year and not for part of year as for tote roads or tractor roads.
(2) Availability for all methods of transport.
(3) Transport of personnel and supplies for river drives.
(4) Facility of installing and maintaining telephones.
(5) Fire protection of forests made more efficient.
(6) More intensive utilization of wood on each area.
(7) Capital value added to forest.
(8) Greater liberty in increasing or reducing year's cut.
(9) Closer supervision of all operations.

All these advantages are secured through a lesser expenditure on the two items of haul of supplies and men alone, which shows the definite advantage of a little planning. In the same way a close study of other agencies should decrease still more the cost of every cord of pulpwood.

Therefore, on every forest area over which transport must be effected, every year should see a section of good road completed proportionate to the cut. By following this policy a network of good motor highways will be finally developed from which not only cutting operations will be cheaper from the start, but also the whole forest will benefit materially.

The Process of Zinc Coating Steel Wires

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Paper read before the Montreal Branch of The Engineering Institute of Canada, January 16th, 1930.

Wires are the webs of industry, and without their steadying force towering structures in many instances would topple to the ground. This statement, which is accredited to a structural engineer of note, is in itself significant. Among the various types of wires that lend their support to towers, bridges, masts and stagings we find those classed as guy, stay and rigging wires. These, which are stranded in the conventional manner, are invariably of steel manufacture, and thus are susceptible to atmospheric corrosion unless means are taken to protect them.

Guy D. Bengough gives the following factors which influence the rate at which corrosion takes place:

(1) The chemical composition of the iron or steel under consideration.
(2) Contact with other more or less electro-negative substances which are metallic conductors.
(3) The presence of stray electric currents passing to or from the iron or steel.
(4) The quantity of dissolved oxygen present in the water or moisture in contact with the metal.
(5) The rate of motion of water in contact with the steel or iron.
(6) The presence in the water of acids, salts or alkalis.
(7) The presence of previous rust.
(8) The temperature.
(9) The physical condition of the metal.
(10) The quantity of light falling upon the metallic surface.

It will now be understood that the phenomenon of corrosion is most complicated and some factors so influence its rate that no means as yet devised are capable of stemming its attack. Replacement of the faulty part is the only solution for the engineer.

The most practical method of protecting steel against the deteriorating effect of the weather is by zinc coating. Wire coated in such manner is classed as galvanized wire, although there is some contention that the term is a misnomer. Far rather had the word zincing be used in its stead.

Zinc gives efficient protection to steel and iron as long as the coating remains intact. If the wire be so bent as to crack the coating, corrosion of the exposed metal will begin. Zinc, however, is electro-positive to iron, thus when a portion of the iron is exposed, even though the zinc coating may deteriorate rapidly, the negative metal will be protected. The area over which the zinc can exert its protective influence is restricted and very apt to vary with conditions of exposure.

Galvanized steel wire is adapted to the following uses:

Telegraph and telephone wire.
All grades of woven and barbed fencing wire.
Netting wire.
Rigging and guy wire.
Hawser and plough wire.
Cable wire.
Grappling wire.

Zinc coated wire is further sub-divided according to the condition of the metallic coating:

(1) Wiped wire.
(2) Unwiped wire.
(3) Annealed galvanized wire.

In differentiating between the first two classes, the method of removing the wire from the zincing pan is taken into account. The latter classification is dependent upon a heat treatment that is subsequent to the process of galvanizing.

Before describing the process of galvanizing steel wires, it will perhaps be best to briefly outline the actual wire-drawing operation, since it has a distinct bearing upon the quality of product. It is imperative that a high grade of steel be chosen for the wires which are to be coated. Some steels are utterly unfit for wire-drawing, not to mention galvanizing. Defects which originate at the open hearth and are further exaggerated during the rigorous rolling from an ingot 2½ feet thick down to a rod perhaps ¼ of an inch in thickness, cause no end of trouble in the wire mills.

Thick skinned ingots resulting from improper pouring into cold moulds give rise to slivery steel. Surface seams and laps develop, which make the finished product valueless for wire-drawing. Segregation of the constitutent elements in the heat, causes blow holes and pipes in the ingot. These defects result in planes of weakness, which obviously render the wire unfit for heavy strain duty.

From the open hearth the ingots pass to the roughing rolls of the blooming mills where they are transformed into blooms. These in turn are carried along to the reheating furnaces where they are heated to a red hot temperature so that they can be further rolled in the billet mills. The billets pass to the rod-mill reheating furnace after which they are rolled into bars and rods of varying thickness. Rods are usually coiled on water-cooled reelers while they are in a red hot condition, thence they are hung in 300 or 150 pound bundles, upon the hooks of a conveyor, which transfers them to the wire-mills. This hook-conveyor is of such a length that the metal gets ample time to cool during the transfer.

The rod bundles are next removed from the conveyor and are acid immersed in lots of one ton each. The immersion takes place in pickling vats, where the ferrous oxide or fire scale, formed during the rolling, is entirely removed. This so called rod pickling is one of the most important steps in wire manufacture, for an improperly cleaned rod, viz., one that has the least trace of oxide upon the surface, means trouble; serious trouble at that.

Ordinarily the amount of ferrous oxide on the surface of the rod can be kept fairly low by using plenty of water at the rod mills. In the case of high carbon rods, however, inasmuch as the quantity of water employed in cooling will probably affect the hardness of the metal, a proper balance must obtain between the scale percentage and toughness of the steel. Good practice never exceeds 1.25 per cent scale on the rod, for obviously the more oxide present the greater the loss in metal and acid necessary to remove the oxide.

That portion of the mill devoted to cleaning the rods is called the pickling house. It is the link between the rod and wire mills. Pickling vats or tubs are usually arranged in a circle, having a crane at the centre. This crane is so proportioned, that its extreme radius makes it possible to lower and raise the batches of rods into and from the vats. Twelve pickling vats will handle an average of 240 tons in a period of 10 hours. Each vat is made to hold 1,000 Imperial gallons of solution and is constructed from wood. The solution itself is in the most cases made up of a dilute solution of sulphuric acid, ranging from 3.0 per cent to 4.5 per cent by weight. The bath is kept hot either by steam pipe coils or direct steam blowdowns, in order to accelerate the pickling action. Of the two systems the former is more efficient because it makes possible the reclamation of the latent heat in the steam besides doing away with over-dilution of the solution. Again it does not have the effect of the live steam in sweeping away the bubbles of gas that form on the steel, protecting it from acid attack.

The baths need not always be at a high temperature, for acid brittleness of the steel sometimes results from a hot pickling solution. The speed of cleaning is the real criterion of temperature. Steel that is intended for galvanizing purposes should have a low silicon content, since the presence of that element in the heat tends to form silicon carbide. Rusty rods should never be cleaned with the intention of galvanizing them later; since the surface of such rods is invariably rough and pitted.

For long pickling periods, cold hydrochloric acid is sometimes employed, since there is less danger of the iron carbides dissolving out of the steel than if sulphuric acid were used. Dissolution of the iron carbides impairs the surface of the steel and consequently the zinc would not adhere properly.

Both hydrochloric and sulphuric acid, used hot or cold, must be inhibited. Inhibitors, which are composed of organic carbohydrates, prevent the acid attack upon the steel base of the rod after the oxide scale has been removed. In many instances, batches of rods must of necessity remain in the pickling solution for some time after the scale has been removed. The acid of the pickling solution readily attacks the steel which has been laid bare and as a consequence there is a loss of both acid and metal. The author described in a paper written for September 4th, 1929, issue of the "Iron Age," a cheap efficient compound that was developed from experiments extending over an eight month period.

Chemists lately have been devoting some time to the study of inhibition. The so called 'black acid' obtained from a process in the refining of crude oils offers considerable inhibiting features. During the distillation of the crude the various hydrocarbons distill over in the general order of their boiling points. The distillate, which collects between certain limits, is further purified by scrubbing with sulphuric acid. The result is a substance that is not a definite chemical compound, but consisting of a mixture of hydrocarbons, the boiling points of which lie within certain limits. The 'black acid' commonly gives 69 per cent of 66° Baumé sulphuric acid, 9.0 per cent free hydrocarbons, 10 per cent sodium sulphate and 12 per cent oil sludge, on analysis. The free hydrocarbon content undoubtedly accounts for the passiveness of this acid when coming in contact with iron or iron carbon alloys.

Subsequent to the pickling, the rods are rinsed in a tub of cold water in order to wash off any traces of acid that may yet remain upon the steel. They are then placed upon what is termed a 'ruster,' which may assume the shape of a circular revolving platform, having annular rings that support each batch of rods. Water sprays constantly keep the steel wet and aid the formation of a greenish-brown rust coating or sull. This sulling coat, when dry, enables the rod to be drawn down to small diameters, since it acts in the capacity of a lubricant.

When the cleaner has decided that the rods are sufficiently rusted they are dipped in a vat of hot lime solution. This serves a double purpose, viz., to neutralize any acid that may be present on the steel and to lubricate the metal during the coarser drawing stages. The lime employed for this operation must be of a good grade and free from abrasive substances such as magnesium oxide.

The rods are then transferred by means of steel trucks to the baking ovens, where they undergo a mild heat treatment. The temperature of these bakers should not be less than 400° Fahrenheit, since the prime object of baking is to drive out any traces of occluded hydrogen from the surface pores of the metal. This element if present during the wire-drawing will tend to destroy the character of the lubricant and possibly spoil the product. Twenty minutes to half an hour is required for thoroughly drying out the steel, after which the rods are ready to be drawn into wire.

The trucks of rods are next removed from the bakers and taken to the wire-mill, where they are placed at the disposition of the wire-drawer. Wire mills are ordinarily arranged in benches having the machines or blocks running side by side. The block is a tapered steel cylinder upon which the wire is wound after passing through the die-hole. The taper is provided so that the wraps or turns of wire can slip upwards during the operation and thus leave room for the remainder which are constantly being wound about the block. Blocks are of variable speeds according to diameter, which varies from 16 to 28 inches in practice. For instance the 16-inch block has a constant speed of 60 r.p.m. while the 28-inch block revolves at a lower speed of 45 r.p.m. Each block is supported by a vertical drive spindle, which in turn is geared to the motor drive shaft.

There are two types of wire-drawing blocks in use to-day, viz., the multiple drive and the individual power block. The multiple drive block is driven along with nine to eleven others from one motor and is constant in speed, while the power block is equipped with a single adjustable speed motor. The former is started and stopped by means of clutches while the latter is set in motion by means of the rheostat in the motor field circuit and is stopped by the dynamic braking effect of the motor.

The chief advantages of the power block are as follows:

(1) Adjustable working speeds over a wide range, secured through an adjustable speed direct current motor and simple rugged control. This assures high quality product since the speed can be varied to suit various sizes of wires. The multiple block is lacking in this feature.

(2) Very slow starting or pulling-in speed, regardless of final working velocity. This eliminates the danger of the wire breaking in the die hole due to excessive initial velocity and heavy wear on the die is done away with entirely.

(3) Positive, easily operated, fool proof electrical safety devices. The danger to the workman is practically nil due to this feature.

(4) Increased production per operator, less floor space per unit of production and better grade finished wire.

Die holes are set in steel plates, which vary in size according to the gauge of the wire. There are from 10 to 16 holes set in a plate to facilitate operation. The die plate is firmly clamped to the bench in a position at right angles to a tangent drawn to the projection of the block circle. The tapered portion is termed the bearing or backing surface while the small end of the hole is called the size. As can be seen the wire goes through a gradual reduction in area according to the gauge of the sizing portion.

The wire-drawer is now ready to perform his duty. A bundle of rods is first placed on a stationary reel which has its base inclined at an angle of 65° to the floor. One end of the rod is pointed by a suitable device which forms part

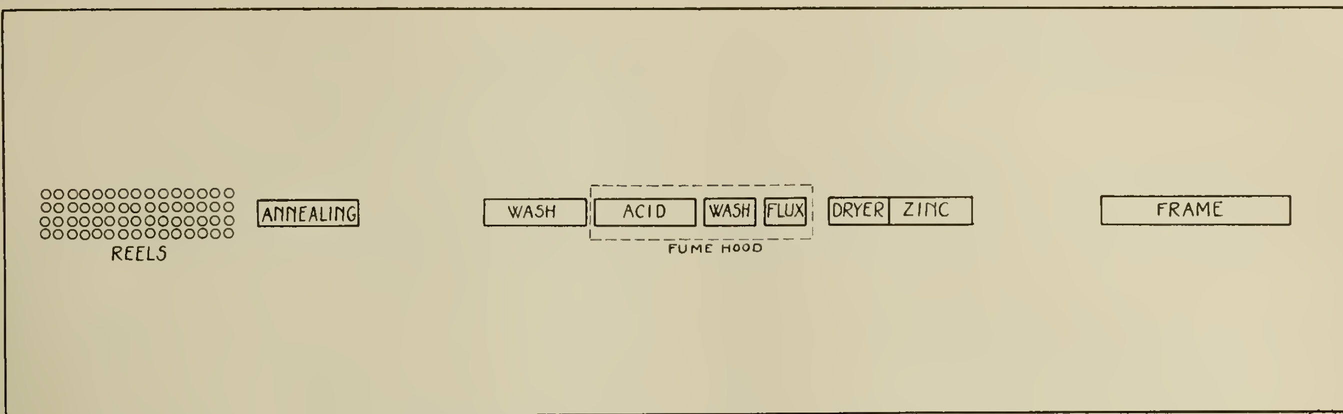

Figure No. 1.—Diagram of Layout for Galvanizer.

of the bench equipment. This enables the operator to pass about two or three inches of the stock through the die hole and thus offer a grip for the pulling attachment on the drawing block. The machine is given two or three revolutions, which causes the same number of snubbing turns to be taken about the block. The free end of the wire is then fastened to one of four guide pins at the upper portion of the machine and the clutch is thrown in again or the motor started. The rod is allowed to run through the die until the whole has been drawn, after which the wire is removed from the block and placed upon a horizontal reel. The operation progresses using another block and smaller size die until the wire has received a further draft. This continues until the desired size is reached.

After a die hole is worn out another one is used, and so on until a new plate is necessary. A properly reamed die hole will last for two or three operations, depending upon the steel being drawn and the quality of the die material. Used die plates are sent to a shop where they are reamed to a larger diameter. Frequently the holes enlarge during the actual operation, which results in a wire finishing at the same diameter as it started. Such wires are termed run-outs and are unsuitable for galvanizing.

Scratched and slivered wire is also unfit for galvanizing. Slivers are as the name implies: small flakes of steel which break off and leave pits on the wire surface. Often these flakes of steel tear off in the die hole, wedging against the bearing and scratching the wire as it passes through. This instance is analogous to emery in the bearing of a wheel and axle. Improperly reamed dies also result in scratched wire, so precautions must be taken to observe the effect of each hole during the first stages of the process.

Particular attention must be paid to the choice of lubricant in dry-drawing operation. Soft and hard greases are the most common. An experienced operator can tell by the feel of his wire whether it requires soft or hard grease in the die hole. Wires such as welding steel, which are specified to be grease free, are drawn through soap or common flour. A good rule to follow in the selection of greases is to use a soft grade when the rod is heavily limed and a hard quality when there is little or no lime on the steel. Often scratches can be eliminated at the offset by tightly wrapping the wire, just behind the die plate, with a piece of smaller diameter. This wrap pulls into the bearing when the block is started and helps to feed the wire correctly. Wrapping the wire with cotton waste dipped in graphite or lard makes an excellent lubricant when fine wires are being drawn. There is no set rule to follow in the selection of lubricants, since their choice depends upon so many factors.

After the wire is drawn to the required size, the coils are placed upon steel trucks and transferred to the galvanizing mill. This unit is laid out in straight line design, the overall length being from 230 to 275 feet. The wire enters one end as it is received from the drawing blocks and leaves the other properly galvanized. Reels such as are used in wire mills are used to support the wire at the ingoing end.

Galvanizers are generally of two sizes; the thirty and thirty-six wire units. The former has sixty reels of which thirty are in continuous use, while the latter has seventy-two reels of which thirty-six are standbys. (Figure No. 1 shows the location of these reels in respect to the other parts of the unit.) The operation of either type of mill is exactly the same, so the following will apply in each case.

Three reelmen look after the ingoing end of the installation, their duty being to remove the bright wire coils from the trucks, place them upon reels so that the wire will pass over guide rollers into the annealing furnace. Since the process is a continuous operation the wire must be fed in one long length, so the reelmen must splice the end of the coils to achieve this condition. The splice is made in the form of a hook and eye, which is strong enough to withstand any extraordinary tension which may come upon the wire during the operation.

When steel is drawn into wire it goes through a process which is known as cold-working. This radically increases its hardness and tensile strength, while at the same time its ductility is decreased. Extreme stiffness in galvanized wire is undesirable, so steps must be taken to restore its properties. The changes which are encountered in cold-working are due to the permanent crystalline deformation which ensues during the treatment. This effect is removed by annealing the steel at a temperature slightly above the critical point and slowly cooling. The operation essentially consists of uniformly heating the steel to a temperature between 770° and 850° Centigrade and then cooling slowly in air. The correct annealing temperature depends upon the composition of the steel and the diameter of the wire being galvanized. It is absolutely necessary that the steel be heated uniformly throughout, so that the whole of the ferrite and cementite be transformed into a perfectly uniform solid solution,—austenite.

This gives rise to a small grain size, which is desirable. Rapid cooling and extremely high temperatures will result in large grain sizes with consequently inferior mechanical properties. The curve in figure No. 2 shows the large grain size which is evidenced when too high a temperature is employed in annealing the steel. That portion of the line AB subtended by the angles A and A' gives the relative grain sizes for moderate and high temperatures respectively. The grain size a_1 which corresponds to the correct annealing temperature is considerably smaller than a_2 which is prevalent with the higher temperatures.

Annealing furnaces such as are employed in galvanizer mills, consist of chrome steel pans, filled to within

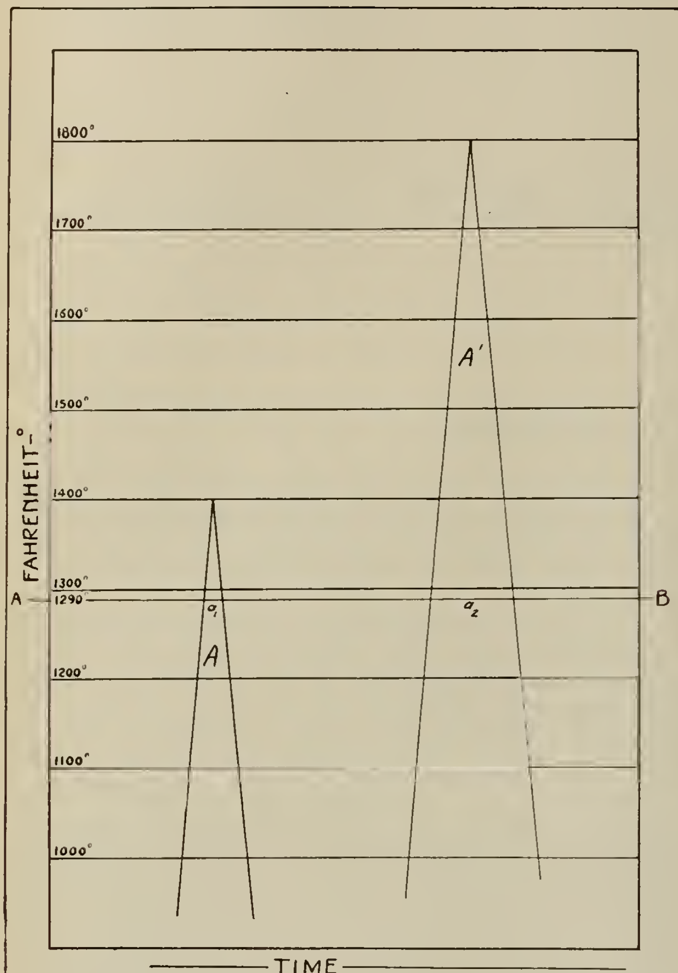

Figure No. 2.—Effect of Temperature and Rate of Cooling on Grain Size.

three inches of the top with molten lead. The metal is kept in a molten state by gas or coal fires beneath the refractory brick support, upon which the shallow pan rests. These so-called lead pans are from 22 to 28 feet in length, 54 inches wide and about 16 inches deep. The wires after passing over the guide roller are led into the metal through inverted steel combs and pass under depressing rollers which keep them submerged in the hot lead. By the time that the wires have emerged from the pan they have become annealed to the desired softness.

Lead pans frequently burn out, because of the high temperatures to which they are subjected. Their average life is from 180 to 200 days, during which period from 5,000 to 6,000 tons of wire can be annealed. Thermo-electric pyrometers keep accurate check upon the furnace temperatures so that the fireman can regulate the heat to suit the class of material being galvanized. This assures a correct balance between elongation and tensile strength.

A thin layer of coke braize sometimes is spread over the surface of the metal in order to check oxidation. The oxides of lead are called 'skimmings' and can be reclaimed by treating in a smelter. Over 50 per cent pure lead is recovered in this manner. A quantity of ferric oxide should be placed at the exit end of the pan, in such a position that the red hot wires pass through the substance. The author has found that this prevents free sulphur being carried over on the wires and also that the lead out-take is cut down considerably. Subsequent to this treatment, the wires pass through a bank of fine wood ashes, which will tend to wipe extraneous lead from the wire surfaces.

One of the qualifications of galvanized wire is that it possesses a fairly large percentage of elongation. Ordinarily the wire is bound to lose some of this property in the annealing furnace, because of the friction on being drawn through the lead. From 4.0 per cent to 8.0 per cent of the elongation is lost in this manner and unfortunately there is no means of escaping the loss. There is one other condition, however, which results in loss of tensile strength, and can be easily remedied. This is the friction encountered by the wires on passing over guides in, and adjacent to, the annealing furnace. Here the metal is in a very plastic state and deforms easily, so care must be taken to see that all guides revolve freely on their supports. Usually sheaves, running on ball or roller bearings, are provided at entrance and exit of the pan. The system is comprised of individual sheaves so that each wire fills a groove which turns only when the wire is moving. The submerged depression rollers revolve in heavy porcelain bearings, the molten lead acting in the capacity of a lubricant between roller shaft journal and bearing surface. Guide pins located in staggered formation on a horizontal pin-board are placed at entrance and exit, serving to keep the wires laterally aligned.

The air cooling system comprises two horizontal grooved rollers, placed about thirty feet apart and elevated to such a height that the operators can pass underneath without danger. The wires emerge from the annealing furnace and traverse the cooling rollers after which they are led down into a wash tank. This tank, which is identical in all dimensions with the lead pan, also is equipped with entrance and exit rollers and depression rolls. Such tanks are usually constructed from rough pine wood and are kept full of water. The water is relatively cool to the entering wires but at this point the metal is so cool as to not be affected by quenching. The purpose of the wash tank is to remove any foreign matter which might adhere to the steel and be carried along in the process.

The next step in the operation is an important one, viz., the cleaning of the wires. All metallic oxides formed on the wires during the annealing are removed in the cleaning tank. Commercial hydrochloric or muriatic acid of 22° Baumé strength is diluted with water to give an acid solution of 10.0 per cent. The best practice is to have the solution tank at least 24 feet long and of the same width and depth as the wash tank. Ordinary brick would not withstand the attack of the cleaning solution, so acid-resisting tile is utilized in the construction of the container. Steam pipe coils, composed of acid-resisting or non-corrosive metal, are laid horizontally along the bottom of the tank and serve to keep the solution at a temperature not exceeding 140° Fahrenheit. The wires are submerged in the cleanser by passing under micarta depression rolls, which turn in stainless steel bearings. The cleanser is tested for acidity at periodic intervals, using the titration with sodium hydrate test.

Following the cleaning, the wires are again washed in a tank about half the length of the previous bath. The water in this wash is kept at a temperature near the boiling point by means of exhaust steam from the pipe coils in the acid tank. An over-flow pipe is provided and all surplus water passes into a shallow trench which has an outlet into the sewer.

It is now assumed that the wires are properly annealed, free from oxide and ready to be fluxed for zincing. Just adjacent to the last wash tank is the flux-box, about ten feet in length and equipped similarly with rollers. The material from which this box or tank is constructed is also acid-resisting tile. The flux solution is heated to 170° Fahrenheit by steam pipe coils which exhaust into the previous wash tank.

Manufacturers in both England and Germany have found that only two substances are suitable for satisfactory fluxing. These are zinc chloride and sal-ammoniac. The former is made at the point where it is desired for use, by placing a quantity of hydrochloric acid in a stone cistern and 'killing' it with slab zinc. Zinc oxide or skimmings from the zincing pan sometimes are used for this purpose, although the author contends that the high percentage of iron found in this substance is detrimental to the solution so formed. Sal-ammoniac or ammonium chloride is purchased in the form of a deliquescent salt and is added directly to the flux box and diluted with water to a specific gravity of 1.040.

Zinc chloride is diluted with water until a solution of 1.150 specific gravity is secured. This substance is not as efficient as sal-ammoniac when fluxing because of the fact that often the acid radical is not entirely absent from the chloride and hence ferric chloride is formed on the steel. This chloride is carried over into the zinc pan where the iron increases the drossing tendency, i.e., the formation of a zinc iron alloy which contaminates the coating metal. About four pounds of iron will render ninety-six pounds of zinc practically useless for high grade galvanizing.

After dipping in the flux box the wires pass over a hot plate about ten feet long, which is in reality a portion of the flue which leads the products of combustion away from the fires of the furnace beneath the zincing pan. The moisture on the wires is quickly dried and there is no danger of the molten zinc spattering as the wires pass under its surface.

A wooden housing, leading to a louvre tower, is placed around the various baths so that objectionable fumes can be carried away.

There have been many attempts made in late years to better the practice outlined in the preceding paragraphs, but with little success. The writer has developed a unit which can be easily installed in any type of galvanizer mill; its chief function being to increase the toughness and quality of the zinc coat. At the time of writing, details regarding this process cannot be divulged, but it is hoped that such will be ready for publication shortly.

So much for the preparation of the wires, which are now in a position to be zinc coated. As was previously stated this coating can be applied in two different ways, and the wire is so classed according to the manner in which it is coated, viz., wiped and unwiped wires. The zinc pans used in the wiping units are from 18 to 28 feet long and about 16 inches deep, while the unwiped units incorporate pans of a much shorter length and greater depth. The zincing pan is heated in the same manner as the lead pan of the annealing furnace and a check on the temperature of the metal kept by a recording pyrometer. The average life of such pans varies between 5 and 7 months for tonnages between 4,500 and 6,000. The tendency for the zinc to oxidize on the surface of the bath is considerable. The formation of this oxide or skimmings is governed by the area of exposed surface and for this reason there is a greater accumulation of zinc oxide on the surfaces of pans used in wiping units than on those employed in the optional unit. The skimmings can be taken from the pan and sifted through a fifty mesh sieve which separates out the true oxide from the partly oxidized metal. The latter is again placed upon the hot metal and allowed to melt, while the finer oxide is stored and sold later to paint and pigment manufacturers.

Depression rollers, of the same design as those incorporated in the lead pan, are placed in the zincing pan in order to keep the wires beneath the surface of molten metal. The second roller, however, is adjustable in both horizontal and vertical directions, so that the distance of travel can be varied. This assures adequate control as regards thickness of coating.

In the wiping units, the wires are pulled out of the zinc through two asbestos wipes. There is one upper and one lower wipe to each wire and their purpose is, as the name implies, to remove any excess metal from the wires. The coating that remains is more or less high in iron, consequently the product of such units is not to be compared with unwiped wire as regards weathering. Two wipers look after the out-take, their duty being to replace the wads of asbestos when they become worn and to keep the correct tension on the wires after they pass the wipes. The asbestos must be kept saturated with a grade of lubricating oil which does not ignite easily. The purpose of this oil is to prevent any of the excess zinc from 'gumming' the wipes and to stop any tendency for this metal to oxidize. An annunciator system warns the wipers when a splice is coming, so that they may raise the upper asbestos wad and allow the hook-and-eye to pass through the aperture. This practice results in considerable scrap wire, since there is a portion of the material which has not been wiped smoothly, on either side of the splice. If the wipers exert too great a pressure on the wads the wires will break just behind the wipes, so it is important that the proper tension be kept on all wires. The unwiped galvanizer mill does not have any of these disadvantages, since the wiping is purely natural.

From the zincing pan the wires are drawn over individual sheaves and are immediately cooled in a water-box. This box is kept full of pure water and is exactly the same size as the wash tank between the acid and flux containers. The sudden cooling encountered by the wires assures a lustrous coating, but invariably affects its tightness and ability to withstand deformation. When a specification calls for a tight coating, i.e., one that will not crack off when the wire is bent, the water-tank is by-passed and the wires cool in air before coiling upon the reels of the take-up frame. This constitutes a rigid assembly supporting 30 reels which are driven on horizontal spindles. The power is secured from an adjustable speed direct current motor and is transmitted to each spindle by means of worm reduction gears off a main drive shaft. Clutches are provided for starting and stopping each reel or block. A system of individual sheaves of fairly large diameter guide the product into correct alignment with the reels.

Two blockers, each with one helper, strip the finished material from the reels and place the coils upon steel trucks. The tightness of coating as secured under this process is influenced by the speed of travel of the wires, the temperature of the zinc bath, length of immersion in this pan, quality of the cleaned surface and the method of cooling.

Unwiped galvanizing has been devised to overcome the natural tendency of the asbestos wipe in removing nearly all the pure zinc from the wire. The latter method secures a smooth coating by pressure while the former takes advantage of the surface tension of the metal to secure a satisfactory coating. In most units the wire is led almost vertically from the pan and passes over an elevated sheave system and thence travels downwards to the take-up frame. The vertical travel assures a smooth, easy flowing coating which quickly freezes as it passes upwards. The wiping is secured by means of a small cone of zinc which forms naturally at the point on the surface of the metal where the wires emerge. The system is most elaborate and would take more space than is available to adequately describe. From day to day the galvanizing industry is learning of newer and better methods of galvanizing under this system. To illustrate one point which clearly shows the necessity for proper construction in unwiped units; the wires being tightly stretched between the submerged roller in the zinc pan and the overhead sheaves, are free to vibrate in a manner similar to a violin string. Such vibration is undesirable since it will destroy the small wiping cone and thus result in a few feet of spoiled wire until a new cone forms. For this reason the speeds usually encountered in units of this type are considerably less than those found in wiping practice.

One man looks after the out-take of the pan since the wiping cones frequently oxidize and must be spooned out and replaced by pure metal. The operation is purely natural and does not affect the operation in any way. When a hook-and-eye tears out the wipe another quickly forms.

The question sometimes is asked just why some grades of unwiped wire have a bright lustrous coating and others a dull leaden gray finish. Obviously the latter condition is brought about by undue oxidation of the wires while the metal coating is assuming a solid state. This oxidation can be checked by sprinkling a quantity of nitrified petroleum coke which has been pulverized to pass 80 per cent through a 100-mesh sieve, over the portion of the pan's surface where the wires emerge. Sometimes this substance will give better results if it is saturated with a thin mineral oil. Various schemes have been devised to overcome the tendency towards oxidization which give more or less satisfying results.

To obtain a high quality zinc coating a good, reliable brand of zinc must be used. The American Society for Testing Materials has set a standard for the chemical composition of 'Prime Western Slab Zinc' which is that such shall not contain over 1.60 per cent of lead and 0.08 per cent of iron. It is important that such metal should be cadmium free since the presence of this element will affect the tightness of coating.

Wallace G. Imhoff, authority on metallic coatings, in his paper on "Obtaining a Satisfactory Zinc Coating" which appeared in the October 4th, 1928, issue of "Iron Age," has this to say in regard to impurities usually found in slab zinc. "Lead does not seem to be harmful in zinc for two reasons; first, it alloys with the zinc in small quantities only; second, any excess lead over the amount that will alloy with the zinc, settles to the bottom of the galvanizing pot and is not harmful unless it becomes too deep. If lead were lighter than zinc and thus remained at the surface, it would quickly oxidize at zincing temperatures thus producing an inferior coating." The article from which this extract was taken, referred to galvanizing of sheet metal products, but the same holds true in any process for obtaining a zinc coating. When the zinc becomes so contaminated with dross so that it floats to the surface, it is a good scheme to throw a few handfuls of finely divided lead into the pan. The heavy metal at once alloys with the iron of the dross, precipitating it to the bottom of the pan out of the way of the wires. The dross is removed at definite intervals depending upon the production and the celerity of the accumulation.

The vapour density of zinc is about 32.5 one half its atomic weight 65.0, since the molecule of zinc when in the condition of a gas consists only of one atom. Thus at ordinary zincing temperatures, between 800° and 950° Fahrenheit, zinc readily alloys with iron. The protective metal is not acted upon to any extent by either dry or moist air at ordinary temperatures, since a thin film of basic carbonate of zinc adheres closely to the metal and protects it from further change.

In testing galvanized wires for quality of coating the Preese copper sulphate test is usually employed. A solution of copper sulphate, specific gravity 1.186 and temperature 65° Fahrenheit, is used for this purpose. Test samples about 7 inches in length are taken from the end of each coil when it is removed from the reel. The number of tests, of course, rests entirely with the foreman of the galvanizing mill. It is often the case where a fewer number of samples are taken. Each test piece is wiped clean with cotton waste and gasoline before examining. As many samples up to seven or eight may be tested at once but care must be taken to prevent any of the samples touching when in the solution, otherwise an electrolytic action would hasten the removal of the zinc. After a thorough cleansing, they are immersed in the copper sulphate for a period of exactly one minute. At the expiration of this time the samples are removed, rinsed in cold water and wiped dry with a piece of waste. This removes the dark deposit from the wire. Such a deposit is termed ferrous zinc sulphate and results from a breakdown of the metallic coating. The samples are immersed again in the solution for one minute, then rinsed and wiped off once more. This operation continues, counting each one minute immersion as a dip, until copper is apparently depositing upon the steel base, showing that the zinc has been removed. When inspecting the samples the bottom portions for a length of one inch are disregarded. The number of immersions or dips withstood by the wire is a criterion of its thickness of coating. For example, the Western Electric specification for telephone and telegraph wire requires four such one minute immersions. This is a higher quality wire than that used for ordinary barbed wire fencing.

Another test which is quantitative is called the lead acetate test of determining ounces of zinc to the square foot of surface. This method of testing is too lengthy to outline here, but it may be said that it is the better of the two procedures.

Tightness or toughness of coating is examined by the wrap test. This consists of wrapping a sample of the finished wire tightly about a mandrel and observing the effect of the distortion upon the coating. An unwiped wire will if properly galvanized withstand high values when subjected to both the Preese and wrap tests. Very often specifications call for a wrap on the wires own diameter, which is a very rigid one indeed.

Micro-photographs of unwiped wire cross-sections show distinct layers of different chemical composition. The outer layer is composed of pure zinc and inside of this band is found a thin layer of zinc ferrite which is quite high in zinc. Next to the zinc-ferrite layer is an alloy of iron and zinc in which the former metal is predominant. Lastly the steel base is detected, which is composed of uniform grains.

It is not generally known in terms of years how long different classes of galvanized wires will last when exposed to the weather. Unfortunately sufficient time has not elapsed since the manufacture of the higher grade materials to give any idea of its weathering ability. Specimens are now under observation at the United States Bureau of Standards in Washington, where data in regard to their life in various localities is being compiled. In an interesting bulletin, R 10, the bureau makes public the results of simulated atmospheric corrosion tests which were carried on during the summer of 1928.

As for the future of the industry, very little can be said, except that the prediction might be made, since due to the ever increasing popularity of copper, bronze and cadmium copper wires, this class of wire will soon be discarded for communication work and be used entirely for the other purposes outlined in the opening paragraphs of this paper.

Graphs for Design of Reinforced Concrete Beams

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The accompanying graphs are offered to designers who have not yet had the time or opportunity to re-arrange their own system of computations to agree with the C.E.S.A. 1929 specification.* One of the principal changes from the older methods is the determination of n or the ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete. Formerly it was common practice to use 15 for 1:2:4 concrete and 12 or even 10 for mixtures of a higher ultimate strength. Under the new specification n has a varying value and is based upon the ultimate unit compressive strength of the concrete at the age of 28 days, or,

$$n = \frac{30000}{\text{ult. comp. strength}}$$

This straight line formula has the advantage of simplifying equations and is probably as close to the truth as other fundamental assumptions.

The maximum unit fibre stress in bending is taken as being equal to four-tenths of the ultimate compressive strength, and the primary equation $nf_c = 12000$, as shown on the graphs, is a direct result. If $f_s = 20000$ then $k = .375$ and $f_s' = 8800$ when the total depth is $1.1d$.

With the two graphs it is possible to arrive at a fairly rapid and direct solution of the bending moment problems commonly met with in the design of rectangular sections.

The symbols used are as follows:—

d = depth from compression surface of beam to centre of longitudinal tension reinforcement.
e = eccentricity in inches.
f_s = unit stress in tension steel.
f_s' = unit stress in compression steel.
f_c = unit compressive stress in extreme fibre of concrete.
M = moment in inch-pounds per inch breadth.
N = thrust in lbs. per inch breadth.
n = ratio of modulus of elasticity of steel to modulus of elasticity of concrete.
p = ratio of area of *tension* reinforcement to effective area of concrete.
p' = ratio of area of *compression* reinforcement to effective area of concrete.

$$c = \frac{d}{\sqrt{M}}$$

$$x = \frac{M}{d^2}$$

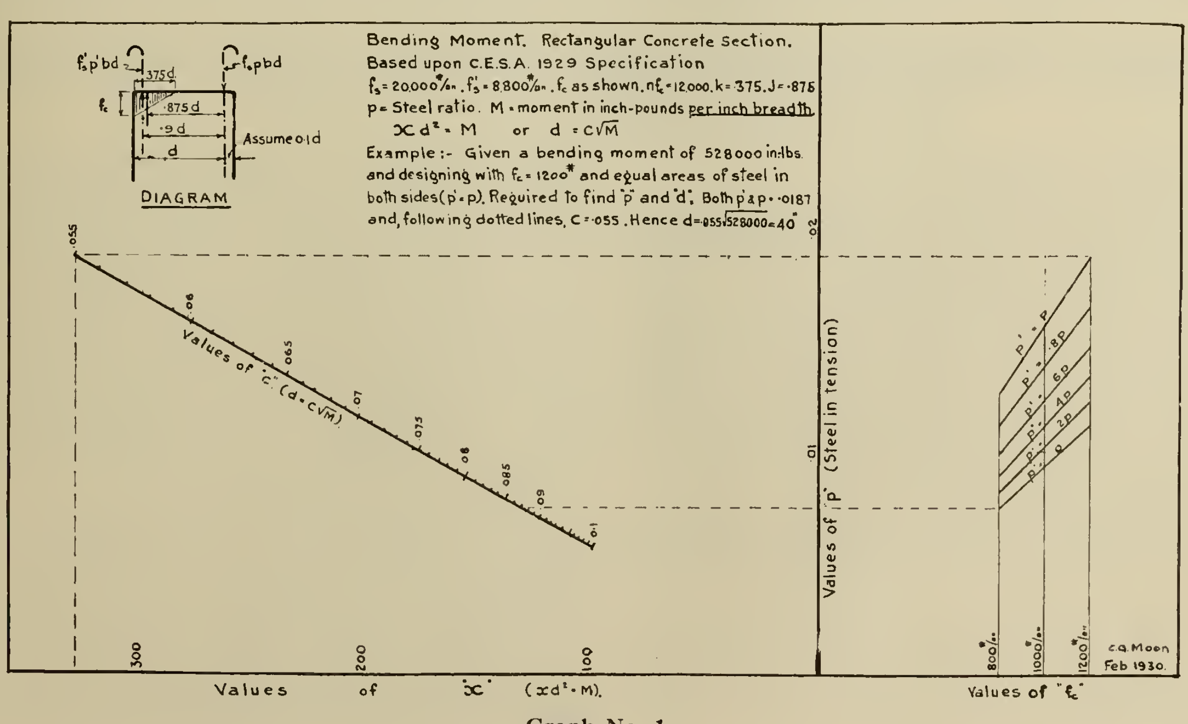
$$k = \frac{1}{1 + \frac{f_s}{nf_c}}$$

Graph No. 1 solves for moment, effective depth, and consequent ratio of steel, for conditions ranging from no steel in the compression side to an amount of steel equal to that in tension.

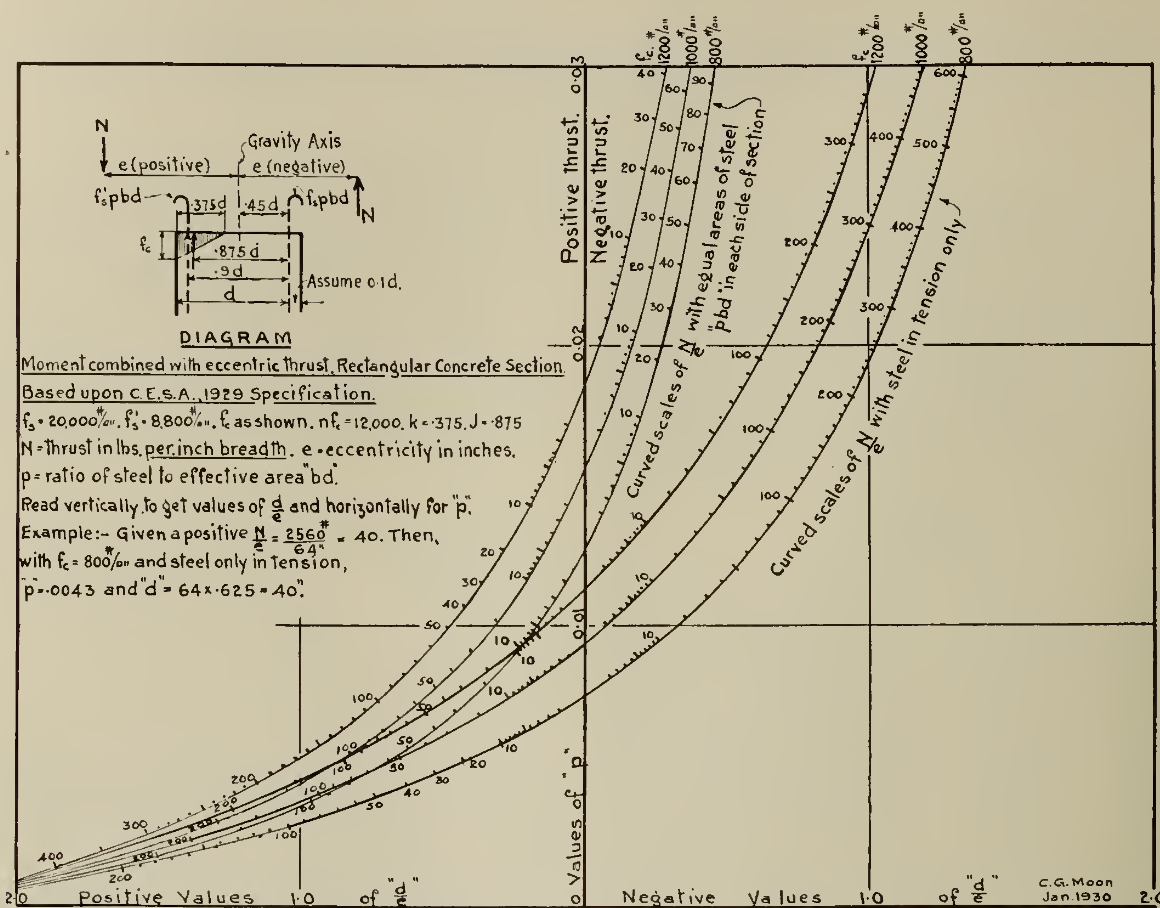
In using No. 1, select the desired value of f_c at the right hand end, and read vertically upward to the line giving the known ratio $\frac{p'}{p}$, thence horizontally to the left to get values of p and c. If x is desired, read vertically downward from the point giving the proper value of c.

Graph No. 2, gives a direct determination of d when bending is combined with an eccentric thrust. End walls or columns carrying fixed beams are subject to a combination of bending moment and "positive" thrust, while the

*Canadian Engineering Standards Association, Publication A23, 1929. Standard Specification for Concrete and Reinforced Concrete.



Graph No. 1.



Graph No. 2.

corners of cribs, bins or retaining walls resisting the load from an interior fill may be cited as examples of "negative" thrust.

In using No. 2, select the curve corresponding to the desired value of f_c, and follow it to the point marked with the known value of $\frac{N}{e}$. From this point read horizontally to get the value of p and vertically for the value of $\frac{d}{e}$.

Discussion of Paper on Recent Improvements in Mechanical Transport Vehicles by Captain N. G. Duckett (1)

Lieut.-Col. Frank Chappell, a.m.e.i.c. (2)

Colonel Chappell observed that the commercial motor vehicle did not develop to any great extent until roads became sufficiently improved to make this means of rapid transportation one upon which reliance could be placed. The cross country aspect of such travel naturally had at first no appeal to the commercial manufacturer of vehicles.

Now, however, the reliability of commercial vehicles on good roads having been assured, there was a reasonable possibility that such vehicles might be so durable as to be available for use under less favourable conditions than those for which they were originally designed.

Some of the problems involved in the original presentation of a vehicle in the field of commerce, included the development of an improved cooling system, due to the higher motor speed required. A different type of valve material had to be used in order to withstand the increased heat. A new drive shaft had to be designed, due to the excessive frame travel which affected the drive shaft angles. A reduction in the weight of the different assembled parts was necessary, otherwise the load capacity of the vehicle was reduced and operating economy thereby affected. The tire design was not satisfactory for high speeds. The development of the cord tire resulted in this latter handicap being very readily overcome, and rapid progress had been made in recent years in the development of other items of design, until now the operating economy was such as to make the commercial vehicle a practical, reliable and economical means of transportation.

This outstanding development included the six-wheel design, particularly the six-wheel flexible rear axle type. Owing to the assistance given by various war departments, development of this latter type had been most marked in Europe, since military requirements had called for a most comprehensive research in this style of construction.

However, in the United States, the six-wheel flexible rear axle unit was also in process of development, since there was evidently a commercial field for this type. To

(1) This paper was presented at the Annual General Meeting of The Institute, Ottawa, Ont., February 13th, 1930, and published in the February 1930 Journal.

(2) Assistant Factory Manager, General Motors of Canda, Oshawa, Ont.

quote one manufacturer alone, General Motors Truck Division had now progressed to the stage of actual production of such a heavy duty unit.

The 1929 Paris and London shows revealed the rapid progress made in the development and refinement of commercial chassis and motor design. Particularly interesting was the development of the motor unit, for in addition to the variety of six-wheelers shown at the recent shows, Mercedes, Renault, Junkers and Berliet displayed trucks motored by Diesel engines. Undoubtedly, there was a distinct trend toward the adoption of the Diesel engine for commercial vehicle work, and there was also no doubt that in due time refinements of design would result in the development of Diesel motors for the passenger and lighter car field.

It would appear that the improvement of transmission design had lagged somewhat behind the development of design of other essential features. During the later stages of the war, there had been developed a type of hydraulic transmission, something after the principle of the Hele-Shaw clutch, which had been used, according to personal observation, in certain types of tanks. Colonel Chappell recalled that Vickers had a motor omnibus in operation for their works purposes, which was equipped with a hydraulic transmission for test purposes, and while it was admittedly inefficient, it marked a trend toward an infinitely variable gear change.

Developments were now in sight that would enable gears to mesh more perfectly, and he believed that radical improvement in transmission design was at hand.

The problem of steering the type of vehicle under consideration, particularly when used for cross country and high speed purposes, merited very serious consideration. Great refinements had already taken place in this feature in commercial vehicles, resulting in a control that was both positive and sensitive. This had been brought to a high pitch of perfection on passenger cars, and the lessons learned had been applied to the truck field with materially advantageous results. The present stage of research development promised a wonderful improvement in this feature of design within a comparatively near future.

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Visit of the R 100 to Canada

This ship, one of two built for the British government to test the possibilities of long distance passenger flight by rigid airships, has made the crossing from Cardington, England, to Montreal in seventy-nine hours, returning in fifty-nine hours. This is the fourth trans-Atlantic crossing from east to west, previous voyages having been made by the

R 34 (British) in 1919.............in 108 hours.
Los Angeles (built in Germany for the U.S. government) in 1924...in 80 hours.
Graf Zeppelin (German) in 1928....in 111 hours.

The leading particulars of the R 100 are as follows:

Capacity	5,000,000 cu. ft.
Length	709 feet.
Diameter	133 feet.
Total fixed weight	90 tons.
Total lift	156 tons.
Propelling engines	six, each 660 h.p., in three cars.
Electric generators	two, each 15 kw. d.c.
Fuel	gasoline.
Fuel supply	sufficient for 5,000 miles.
Cruising speed	about 70 miles per hour.
No. of passenger berths	100.
Cost	$2,250,000.

Through the kindness of the Minister of National Defence, members of The Engineering Institute of Canada were afforded an opportunity of visiting the airship at the mooring mast at St. Hubert, and a large number of members from Branches in eastern Canada took advantage of this privilege.

At a dinner given by the President and Council of The Institute in Montreal on August 7th, and also at a luncheon of the Ottawa Branch on August 8th, the officers of the ship related some of their experiences on the voyage and discussed informally a number of questions connected with rigid-airship construction and navigation. The views expressed on these occasions may be summarized as follows:

Wing-Commander Colmore stated that the present airship programme of the British government was based on experiments and investigations carried out since 1921, which had led to the conclusion that if success were to be attained in the construction of rigid-airships capable of making long trans-oceanic voyages with passengers, ships of much greater size and strength than any previously constructed would be necessary. When Major Scott crossed the Atlantic for the first time in 1919 with the airship R 34, he was able to make an average speed of only 40 miles per hour, and the fuel capacity of the ship imposed serious limitations. Such difficulties could only be overcome by increasing the size of the airship, but in doing so it was not sufficient merely to build a larger ship exactly similar to a previous smaller one, as the increase in size gave rise to entirely new problems. For example, in connection with the valves for the escape of gas from the bags, a different type of valve capable of discharging much greater volume had to be worked out. The R 100 and R 101 had taken three years to build after the conclusion of the experimental work on which their design was based. Two ships had been constructed, as it was felt that to demonstrate the possibility of passenger traffic it would not be safe to rely on one ship only, a minor failure in which might have brought the experiment to a premature conclusion. The R 100 and R 101 could certainly be regarded as a technical success, and the problem of mooring vessels of this size to masts in winds up to 35 miles an hour had been solved. They had at St. Hubert the most modern and efficient mooring mast yet constructed, and on the arrival of the R 100 it had only taken twenty-five minutes to bring her safely to the mast. He believed that as a result of the experience gained with the R 100 and R 101, much larger ships would be built, having a maximum speed of about 85 miles an hour and a regular cruising speed of over 70 miles per hour. He would leave to Major Scott the task of saying something about the actual experiences with the R 100 on the voyage across the Atlantic.

Major Scott thought it would be interesting to the members present to hear something about the voyage just completed, and the reasons which had led them to take the course they did. The ship left Cardington before dawn, the reason being the low temperature at that time, which would permit of making considerable progress with a minimum loss of gas, it being understood that when a rigid-airship rises in the air, when the temperature rises, or when the pressure falls, gas may have to be allowed to escape from the gas bags. They took a course well to the northward of Ireland, for the purpose of dodging a depression which the meteorological service informed them was centred around the south of Ireland, and in this way they obtained a fair wind from the south-east, afterwards changing to north-east, thus facilitating their progress. He stressed the importance of the receipt of constant meteorological reports during a voyage. Every six hours their meteorological officer had been able to furnish a complete chart of meteorological conditions over the north Atlantic, obtaining his information by wireless from ships, as well as shore stations. When off the north of Ireland with a favouring easterly wind there was, as a matter of fact, a strong unfavourable westerly wind only 200 miles to the south of them. It would be seen that an airship like the R 100 was like a sailing vessel in being largely dependent on the use of fair winds for economy.

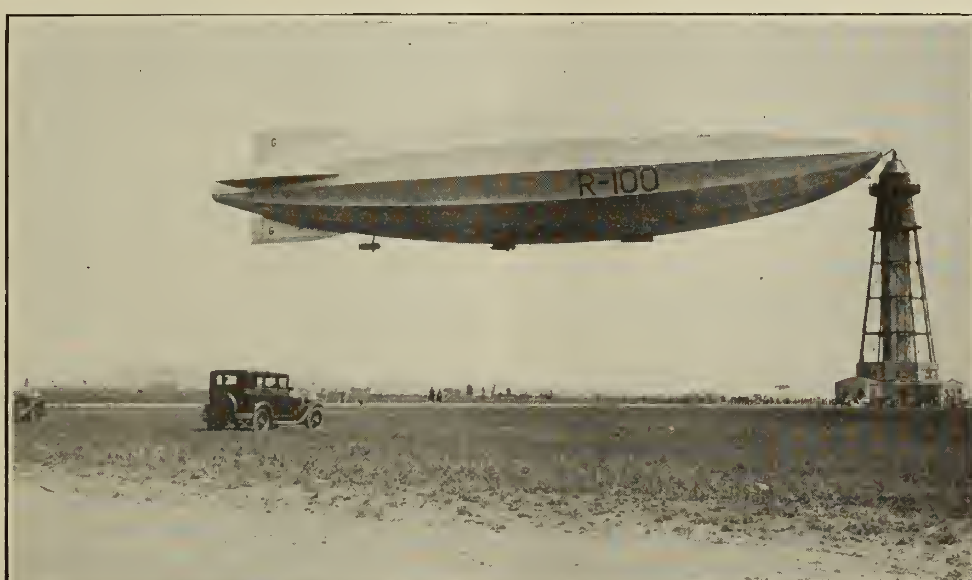
With regard to navigation, they received bearings from a number of ships on the Atlantic and also from the various radio direction-finding stations, and there was at no time any difficulty in determining the ship's exact position. This was evidenced by the fact that they made an accurate landfall, sighting the light at Belle Isle on the port bow, exactly where it should be, and continuing their voyage up the Straits without any alteration of course. In the Gulf of St. Lawrence they had experienced bad weather, particularly thunderstorms. It was desirable to keep a ship like the R 100 clear of thunderstorms, but not for fear of damage by lightning, as while a number of rigid-airships had been struck, no serious damage from lightning had yet been experienced. The chief danger from thunderstorms lay in the existence of violent up-currents of air in their neighbourhood. There were, of course, downward currents, but these were less dangerous. It was probably to such a violent upcurrent that the loss of the Shenandoah was due. The R 100 had been designed to be capable of rising 2,000 feet per minute, without damage to the gas bags or envelope, and the R 101 had been designed for an upward rise of 4,000 feet per minute.

Many believed that the most trying part of the trip was the passage over the ocean itself. As a matter of fact this portion of the run was the least difficult. Actually more fuel was used in coming from the strait of Belle Isle to Montreal than over the ocean portion. The few difficulties which the ship did experience occurred while coming up the St. Lawrence gulf and valley.

In one case a bump just before reaching Quebec caused a rip in some of the fabric of the starboard fin. This was by no means a serious affair and temporary repairs were made actually on board. These repairs allowed the ship to proceed at the rate of forty knots. Then, when off Three Rivers, they encountered violent air movements which dropped the ship to 1,200 feet, after which she rose to 3,000, dropped to 2,000 and then went up to 4,000 feet altitude. The whole of this rapid motion took place in a short time, which it was very difficult to estimate, but which probably did not exceed three minutes. The starboard fin, which had been previously damaged and repaired, withstood this, but the fabric gave way on the port fin. There was, however, no damage to any part of the structure of the ship, and they felt that in the R 100 they had a ship which was capable of weathering any normal disturbance which she was likely to encounter. The delay unfortunately prevented a landing being made in the evening and it was put off until morning. Had the crew been more familiar with the St. Hubert mast and surroundings, however, they would have landed during the night. Night landing, on account of favourable temperature and weather conditions, would undoubtedly be the rule in the future, as it could be much more advantageously effected.

Major Scott remarked further that when ocean navigation was in its infancy it was first developed by the Spaniards, who naturally made their regular voyages to portions of the globe where navigation was easy, and where steady trade winds could be found. It was largely the British who were driven to the development of the art of seamanship, since they had necessarily to make voyages across oceans like the north Atlantic where winds were more irregular and weather conditions frequently adverse. In a somewhat similar way it had fallen to the lot of the British to develop methods of handling and mooring large rigid-airships under adverse weather conditions.

He might mention that the mooring mast for airships had been essentially a British development. The Zeppelins had made their headquarters at Friedrichshafen, where wind conditions were much more peaceful than in Great Britain, and there was accordingly little difficulty in taking an airship in or out of its shed. In Britain, however, and in the province of Quebec, there was much greater risk in moving a large airship into or out of a shed, and the mooring mast was therefore a necessity. At Cardington, the R 101 had ridden out at the mast the severest gale of the winter, with a wind of 60 miles per hour and over lasting for many hours, and one exceptional gust of 83 miles per hour. During this gale the wind had shifted 120 degrees



R 100 at St. Hubert Airport.

in a minute, and the resulting loads upon the mast and the structure of the ship had been well within the limit, the ship having been designed to withstand a horizontal transverse force of 30 tons at the nose, whereas the actual load during the gale in question had not exceeded 15½ tons. At the St. Hubert mooring tower only fourteen men were required to moor the ship, and this could be done in any wind up to 30 miles an hour, a great contrast to the previous conditions, when hundreds of men were unable to control an airship of this size, even in a light breeze.

The experience of the present trip tended to show that, in addition to the main terminal at St. Hubert, the establishment of an emergency base nearer the Atlantic coast for use when weather conditions were adverse, might be advisable so that if strong head winds were encountered, the ship could land mails and take on extra fuel there before proceeding up the St. Lawrence. The mails and other urgent matter could be transported from this base by aeroplane to Montreal. The possibility of replenishing the fuel at an intermediate point would obviate the necessity of the ship having to carry on every trip the reserve of fuel necessary to meet the most adverse conditions. Her useful load could thus be materially increased. The airship could compete much more readily with steamship transport than with transport overland where fast railway and air services were available.

Mr. Giblett, meteorological officer, gave an interesting account of the researches which had been made in England on wind structure, for the purpose of obtaining information as to the size and intensity of eddies and other irregularities in wind, the data thus obtained being necessary for the design of airships like the R 100.

At both the dinner and the luncheon the visitors were warmly welcomed, and congratulated on their achievement. Hopes were generally expressed that they will meet with all success in the completion of their programme and will soon return to Canada.

The Centenary of the Liverpool and Manchester Railway

When the railway from Liverpool to Manchester was proposed in 1822 a grave difference of opinion existed between eminent authorities as to whether the passenger traffic on this road should be handled by steam locomotives, or whether it would be better to avoid these dangerous and new-fangled machines and haul the trains by means of ropes wound by stationary engines. The matter remained unsettled for some years, and finally, the directors having offered a prize of £500 for the best locomotive engine which should demonstrate its capacity for hauling a load of twenty tons at ten miles an hour, a competition took place in October 1829 over a level piece of the completed railway at Rainhill.

Four engines were entered for the prize, and each was required to make twenty runs over the course, a total of seventy miles, during the day. The "Rocket," made by George and Robert Stephenson, more than fulfilled the requirements; its competitors failed, and the prize was duly awarded to its makers. Further, the locomotive was definitely adopted as the motive power for the new line and eight engines were ordered from the Stephensons. The design of the "Rocket" included a number of features which have become standard in locomotive practice, particularly the multitubular boiler and the use of the exhaust steam in a contracted blast pipe for obtaining the necessary furnace draft.

The railway was not officially opened until the following year, when, on the 15th of September, the eight engines, of which one was the "Rocket," with trains accommodating about six hundred people, passed over the whole line in procession, one of them going at such "incredible speed" that it took only twenty-five minutes to go fifteen miles. The success of the steam locomotive on the Liverpool and Manchester Railway effectively terminated the dispute as to the adoption of locomotive or fixed engines, and established the steam locomotive as the standard means of handling railway traffic.

The Hundredth Anniversary of this opening is being celebrated this year in Liverpool in the third week of September, and gives a fitting opportunity to recall some of the achievements of the early railway leaders and engineers in Britain. The railways in England were really an outgrowth of the old tramways of the eighteenth century, on which traffic was hauled by horses, the wagons running on wooden rails. Iron rails were used for the first time in 1767. Trevithick built the first steam locomotive in 1804, but it was not until 1814 that George Stephenson's first engine at Killingworth Colliery hauled a train of eight loaded wagons weighing thirty tons at a speed of four miles an hour. In 1825, a railway having been built from Stockton to Darlington, a distance of thirty-eight miles, a train of thirty-four vehicles was drawn by one of Stephenson's locomotives, but in order to protect the public, the train was preceded by a signal-man on horseback. In spite of the success of this experiment, it was not thought prudent to use the locomotive for the conveyance of passengers, and for some years passenger traffic on this railway was carried on in coaches drawn by horses. The Liverpool and Manchester Railway, whose centenary is now being celebrated, was from the first a commercial success.

The achievements of George Stephenson as a civil engineer in surmounting the many difficulties encountered in the construction of this railway were not less remarkable than his development of the locomotive, and the railway which he made possible began a new era in land travel.

It is interesting to note that the first practical steam locomotive in use in America, the "Lion," was imported from England, and went into service on the 9th of August, 1829, on a line sixteen miles long in Pennsylvania. The first American-built locomotive was constructed in the following year, and worked for some time in South Carolina, but after a few months blew up, its attendant, annoyed by the noise of the escaping steam, having fastened down the safety valve. The first Baldwin locomotive, "Old Ironsides," was tried in 1832, and was modelled on one of Stephenson's successful engines. From that time the record of the steam locomotive has been one of continuous development.

OBITUARIES

Allen Hazen, M.E.I.C.

Deep regret is expressed in recording the death of Allen Hazen, M.E.I.C., which occurred on July 26th, 1930, at Miles City, Mont.

Mr. Hazen was born at Hartford, Vermont, on August 28th, 1869, and received his education at the New Hampshire College of Agriculture and Mechanic Arts, graduating in 1886. Subsequently he became a special student in chemistry at the Massachusetts Institute of Technology, where he came into contact with Dr. Brown, chief chemist of the Massachusetts state board of health, who in 1888 put Mr. Hazen in charge of the experimental station at Lawrence, where he was actively engaged on Boston sewage-disposal problems and those raised by typhoid epidemics in Lowell and Lawrence. In 1893 Mr. Hazen was in charge of the sewage-disposal plant at the World's Fair at Chicago, and the following year was spent in Europe on travel and study. During that time he wrote his first book, a review of European practice in water filtration. On his return to the United States in 1895, Mr. Hazen went into private practice, first in partnership with A. F. Noyes of Boston. In 1897 he went to New York and soon took charge of the design and construction of the filtration plant at Albany, N.Y. In 1904 Mr. Hazen went into partnership with G. C. Whipple, and in more recent years he was associated in sanitary engineering work with Chester M. Everett, Leroy N. Babbitt and Malcolm Pirnie. Mr. Hazen wrote a number of books on hydraulic and sanitary engineering subjects. It was he who introduced the probability concept into hydrology. His most recent work, a book on floodflow studies, has just been published.

Mr. Hazen joined The Institute as a Member on October 14th, 1911.

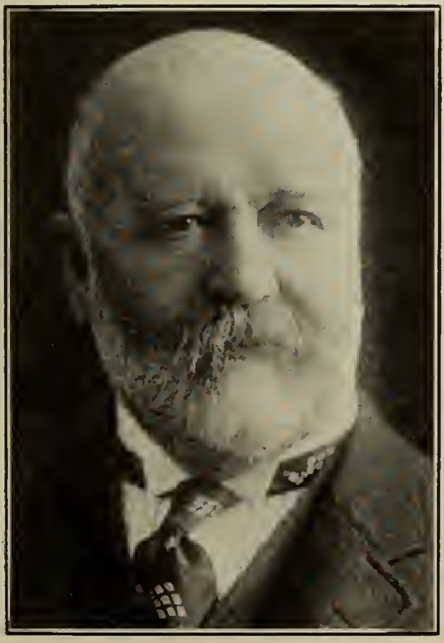
Frederic Lumb Wanklyn, M.E.I.C.

Members of The Institute will learn with regret of the death of Frederic Lumb Wanklyn, M.E.I.C., which took place at Grimsby, England, on August 3rd, 1930.

Mr. Wanklyn was born at Buenos Aires, Argentine Republic, on February 25th, 1860. He was educated at Marlborough College, England, and having decided on engineering as a profession, studied under the late Charles Sacre of Manchester.

His first position of importance was in Italy, where he became resident engineer of the Tramways and General Works Company s lines, Lombardy, and subsequently he acted as general manager and engineer of the Lombardy Roads Railway Company.

Upon coming to Canada, Mr. Wanklyn was appointed assistant mechanical superintendent and manager of the locomotive works for the Grand Trunk Railway. In 1897 he became general manager of the Toronto Street Railway. Then he entered the service of the Montreal tramways organization as manager and chief engineer of the Montreal Street Railway, remaining in that capacity until 1903. Since that date Mr. Wanklyn has been connected with the Canadian Pacific Railway, except during the periods when he assumed public service. In 1910 he was elected a member of the first board of commissioners of the city of Montreal under the charter changes which took active administration of the city from the aldermen, serving for two years. From 1903 to 1910 he was vice-president of the



Frederic Lumb Wanklyn, M.E.I.C.

Brian Douglas McConnell, M.E.I.C.

Dominion Coal Company, and remained as a director until 1920. Mr. Wanklyn was a governor of the Royal Victoria and Alexandra hospitals.

He was elected a Member of the Canadian Society of Civil Engineers on January 20th, 1887. He was a member of Council in the year 1909, and was a member of the Fuel Committee whose report was presented in 1925.

Brian Douglas McConnell, M.E.I.C.

Sincere regret is expressed in recording the death of Brian Douglas McConnell, M.E.I.C., one of the original members of The Institute, which occurred at North Bay, Ont., on July 13th, 1930.

Mr. McConnell was born at Gaspe, Que. on February 29th, 1836, receiving his education at Gaspe, Montreal, and Quebec.

He turned to engineering as a profession and was engaged on the construction of the Canadian Pacific Railway, being one of the party who made the first survey along the north shore of Lake Superior in 1878. At that time he was in the employ of the Dominion government, before the Canadian Pacific Railway Company took charge of the work itself. From 1874 to 1892 he was resident engineer, assistant superintendent and superintendent of the Montreal water works. In 1893 he became city engineer of Westmount, retaining that position until 1896, when he was with the Deep Waterways Commission on the Lake St. Francis and Lake Champlain canal project. In 1896 he entered private practice, which he carried on until 1916, being engaged on various municipal works, surveys and construction.

Mr. McConnell joined The Institute as a Member on January 20th, 1887, and was made a life member on January 9th, 1923.

PERSONALS

George R. Ewart Jr., A.M.E.I.C., who was formerly with Ynchausti and Company, Iloilo, Philippine Island, may now be addressed care of the Bishop Trust Company, Ltd., Honolulu, Hawaii.

William T. Pound, S.E.I.C., is now with the Ontario Paper Company at Thorold, Ont. Mr. Pound, who graduated from Queen's University in 1929 with the degree of B.Sc., was formerly with the Abitibi Power and Paper Company, Ltd. at Sturgeon Falls, Ont.

Bruce S. Taylor, s.E.I.C., is employed in the traffic department of the Bell Telephone Company of Canada at Quebec, Que. Mr. Taylor graduated from Queen's University in 1929 with the degree of B.Sc., and was for a time in the University's chemical engineering department.

Donald G. Robertson, Jr.E.I.C., is at present in the office of the city engineer, Hamilton, Ont. Prior to accepting his present position Mr. Robertson was with the E. B. Eddy Company at Hull, Que. Mr. Robertson is a graduate of Queen's University of the year 1924.

J. A. Rogers, s.E.I.C., has joined the staff of the Provincial Paper Limited, and is located at Port Arthur, Ont. Mr. Rogers, who is a graduate of the Nova Scotia Technical College of the year 1924, was formerly on the engineering staff of the Abitibi Power and Paper Company at Iroquois Falls, Ont.

O. J. McCulloch, A.M.E.I.C., is now with the Sydney E. Junkins Company, of British Columbia, Ltd., at Vancouver, B.C. Prior to accepting his present position Mr. McCulloch was with Porter Brothers and Robert Porter, at Detroit, Mich. He was for a time engaged on the construction of the Welland Ship Canal, at St. Catharines, Ont.

D. G. Geiger, A.M.E.I.C., a member of the staff of the Bell Telephone Company of Canada, has been transferred from Montreal, where he was in the engineering department, to Toronto, where he is transmission engineer, W.A. Mr. Geiger was lecturer in electrical engineering at Queen's University, Kingston, and resigned that position in 1928 to enter the service of the Bell Telephone Company at Montreal.

A. L. Dobson, Jr. E.I.C., is at present connected with the Jamaica Public Service Company, Ltd., at Kingston, Jamaica. Mr. Dobson, who graduated from the Nova Scotia Technical College in 1922 with the degree of B.Sc., was at one time on the staff of the Mound City Electric Light and Ice Company, later joining the staff of the Nebraska Electric Power Company at Broken Bow, Nebraska. Prior to accepting his present position, Mr. Dobson was with the Western Public Service Company at Broken Bow.

E. B. Patterson, A.M.E.I.C., has been appointed resident inspecting engineer for the Water Power Branch, Department of Mines and Natural Resources of the province of Manitoba, at Seven Sisters falls, Manitoba, during the construction of the Northwestern Power Company's development on the Winnipeg river. Mr. Patterson was formerly assistant engineer for the Dominion Water Power and Reclamation Service, at Whitemouth, Man. in connection with the same development. From 1909 to 1911, Mr. Patterson, who graduated from the School of Practical Science, University of Toronto, in 1909, was with Messrs. Smith, Kerry and Chace on concrete work at Pointe du Bois hydro-electric development. In 1911 he joined the Dominion Water Power Branch, being at first assistant engineer on power surveys on the Winnipeg river. From 1912 to 1913 he was resident inspecting engineer on the La Colle falls power development for the Water Power Branch. Following this he became assistant engineer attached to the Manitoba office of the Dominion Water Power and Reclamation Service.

Link Belt Company, Chicago, Ill., have recently issued a new data book No. 1615, entitled "The New Testament on Conveying Methods," containing 176 pages, on belt conveyors. This flexible covered book has been prepared to facilitate the selection and application of the proper type of belt conveyor for handling any material in quantities desired. Free copies will be mailed upon request.

BOOK REVIEWS

Water Supply and Utilization

An Outline of Hydrology from the Viewpoint of the Arid Section of the United States, together with an Outline of Water Law and its Administration as it has developed in the Arid States.

By D. M. Baker and H. Conkling. Wiley & Sons, New York, 1930, buckram, 6 x 9 in., 495 pp., front., figs., tables, charts, $6.00.

The authors of this book deal with the science of hydrology and primarily with its application to the solution of water problems of the arid and semi-arid states. While the book contains fundamental data and considerations applicable to particular areas, the elements of hydrology are fully and clearly set forth in a manner that will facilitate their general application.

The book opens with a history of the early irrigation works of the arid western states and a concise statement of the importance of water in the industrial and agricultural development of that area. The chapters immediately following deal in a very interesting way with water supply and its disposition.

That section of the book relating to administration and adjudication of water rights will undoubtedly be of particular interest to those engineers and administrators in Canada dealing with the contentious water problems of the prairie provinces and the dry belt of British Columbia.

The book is well written and should be useful to engineers having to do with the investigation of water supply, as a considerable portion of the material contained therein is not readily available elsewhere.

R. G. Swan, A.M.E.I.C.,
Engineer, Water Resources Dept.,
Shawinigan Water & Power
Company, Montreal.

Electroplating with Chromium, Copper and Nickel

By B. Freeman and F. G. Hoppe. Prentice-Hall, Inc., New York, 1930, buckram, 6 x 9 in., 212 pp., illus., figs. tables, $5.00.

The authors in the preface of this work say,—"An insistent demand has arisen for information concerning the process of chromium plating. This book has been written in the hope that it will serve, in some small measure, to meet this demand," and, "chromium plating is still in its infancy. New and better methods are constantly being devised. If this book helps others to a clearer understanding of the process, it will serve the purpose for which it is intended." The book very thoroughly covers the scope intended by the authors. It comprises eleven chapters, titled as follows:

I — Fundamental Electrical Considerations.
II — Chemical Fundamentals.
III — Applications of Chemistry.
IV — Plating Department.
V — General Remarks on Polishing and Polishing Compounds.
VI — Cleaning Surfaces for Electroplating.
VII — Specifications for Plating.
VIII — Deposition of Copper.
IX — Nickel Plating.
X — Chromium Plating.
XI — Testing Deposits and Solutions.

The authors cover their subject in a very logical way, as is shown from the titles of the chapters. They cover fundamental electrical and chemical considerations, then the plant itself and finally go into details regarding the processes of copper, nickel and chromium plating. They have wisely included copper and nickel plating because, as they state, no book on chromium plating could be considered complete without a discussion of these other two processes. The authors devote forty-eight pages to chromium plating and give quite a thorough story. Details are given regarding plating solutions, current densities, methods of racking, causes for defective work, etc. This chapter has numerous very good illustrations, which help to clearly bring out many of the points discussed. A very useful appendix and quite a thorough bibliography round off this book.

We consider this a very valuable and useful work. Anyone who is associated with chromium plating or who is contemplating going into this work will be well advised to have a copy of this book before him. Some time is given to theoretical considerations, but on the whole it is so written that it will be useful, not only to the chemist and engineer, but to the practical plater.

W. H. Eastlake, A.M.E.I.C.,
Development Superintendent,
Northern Electric Company,
Limited, Montreal.

American Petroleum Refining

By H. S. Bell. D. Van Nostrand, New York, 1930, buckram, 6 x 9 in., 631 pp., figs., charts, tables, $6.00.

This is the second edition of a book intended for the use of engineers actively employed in the refining of petroleum. It is published seven years after the first edition and has been revised and augmented to bring it up to date, dealing with the latest developments in the technique of refining.

The author has fairly well fulfilled his purpose of preparing a book of reference for those actively employed in installing and operating refinery equipment. The data he has supplied permits one to obtain a good idea of what results can be obtained from existing equipment and also what can be expected from new installations or alterations to old plants based on the inclusion of new principles developed by research.

All branches of refining that have been carried on for the last few years are covered in the various chapters, with the exception of hydrogenation and the production of alcohols, etc., from refinery gases. These two processes, however, cannot yet be considered as regular refinery practice.

The co-authors, T. T. Gray and D. Drogin, have given a very comprehensive discussion on the chemistry of hydrocarbons, classifying these compounds in the well known series and giving the main characteristics of the members of each series. They have also given a good outline of the physical properties of petroleum and its products in Chapter IV.

The book is well written, highly technical language being avoided so that the ordinary refinery employee who is not acquainted with complicated formulae can appreciate and use it to the best advantage; at the same time the data supplied are sufficient to give the engineer direction as to correct design.

Since the technique of refining will probably develop in the future as rapidly as in the past, the information obtainable from this book of reference should be supplemented by consulting current papers submitted to technical societies and articles appearing in the technical journals. The volume will prove a valuable addition to a refiner's library.

F. C. Mechin, A.M.E.I.C.,
Superintendent, Montreal Refinery,
Imperial Oil Refineries, Ltd.,
Montreal East, Que.

Recent Additions to the Library

Proceedings, Transactions, etc.

Presented by the Societies:
- Corporation of Professional Engineers of Quebec: List of Members, June, 1930.

Reports, etc.

Department of Labour, Canada:
- Nineteenth Annual Report on Labour Organization in Canada, for the Calendar Year 1929.

Department of Mines Branch, Canada:
- Investigations in Ore Dressing and Metallurgy, 1928.
- Investigations of Mineral Resources and the Mining Industry, 1928.

Department of the Interior, National Development Bureau, Canada:
- Canoe Trips in the Maritime Provinces.
- Canoe Trips in Quebec.
- Canoe Trips in Ontario.
- Canoe Trips in Western Canada.

National Research Council of Canada:
- Scientific and Technical Societies of Canada, 2nd ed., 1930.

Department of Lands, British Columbia:
- Water Powers of British Columbia, 1930.

Hydro-Electric Power Commission of Ontario:
- Twenty-second Annual Report, 1929.

Federation of British Industries:
- Fuel Economy Review, vol. 10, 1930.

Treasury Department, Public Health Service, United States:
- Effect of Radiant Energy on the Skin Temperatures of a Group of Steel Workers.

Bureau of Mines, United States:
- Mineral Resources of the United States, 1927. Part 1: Metals; Part 2: Non-Metals.
- Economie Paper No. 8: Summarized Data of Silver Production.
- Bulletin No. 325: Quarry Accidents in the United States during the Calendar Year 1928.
- Technical Paper No. 470: Results of Air Repressuring and Engineering Study of Williams-Pool Putnam-Moran District, Callahan County, Texas.
- Technical Paper No. 476: Stock Distribution and Gas-Solid Contact in the Blast Furnace.
- Technical Paper No. 477: A Study of the Lubricant Fraetions of Cabin Creek, (W.Va.), Petroleum.
- Water Supply Paper No. 631: Surface Water Supply of the United States, 1926: Part 11: Pacific Slope Basins in California.
- Water Supply Paper No. 634: Surface Water Supply of the United States, 1926: Part 12: North Pacific Slope Basins, (c) Pacific Slope Basins in Oregon and Lower Columbia River Basin.

Geological Survey, United States:
- Professional Paper 155: The Flora of the Denver and Associated Formations of Colorado.
- Bulletin No. 813-A: Mineral Industry of Alaska in 1928 and Administrative Report.
- Bulletin No. 814: Geology and Ore Deposits of the Wood River Region, Idaho.

University of Michigan, Department of Engineering Research:
- Engineering Research Bulletin No. 14: The Volatility of Motor Fuels.

National Electric Light Association:
- Meter Committee, Engineering National Section: High Tension Meter Installations.
- Prime Movers Committee, Engineering National Section: Burning of Liquid and Gaseous Fuels.
  Stoker Equipment and Furnaces.
  Condensing Equipment.
- Underground Systems Committee, Engineering National Section: Acceptance, Inspection and Testing of Cable.
- Purchasing and Storeroom Committee, Accounting National Section: Miscellaneous Purchasing and Storeroom Subjects: A Uniform Classification for Materials and Supplies.

Technical Books, etc.

Presented by John Wiley & Sons:
- Water Supply and Utilization, by Baker and Conkling.

Presented by Aluminum Company of America:
- Structural Aluminum Handbook, 1930.

Presented by D. Van Nostrand:
- Strength of Materials, Vol. 1: Elementary Theory and Problems; Vol. 2: Advanced Theory and Problems, by S. Timoshenko.

Presented by American Standards Association:
- American Standard: Slotted Head Proportions, Machine Screws, Cap Screws and Wood Screws.
- American Standard: Taps, Cut and Ground Threads.
- American Standard: Milling Cutters.

Presented by American Society of Mechanical Engineers:
- The Engineering Index, 1929.

Presented by Carnegie Steel Co., (United States Steel Produets Corporation): Carnegie Pocket Companion, abridged edition.

Presented by Gnaedinger-Wilson, Ltd.:
- The Architect's, Engineer's and Contractor's Reference Desk Book, 1930 edition.

Presented by J. W. Roland, M.E.I.C.:
- Rivers, Canals and Ports: Bibliographic Notes, 5th Series, 1927. Published by Permanent International Association of Navigation Congresses.

Errata

In connection with paper on "A Short Monograph on Nomography" by F. M. Wood, A.M.E.I.C., which was published in two parts in the June and August issues of The Journal respectively, the following errors are noted:—

Page 373. Figure No. 5. Q scale on top shows value of 100 near the right end. This should read "1000".

Page 377. In the third determinant, the centre element of the top row should read $2.65 \log D + \log 1.272 - 0.80$.

Page 509. Centre element of last determinant should read $50 \frac{D}{D} \tan \phi$.

Page 510. Seventh determinant, first element of second row should be $\frac{B_3}{B_2}$.
Fifteenth line from end should read "point on the R scale", etc.

Page 518. Sixth determinant, first element should have minus sign, and read $\frac{-(1+k)}{\alpha - m - n}$
Thirteenth determinant, a_2 should read α_2.
Sixteenth determinant, a_1 should read α_1.

Waste Heat Boilers

A new bulletin describing waste heat boilers of an entirely different character from those used in the past has just been issued by the Foster Wheeler Corporation of 165 Broadway, New York City.

Several installations have been made in connection with the exhaust gases from Diesel engines and it has been found that in this service the boilers act as excellent mufflers.

Another interesting departure from usual boiler practice is that when operated with waste heat gases not exceeding 800° F., it is not necessary to by-pass the boilers for protection, even when dry. Repeated tests in operation have shown that the boilers are not damaged when used as mufflers alternately with and without water.

The boilers may thus be run as flash boilers, the steam production being controlled by setting the feed valve for the desired steam quantity.

The catalogue shows several designs, installations and details of construction which will be of interest to those having waste gases at temperatures above 500°. The bulletin is known as WB-30-2 and is available upon request.

Maximum Moments in Simple Beams, Plate Girders and Trusses of the Pratt Type

O. T. Macklem, A.M.E.I.C.,

Associate Professor of Engineering, Royal Military College, Kingston, Ont.

Table No. 1 gives the maximum moments, in thousands of pounds-feet, due to Cooper's E. 40. loading, at the one-tenth, two-tenths, three-tenths, four-tenths and five-tenths points of the even ten feet spans up to 300 feet and the maximum moments near the centre for the same spans up to 200 feet.

Plotting moments as ordinates, and span lengths as abscissae, there result curves giving the maximum moments at the 0.1, 0.2, 0.3, 0.4 and 0.5 points of all spans up to 300 feet.

To obtain the maximum moment at any point in a given span, lay off the span length to any convenient scale and mark the 0.1, 0.2, 0.3, 0.4, and 0.5 points on it. Through these points erect perpendiculars equal to the ordinates, for the given span, to the 0.1, 0.2, 0.3, 0.4, and 0.5 moment curves respectively. Joining the extremities of these perpendiculars gives the curve of maximum moments for the given span and the maximum moment at any point can be scaled from it.

Maximum Shears in Simple Beams and Plate Girders

Table No. 2 gives the maximum shears in pounds in a simple beam or plate girder due to Cooper's E. 40. loading at the 0.0, 0.1, 0.2, 0.3, 0.4 and 0.5 points of the even ten feet spans up to 200 feet.

To obtain the maximum shear at any point in a simple beam or plate girder, lay off the span length as before and at each tenth point erect a perpendicular equal to the ordinate, for the given span, to the corresponding shear curve. Joining the extremities of these perpendiculars gives the curve of maximum shears for the given span and the maximum shear at any point can be scaled from it.

Maximum Shears in Trusses of the Pratt Type.

Let AB represent a truss of n panels.

Let p be the panel length.

Assume the load to be moving from right to left, and draw the influence line $bgdha$ for shear in EF, the $(m + 1)$th panel from the right support.

$$\text{Then } DF = df = gf\frac{hk}{gk} = gf\frac{ef}{gf + eh} = gf\frac{ef}{gf + gf\frac{ae}{bf}} = bf\frac{ef}{bf + ae}$$

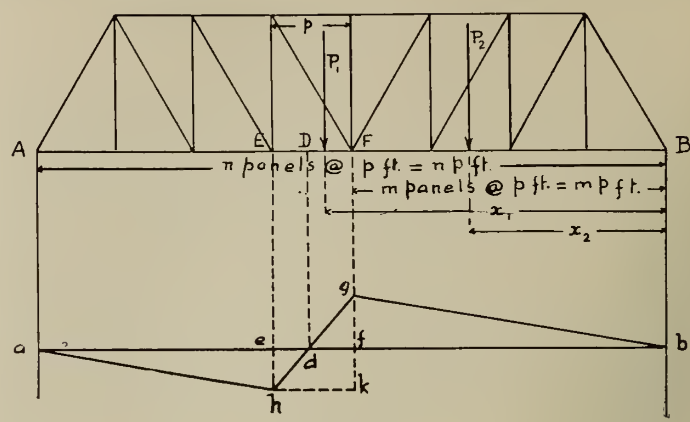


Figure No. 1.

$$\text{whence} \quad DF = bf\frac{ef}{ab - ef} = mp\frac{p}{np - p} = \frac{mp}{n - 1}$$

$$\text{Also } BD = bd = bf + df = mp + \frac{mp}{n - 1} = n\frac{mp}{n - 1} = n \,.\, DF$$

$$\text{Therefore} \quad DF = \frac{1}{n}BD \text{ or } \frac{DF}{BD} = \frac{1}{n}$$

Let P_1, distant x_1 from the right support, be the resultant of all loads in the panel EF.

Let P_2, distant x_2 from the right support, be the resultant of all loads on BF.

Consider the case in which $x_1 > BF$ and $=$ or $< BD$.

Then for a maximum shear in the panel EF, the load in EF must be equal to the average panel load on the span.

$$\text{Therefore} \quad P_1 = \frac{P_1 + P_2}{n}$$

Table No 1—Maximum Moments, in Thousands of Pounds-Feet, due to Cooper's E. 40. Loading.

Span Ft.	M 0.1	Under Wheel	M 0.2	Under Wheel	M 0.3	Under Wheel	M 0.4	Under Wheel	M 0.5	Under Wheel	M Max.	Under Wheel	Distance from Left Support
10	26.0	2	44.0	2	54.0	2	56.0	2	50.0	2	56.250	2	3.75 ft.
20	84.0	2	136.0	2	176.0	3	204.0	3	200.0	3	206.250	3	8.75
30	*160.0	5	*266.0	5	*353.0	4	396.0	3	410.0	3	410.454	3	14.61
40	254.0	2	431.8	3	562.7	3	632.0	3	655.5	4	655.630	4	19.79
50	367.6	2	635.2	3	818.8	3	918.4	4	945.5	4	950.922	4	23.55
60	494.5	11	859.2	12	1118.2	12	1259.6	13	1294.0	13	1298.878	13	28.63
70	638.2	2	1116.8	12	1439.5	12	1637.8	12	1707.5	13	1707.514	13	34.92
80	827.0	3	1430.8	3	1820.4	4	*2079.2	13	2159.5	13	2159.643	13	40.28
90	1035.9	3	1794.0	3	2277.6	4	*2569.4	13	2669.0	13	2669.687	13	45.60
100	1264.3	3	2186.2	4	*2804.8	13	*3154.4	12	3217.0	12	3219.040	12	50.15
110	1510.5	3	2622.4	4	*3389.2	13	*3813.6	12	3859.0	11	3886.540	11	59.18
120	1770.6	3	3081.8	4	*3986.3	13	*4512.0	12	4596.5	11	4612.691	11	62.86
130	2046.9	3	3565.0	4	*4593.2	13	*5241.6	12	5356.5	11	5391.691	11	67.71
140	2348.4	3	4073.8	4	*5213.2	14	*5993.4	12	6196.5	11	6199.876	11	71.35
150	2666.1	3	4608.2	4	5892.5	7	*6785.4	13	7056.5	12	7062.262	12	76.77
160	3000.0	3	5181.2	5	6642.2	7	*7596.6	13	7954.0	12	7954.229	12	80.36
170	3350.1	3	5782.8	5	7421.3	7	8472.4	11	8876.5	12	8878.456	12	83.93
180	3716.4	3	6410.0	5	8250.2	8	9442.0	11	9836.5	13	9837.427	13	89.26
190	4089.9	3	7062.8	5	9113.3	8	10440.4	11	10834.0	13	10842.005	13	92.80
200	4497.6	3	7741.2	5	10016.3	9	11485.6	12	11856.5	13	11878.248	13	96.32
210	4912.2	3	8457.8	6	10959.2	9	12565.6	12	12916.5	14			
220	5343.6	3	9216.2	6	11942.7	10	13674.4	12	14014.0	14			
230	5796.4	4	10000.2	6	12981.2	11	14822.0	13	15137.5	14			
240	6268.9	4	10813.8	7	14079.5	11	16012.4	13	16324.5	15			
250	6757.6	4	11665.0	7	15207.2	11	17231.6	13	17559.5	16			
260	7262.5	4	12541.8	7	16364.3	11	18481.6	14	18833.0	17			
270	7783.6	4	13444.2	7	17556.3	12	19782.4	14	20155.5	17			
280	8320.9	4	14389.0	8	18793.2	12	21112.0	14	21520.5	18			
290	8874.4	4	15361.8	8	20059.5	12	22474.0	15	22918.0	18			
300	9444.1	4	16360.2	8	21355.2	12	23904.4	15	24400.0	158	ft. of train load on span.		

*Signifies the load moving from left to right. In all other cases the load moves from right to left.

Table No. 2—Maximum Shears, in Pounds, due to Cooper's E. 40. Loading.

Span Ft.	S 0.0	Under Wheel	S 0.1	Under Wheel	S 0.2	Under Wheel	S 0.3	Under Wheel	S 0.4	Under Wheel	S 0.5	Under Wheel
10	30000	2	26000	2	22000	2	18000	2	14000	2	10000	2
20	50000	2	42000	2	34000	2	27000	2	21000	2	14000	2
30	63034	2	53300	2	44000	2	35667	2	26667	2	17667	2
40	75400	2	63500	2	52575	2	41300	2	31000	2	22000	2
50	87220	11	73520	2	59920	2	47020	2	35420	2	24860	2
60	98017	11	82417	11	67350	11	53000	2	39667	2	27850	2
70	110515	2	91172	2	74129	11	58343	2	44000	2	30729	2
80	124200	2	102000	2	81050	2	63100	2	47900	2	33700	2
90	137234	2	112900	2	89556	2	68800	2	51600	2	36734	2
100	150000	2	123310	2	98160	2	75160	2	55360	2	39360	2
110	162010	2	133600	2	106500	2	82000	2	59709	2	41782	2
120	173675	2	143342	2	114534	2	88300	2	64667	2	44467	2
130	185085	2	152800	2	122500	2	94531	2	69631	2	47507	2
140	196293	2	162065	2	130065	2	100800	2	74257	2	50829	2
150	207340	2	171174	2	137474	2	106774	2	79774	2	54374	2
160	218256	2	180156	2	144756	2	112556	2	83400	2	57600	2
170	229065	2	189035	2	151935	2	118235	2	87935	2	60830	2
180	239783	2	197828	2	159028	2	123828	2	92228	2	64061	2
190	250426	2	206547	2	166047	2	129347	2	96447	2	67226	2
200	261005	2	215205	2	173005	2	134885	2	100605	2	70400	2

And for a maximum moment at F in a beam of length BD, the average load to the left of F must equal the average load on the span.

Therefore $$\frac{P_1}{DF} = \frac{P_1 + P_2}{BD}$$

and $$P_1 = \frac{DF}{BD}(P_1 + P_2) = \frac{P_1 + P_2}{n}$$

Therefore, the position of the load for a maximum shear in the panel EF of the truss AB is the same as for a maximum moment at F in a beam of length BD.

Let M = maximum moment at F in the beam BD.

And S = maximum shear in the panel EF of the truss AB.

Then $$M = \frac{P_1 x_1 + P_2 x_2}{BD} DF - P_1(x_1 - BF)$$
$$= \frac{P_1 x_1 + P_2 x_2}{n} - \frac{P_1 n (x_1 - mp)}{n}$$
$$= \frac{P_1 (x_1 - nx_1 + mnp) + P_2 x_2}{n}$$

And $$S = \frac{P_1 x_1 + P_2 x_2}{AB} - \frac{P_1(x_1 - BF)}{EF}$$
$$= \frac{P_1 x_1 + P_2 x_2}{np} - \frac{P_1 n (x_1 - mp)}{np}$$
$$= \frac{P_1 (x_1 - nx_1 + mnp) + P_2 x_2}{np} = \frac{M}{p}$$

When $x_1 = BD$ then $x_1 - nx_1 = n\dfrac{mp}{n-1} - n^2\dfrac{mp}{n-1} = -mnp$

and therefore the P_1 term becomes zero.

When $x_1 > BD$, the P_1 term becomes negative and therefore, for a maximum shear in the panel EF of the truss AB, x_1 must be equal to or less than BD.

Therefore the maximum shear in the panel EF of the truss AB is equal to the maximum moment at F in the beam BD divided by the panel length, or $S = \dfrac{M}{P}$.

And hence, to find the maximum shears in a truss having n panels draw the influence lines for shear in each panel and scale the lengths db (or the lengths bd can be easily obtained from the equation $bd = n\dfrac{mp}{n-1}$). Plot the curve of maximum moments for each beam bd and from each of these curves scale the moment at the $\dfrac{1}{n}$th point. These moments divided by the panel length will be the maximum shears in the panels of the truss.

BRANCH NEWS

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Joint Luncheon to R 100 Officers

On Friday noon, August 8th, a joint luncheon with the United Service Institute of Ottawa was held in the banquet room of the Chateau Laurier, which was filled to overflowing. The speakers were Wing-Commander R. B. B. Colmore, O.B.E., Director of Airship Development, and Major G. H. Scott, C.B.E., A.F.C., Assistant Director of Airship Development (Flying). Among the guests at the head table were Colonel the Hon. D. M. Sutherland, new Minister of National Defence, and G. J. Desbarats, C.M.G., M.E.I.C., Deputy Minister of National Defence, through whose good offices the luncheon was made possible.

John McLeish, M.E.I.C., Chairman of the Ottawa Branch of The Institute, introduced Wing-Commander Colmore, who discussed briefly the progress in airship development since the present programme (of 1924) was commenced. This programme was approved by the British Cabinet in August of that year and the construction of the R 100 and the R 101 is in accordance with it. In this programme the work was to be limited only to the experimental stage, leaving the Government of the day free to consider the best method of future development in the light of experience gained.

In other words, the programme was to test out the practicability of airships in the light of post-war knowledge as vehicles of long distance transport. It was not intended with the present ships to inaugurate regular commercial services but rather to consider them in an experimental way so that from them a knowledge can be gained which will be beneficial in the establishment later of regular airship lines.

The R 100 and the R 101 are the largest airships ever built and have practically twice the capacity of anything heretofore. Both airships represent a radical departure from previous airships and are completely novel in many respects. They are not sister ships, the designer of each ship having had, subject to certain requirements, a free hand in the design.

The position today, according to Wing-Commander Colmore, is that these ships have been built and may be considered as fully satisfactory. They are stable in the air and their strength in the air has been proved; they are capable of landing in winds up to 30 miles per hour and it is expected it will be able to have them land in winds up to forty or forty-five miles per hour. They have travelled in winds up to eighty-five miles an hour and the knowledge and data obtained from the trial flights will be of great value in influencing the design for future ships. It is expected that in the next ship built there will be a far greater advance over the present ships than the present ships are over the previous ones.

One thing which the speaker stressed was the vital importance of meteorological data in conducting flights. These data are collected en route, correlated and made use of in determining the actual course of the flight.

The speaker expressed the hope that Canada would join with the Mother Country more closely in the matter of advancement of airship design and hoped that at the Imperial Conference next month the subject would receive favourable consideration. He closed with the thought that it was only a matter of time when airships would become a very practicable proposition for use on long voyages, particularly across large bodies of water.

Major Scott, who was introduced by Lieutenant Colonel C. B. Topp, President of the United Service Institute, outlined the course of the flight from the time that the R-100 left its mooring mast at Cardington, England, until it reached the St. Hubert mast near Montreal. The ship left England early in the morning with as much fuel as possible, and in this connection the speaker stated that on account of temperature conditions and the weight of fuel to be carried for a long flight, the take-off for such ships is always most favourable during the hours of darkness.

With regard to life aboard the airship, the speaker stated that many of the passengers had expected to receive a thrill from the trip, but on the contrary life aboard was very quiet and even boring at times. The ship was steady, there was no vibration, and eating and sleeping arrangements were all that could be desired. The trip in no way could be considered as a stunt but merely an effort to inaugurate a dependable and safe means of travel. There was no noise and—what is more to the point—no seasickness.

Trouble was experienced with a thunderstorm on the other side of Three Rivers. Certain conditions of the atmosphere during storms caused the ship to rise and descend vertically, but not to vibrate or wobble. This naturally caused a severe strain upon the ship; however in its construction, such contingencies are provided for. The experience near Three Rivers did no damage to the structure but caused a slight tear in the fabric of the fin.

Major Scott closed his very interesting discourse by expressing the hope that before long he would have the pleasure of entertaining aboard many of the members of the audience to whom he had spoken.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Vacant

MECHANICAL ENGINEERS. Two young graduate engineers with sales ability wanted by a well-known Canadian company. Apply, giving full particulars, to Box No. 562-V.

DRAUGHTSMEN—Preferably familiar with cruising, flotation and cyanide mill work. Men experienced in concrete, structural steel and plant layouts considered. Only Canadian citizens need apply. Work will be about eight months. Apply by letter. Location, Canada. Apply to Box No. 595-V.

ELECTRICAL ENGINEER, preferably with sales experience, to handle engineering equipment in Montreal and vicinity. Apply to Box No. 596-V.

ESTIMATOR OR QUANTITY SURVEYOR, required for a large building construction company. Must be experienced in this particular work and acquainted with Canadian methods of taking off and extending building quantities in detail. Apply giving age, experience and references to Box No. 597-V.

ESTIMATOR—One experienced in layout and estimating in reinforced concrete work. Location, Montreal. Apply, giving full particulars, to Box No. 599-V.

CHIEF DRAUGHTSMAN, experienced in design of pulverized fuel, pulp and paper mill and mining equipment. Location Ontario. Apply, giving full experience, to Box No. 600-V.

ESTIMATOR. Quantity surveyor and estimator wanted by a construction firm in Montreal. French and English preferred. Apply giving full particulars to Box No. 695-V.

CIVIL ENGINEERS. One or two junior instrumentmen on railway work. Location northern Ontario. Apply to Box No. 607-V.

MECHANICAL DRAUGHTSMEN, experienced in plant layout, required by a construction company with headquarters in Montreal. Apply at once to Box No. 610-V.

Situations Wanted

ELECTRICAL ENGINEER, M.Sc., A.M.E.I.C., graduate, seven years' experience in high tension calculation design and construction, seeks connection. Location immaterial. Age 30. Married. Apply to Box No. 7-W.

CIVIL ENGINEER, A.M.E.I.C., experience: highways, railways, drainage projects, stream diversion, earth, timber and concrete dams, laying large and small pipe, timber structures, concrete walls and pavements. Location, construction or maintenance. Desires position as engineer or superintendent. Location immaterial. Apply to Box No. 34-W.

ELECTRICAL ENGINEER, A.M.E.I.C., college graduate. Five years design and construction power house, substation and industrial plants. Two years operation and maintenance large substation. One year commercial experience. Age 32, single. Present location Montreal. Apply to Box No. 82-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years' experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal engineering, construction work, inspection, estimating. Apply to Box No. 107-W.

COLLEGE GRADUATE, age 34, with over ten years experience in power developments and pulp and paper mill construction and maintenance, largely in direct charge of design or construction; desires new connection as chief or assistant engineer or construction superintendent. Apply to Box No. 167-W.

ENGINEER—Sales executive, A.M.E.I.C., age 37, presently employed as district representative, desires change in wider field. Experience (Canada and abroad), covers structural steel and iron foundry work as chief draughtsman, designer, etc. Available on reasonable notice. Apply to Box No. 227-W.

CIVIL ENGINEER, A.M.E.I.C., Canadian, 21 years experience, railways, highways, water power and conservation, concrete structures, electric transmission lines, etc.; field surveys, office engineering and construction. Working knowledge of French and Spanish. Available about October 1st. Now employed in Mexico. Prefer Canada, but willing to go anywhere. Apply to Box No. 327-W.

MACHINE DESIGNER. Experienced machine designer and draughtsman shortly open for position. A.M.E.I.C. Considerable experience in mining and winding machinery. Well up in steam power house equipment layouts and piping. Own design in successful operation. Accustomed to structural work. References good. Present location Montreal. Interview easily arranged. Apply to Box No. 329-W.

CIVIL ENGINEER, A.M.E.I.C., Reg. Pro. Eng. Ont. and N.B., age 47, married, twenty years experience in this country, twelve years in Scotland as construction and municipal engineer, specializing in roadway, water and sewer works, desires similar position, available forthwith. Just completed sewer and waterworks schemes for town in Maritime Provinces. Have also been engaged as engineer and superintendent with contractors on steam shovel excavation, concrete and caisson works for large buildings in Toronto, etc. Apply to Box No. 336-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., is open for engagement. Twenty-four years general experience both as engineer and as contractor. Has specialized in the construction of wharves, dams, foundations, etc. Apply to Box No. 358-W.

CIVIL ENGINEER, B.Sc., '24, Jr.E.I.C., C.P.E.Q., Canadian, age 30, married. Experience: Construction power developments, railways, highways, pulp and paper mills, maintenance pulp and paper mills, railways, desires permanent position with opportunity for advancement. Apply to Box No. 402-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), graduate. Eighteen years experience in survey and construction, railway, hydro-electric and buildings. Experience comprises both office and outside work. Desires responsible position. Would consider position with commercial or manufacturing firm. Available at once. Apply to Box No. 425-W.

ELECTRICAL ENGINEER, B.A.Sc., age 25 years, single; two five-month summer vacation periods on electrical construction and maintenance; three years and three months with large electrical manufacturing company, including twelve months standard test course, twenty-one months machine design, six months commercial experience. Apply to Box No. 426-W.

CIVIL ENGINEER, S.E.I.C., 1930 graduate of Nova Scotia Tech. with experience as plane table topographer, instrumentman and draughtsman and particularly interested in hydro-electric power development and reinforced concrete design, desires position. Willing to go to foreign fields. Available at a few weeks notice. Apply to Box No. 431-W.

SALES ENGINEER, B.Sc. (McGill, 1914), A.M.E.I.C., 37, married, presently employed in position of responsibility, desires to communicate with a prominent railway equipment supply house, with a view to becoming its Pacific Coast representative. Has a complete knowledge of railway locomotive equipment particularly. Excellent references can be furnished. Apply to Box No. 444-W.

CONSULTING ENGINEER. A member of The Institute with many years experience in general engineering is open for an engagement in consulting, advisory or inspecting capacity Would like to meet corporation or large contracting firm to whom such qualifications may be useful. Apply to Box No. 445-W.

Preliminary Notice

of Applications for Admission and for Transfer

August 23rd, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in October 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BARTLETT—OSWALD WILLOUGHBY, of Montreal, Que., Born at High Wycombe, Bucks., England, Sept. 16th, 1900; Educ., B.Sc., (Eng.), Univ. of London, 1924. Assoc. City and Guilds Engrg. College, London; 1917-18, engrg. ap'tice, Wm. Bartlett & Son, Ltd., High Wycombe, England; 1923-26, asst. engr., in charge of permanent way and overhead constrn., Reading Corporation Tramways, Reading, England; 1926-27, asst. to engrg. sales dept., Northern Electric Co. Ltd., Montreal; 1927 (Mar.-Oct.), asst. elect'l. engr., Lake St. John Power & Paper Co. Ltd., Montreal; Oct. 1927 to date, asst. elect'l. engr., Fraser Brace Engineering Co. Ltd., Montreal, Que.

References: J. B. D'Aeth, T. W. W. Parker, G. C. Clarke, J. C. Day, C. Bang, J. Stadler.

FEETHAM—LUKE BERNARD, of Halifax, N.S., Born at Halifax, N.S., Aug. 5th, 1897; Educ., B.Sc. (C.E.), N.S. Tech. Coll., 1921; 1917, concrete constrn. work, Quaker Oats Bldg., Saskatoon, Sask.; 1918, concrete constrn. work, Simpson Bldg., Halifax; 1919, machine shop, N.S. Steel Co., New Glasgow, N.S.; 1920, with Ballard, Sprague & Co., Quebec, engrs. and contractors, as engr. asst. in respon. charge of layout and part supervision of struct'l. steel and reinforced concrete paper mill in Nfld., street sewers and houses for small town, etc.; 1921-22, with Jackson & Moreland, Boston, Mass., and Pickings & Wilson, Halifax, on valuation work for N.S. Tramways and Power Commn.; 1922-23, with Doane Engrg. Co., Halifax, as res. engr. in charge of installing sewage and water systems for town of Middleton, N.S.; 1923-24, dfting and design of furnaces, W. S. Rockwell Co., New York; 1924, junior valuation engr., New York Edison Co., New York; 1924-25, asst. engr., Ballard, Sprague & Co., of New York, design, sales and supervision of constrn. of boiler settings, etc.; 1927, dfting and detailing struct'l. steel and concrete at main office, and 1928-30, asst. engr., on layout, design and supervision of constrn., Nova Scotia Power Commission, Halifax; at present, asst. engr., Halifax Harbour Commissioners, Halifax, N.S.

References: F. W. W. Doane, F. R. Faulkner, H. S. Johnston, K..E. Whitman, H. W. Mahon.

MATHEWS—HENRY MENDS, of Montreal, Que., Born at Alverstoke, Hamps., England, Feb. 16th, 1903; Educ., Diploma, Faraday House Elect'l. Engineering College, London, Eng., 1925; Assoc. Member, I.E.E.; 1925-26, asst. elect'l. engr., City of Winnipeg Hydro-Electric System; 1926-27, asst. engr., Messrs. Merz & McLellan, consltg. engrs., London, Eng. Preparation of reports, estimates, designs and schemes for the Electricity Commission and the Central Electricity Board, London, England; 1927-30, supervising engr., Messrs. Merz & Partners, Bombay, India (consltg. engrs. to the Govt. of India for railroad electrification). Supervising engr. for the constrn. and putting into operation of the 53,000 h.p. steam power plant at Kalyan, near Bombay, supplying power at 110 kv. for the operation of the electrified portion of main line of the Great Indian Peninsular Railway; at present, Canadian representative for Messrs. Merz & Partners, Montreal.

References: J. M. R. Fairbairn, J. W. Sanger, R. A. Ross, P. S. Gregory, J. C. Kemp.

MOULD—JOHN, of Saskatoon, Sask., Born at LundbreC, Alta., Nov. 26th, 1905; Educ., B.E. (Civil), Univ. of Sask., 1930; 2 years, telephone lineman; 1 season, rodman, Phillips, Stewart & Phillips, Saskatoon; 1 season, instr'man, City of Saskatoon; at present, res. engr., Dept. of Highways, Prince Albert, Sask.

References: C. J. Mackenzie, R. A. Spencer, G. M. Williams, W. E. Lovell, W. E. Denley.

PORTER—WILLIAM THOMPSON, of St. Catharines, Ont., Born at Hagersville, Ont., Aug. 16th, 1876; Educ., Hagersville and Weston High Schools, 1889-1895; Completed Stillwell-Bieree mech'l. engrg. shop course, (2 years), Dayton, Ohio; 1898-1901, switchboard attendant i/c shift at power house of Dominion Power & Trans. Co.; 1901-03, dftsman and student, Stillwell-Bierce Co., Dayton, Ohio; 1903-05, engrg. dftsman., Canada Foundry Co., Toronto, Ont.; 1905-10, mech'l. engr. and squad dftsman., Canadian Westinghouse Company, Hamilton, Ont.; 1910-12, sales engr. for elevator and conveying machinery, Dodge Manufacturing Co., Toronto, Ont., 1912-17, mech'l. dftsman., Welland Ship Canal, St. Catharines, Ont.; 1917-18, engrg. dftsman., Victoria Machy. Depot, Victoria, B.C.; 1918-20, mech'l. engr., Puget Sound Mchy. Depot, Seattle, Wash.; 1920, engrg. dftsman., Dominion Steel Products, Brantford, Ont.; 1920 to date, asst. mech'l. engr., Welland Ship Canal, St. Catharines, Ont.

References: A. J. Grant, E. G. Cameron, F. E. Sterns, F. Gaskill, J. B. McAndrew, M. B. Atkinson, H. U. Hart, W. F. McLaren.

ROBERTSON—JAMES ROBERTSON, of 618 Carleton Ave., Westmount, Que., Born at Montreal, July 12th, 1901; Educ., 1908-19, Westmount High School and St. Albans School, Brockville. 1920-21, evening course, Montreal Technical School, mech'l. drawing. Home study; 1919-21, telephone inspection work, etc., Northern Electric Co., Ltd.; 1921-22, ap'tice course including power house and substation operation, etc., Southern Canada Power Company; 1922 to date, with the Montreal Light, Heat & Power Cons., first at Cedars Power House as floorman, then asst. transformer house operation, chief operator in transformer house, and switchboard operator; transferred to Montreal office and spent one year studying outside underground distribution. Since then has held several responsible office positions, and at present in charge of office and field operations of the Underground Divn. of Electr'l. Distribution Dept., under Mr. R. F. Schmidt.

References: G. K. McDougall, G. S. Davis, H. W. Fairlie, G. E. Templeman, H. B. Pope, A. Walker, F. Thomson.

STENDAL—LARS, of 3459 St. Famille St., Montreal, Que., Born at Kristiansand S., Norway, May 22nd, 1904; Educ., Graduate civil engineer, Technical Institute of Norway, 1927. (This is the principal engrg. school of Norway. It is of university rank, and its diploma qualifies for member of Norwegian Society of Engineers—(4 years course); 1927 (Aug.-Nov.), field engr. in charge of survey, Kristiansand Mechanical Works, Ltd.; Dec. 1927 to May 1928, constrn. engr. in charge of alteration and mtce work with the Refinery Ltd., Kristiansand S.; June 1928 to July 1929, dftsman and transitman with the Shawinigan Engineering Company; July 1929 to Mar. 1930, engrg. dftsman., reinforced concrete designer, etc., with Power Engineering Company, Montreal.

References: C. Luscombe, J. A. McCrory, S. Svenningson, A. L. Patterson, C. R. Lindsey.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

O'CONNOR—GARRETT DAUNT, of Bridgeburg, Ont., Born at Niagara Falls, Ont., June 4th, 1895; Educ., B.Sc., Queen's Univ., 1921. M.S.E., Univ. of Mich., 1929; 1914-19, overseas, Lieut., Can. Engrs.; 1921-22, instr'man., and foreman on constrn. work for Prof. W. L. Malcolm, M.E.I.C.; Nov. 1922 to Feb. 1927, asst. to city manager, Niagara Falls, Ont., on design and layout of bldgs., pavements, sewers, sidewalks, etc.; 1927 (Mar.-July), res. engr., C.N.E.R. constrn. at Niagara Falls, Ont. for Roger Miller & Sons, Toronto; 1927-28, res. engr., on sewerage system as asst. to

M. F. Ker, A.M.E.I.C., Stamford Twp. Engr.; 1928 (Apr.-Sept.), private practice, Niagara Falls, Ont., air harbours, pavements, sewers, subdivisions, etc.; 1929-30, res. engr., for James Proctor & Redfern, Ltd., Toronto, at Capreol, Ont., waterworks and sewerage systems; at present, asst. to town engr., Port Colborne, Ont.

References: A. Macphail, W. P. Wilgar, W. L. Malcolm, M. F. Ker, W. B. Redfern, D. S. Ellis, T. S. Scott.

WEST—ARTHUR ELEMERE, of Walkerville, Ont., Born at Ridgetown, Ont., Oct. 21st, 1886; Educ., Night school, corres. school, and home study; 1908-09, blueprinting and tracing, Whitehead & Kales, Detroit, Mich.; 1909 to date, with the Canadian Bridge Co. Ltd., as follows: 1909-11, struct'l. dfting; 1911-14, checking struct'l. details; 1914-18, squad foreman; 1918-19, asst. mgr. of constrn.; 1919-23, chief dftsman.; 1923 to date, operating manager.

References: W. H. Baltzell, J. C. Keith, C. M. Goodrich, F. H. Kester, H. Thorne, A. J. M. Bowman, S. E. McGorman, O. Rolfson.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

BUDDEN—ARTHUR NAPIER, of Grand Mere, Que., Born at Montreal, April 28th, 1902; Educ., B.Sc. (Mech.), 1923, B.Sc. (Elec.), 1928, McGill Univ.; 1921 (summer), supernumerary engr., S.S. Victorian and S.S. Empress of Britain; 1922 (summer), fitter, mech. mtce, dept., Canadian Vickers Ltd.; 1923-24, testman, Gen. Elec. Co., Schenectady, N.Y.; 1924-25, office engr., International General Electric Co., Schenectady, N.Y.; 1925-27, engr., General Electric Sociedad Anonima, Mexico, D.F.; 1928, asst. supt., Laurentide Power Company, Grand Mere, Que.; 1929 to date, supt., Laurentide Power House, Shawinigan Water & Power Co., Grand Mere, Que.

References: C. M. McKergow, C. V. Christie, E. Wilson, E. B. Wardle, S. Svenningson.

COOIL—THOMAS REGINALD, of North Battleford, Sask., Born at Maple Creek, Sask., Mar. 1st, 1903; Educ., B.Sc. (Civil), Univ. of Sask., 1926; 1925, asst., surveys branch, Sask. Dept. Highways; 1926 (May-Nov.), instr'man and field engr., City of Saskatoon; 1927 (Jan.-May), signal office, Chicago & North Western Rly.; May 1927 to June 1930, engr., sewers and water dist. system, City of Saskatoon. Also special work on street rly. track, river bank protection, constrn. of concrete reservoir, and misc. engrg.; at present, city engr., North Battleford, Sask.

References: C. J. Mackenzie, J. E. Underwood, H. M. Weir, H. B. Brehaut, R. A. Spencer, J. G. Schaeffer.

COYNE—CLARANCE STANLEY, of 54 Boustead Ave., Toronto, Ont. Born at Ingersoll, Ont., Nov. 28th, 1888; Educ., Night classes, Toronto Technical High School, I.C.S.; 1909-16, clerk, rodman, dftsman., transitman, and asst. acct., C.P.R., Ontario Lines, Mtce. Dept.; 1916-17, transitman, and from Mar. 1917, asst. engr., G.T.R.; from Mar. 1928, asst. engr., C.N.R., and at present, asst. divn. engr., C.N.R., London, Ont., in charge of general mtce. work on the above mentioned railways.

References: G. H. Davis, S. G. Smith, E. Nicholson, A. R. Hannaford, H. B. Kippen.

DICK—VICTOR WILLIAM, of 140 Harvard Avenue, Winnipeg, Man., Born at Winnipeg, June 12th, 1897; Educ., B.Sc. (E.E.), Univ. of Man., 1921; 1918 (summer), Greater Winnipeg Water Dist.; 1920 (summer), City Hydro System, Winnipeg; 1921-23, student course, Canadian Westinghouse Co. Ltd.; 1923-26, sales engr., Canadian Westinghouse Co. Ltd., Calgary; 1926-29, dftsman., Manitoba Power Co. Ltd.; 1929 to date, elect'l. designer, Northwestern Power Co. Ltd., Winnipeg, Man.

References: F. H. Martin, E. V. Caton, R. Morham, E. P. Fetherstonhaugh, N. M. Hall, J. P. Fraser.

MAXWELL—EDWARD GERRARD, of Tarentum, Alleg. Co., Pa., U.S.A., Born at Halifax, N.S., April 8th, 1897; Educ., B.Sc. (Arts), Dalhousie Univ., 1922. B.Sc. (Civil), McGill Univ., 1924; 1924-25, cost. acct'g., Bell Telephone Company, Montreal; 1925-26, production tracer, Northern Electric Co. Ltd., Montreal; 1926-27, special studies and later in charge of alterations, production dept., Packard Motor Car Co., Detroit, Mich.; 1927 to date, with Pittsburgh Plate Glass Co., as follows: 1927-28, efficiency dept., Ford City, Pa.; 1928-30, asst. efficiency engr., and at present, plant efficiency engr., Creighton, Pa., in charge of wage incentive system, special studies, improvements in equipment and organization of labour.

References: H. M. MacKay, W. P. Copp, E. G. M. Cape, G. R. Heckle, R. DeL. French.

POOLE—JOHN MAURICE, of 29 Preston Street, Halifax, N.S., Born at Scotch Village, Hants Co., N.S., Dec. 23rd, 1889; Educ., 1908-12 (inc.), 3 yrs., Kings College, and 2 yrs., N.S. Tech. Coll., special subjects in civil engrg. course; 1912-15, rodman and instr'man. on Can. Nor. Ont. Rly., Montreal to Hawkesbury; 1915 (June-Oct.), office, Public Works Dept., Halifax, N.S.; 1915-17, inspection and gen. engrg. work, Halifax Ocean Terminals; 1917-18, i/c survey party, N.S. Tramways & Power Co.; 1918-21, with Pickings & Roland, Halifax, i/c survey party, land subdivisions, etc.; 1922 (Feb.-July), survey for power line, N.S. Power Commission; 1922 (July-Aug.), inspr. on street pavings, City of Halifax; Sept. 1922 to Jan. 1923, i/c party survey for power line, N.S. Power Commn.; Summers 1923, 24, 25 and 26, office man, leveller, etc., topographical surveys, Dept. of the Interior; Winters 1923, 24 and 25, taught a short course in land surveying at N.S. Tech. Coll, Halifax; 1926, land surveying work for Dept. of Lands and Forests of Prov. Govt.; 1927-29, Dept. of Lands and Forests, (Crown Land Office), Halifax, N.S.; Sept. 1929 to date, dfting and outside engrg. work, with the Halifax Harbour Commission.

References: K. L. Dawson, R. R. Murray, F. R. Faulkner, J. L. Allan, A. G. Tapley H. W. L. Doane, H. W. Mahon, C. A. D. Fowler.

ROSS—MALCOLM VAUGHAN, of La Tuque, Que. Born at Quebec, Que., April 6th, 1897; Educ., B.Sc. (E.E.), McGill Univ., 1923; 1919, machine shop work, for A. McKay, boilermaker, Quebec; 1920, power house wheelman, for Laurentide Power Company, at Beaupre, Que.; 1923-27, asst. in elect'l. dept., Brown Corporation pulp mill at La Tuque, power house, steam and hydro, sub-station, industrial and town lighting work, and 1927 to date, in charge of premiums and standards dept. for same company.

References: F. M. Gaudet, A. E. Doucet, C. V. Christie, A. R. Roberts, E. G. Burr, L. W. Bourassa, C. M. McKergow.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

CHAMPION—CECIL HUGH, of Kenogami, Que., Born at Toronto, Ont., Mar. 16th, 1898; Educ., B.Sc., McGill Univ., 1923; 1921, design, Harland Engineering Company; 1920, instr'man., Palais Stn., Foundation Co., Ltd.; 1923, engr., Model City school constrn., Bremner Norris Ltd.; 1923 to date, engr., Price Bros. & Co. Ltd., paper mills, Kenogami, Que., at present in charge of mech'l. dept.

References: G. F. Layne, A. A. MacDiarmid, W. G. Mitchell, N. D. Paine, N. F. McCaghey.

DAVIS—GEORGE ROLAND, of Smiths Falls, Ont., Born at Smiths Falls, Ont., June 12th, 1903; Educ., B.Sc. (E.E.), Queen's Univ., 1927; 1927(May-Dec.), inspecting meter and relay installns. and calibrating; supervisory central and automatic equipment and tests on generators and system equipment; Jan. 1928 to date, asst. to district meter and relay engr., H.E.P.C. of Ontario, at present working on systems east of Kingston, with headquarters at Smiths Falls, Ont.

References: R. L. Dobbin, H. V. Armstrong, J. W. Falkner, G. B. Smith, O. R. Thomson, F. S. Keith.

McMILLAN—RALPH EDWIN, of 459 Marcil Ave., Montreal, Que., Born at Detroit, Mich., Nov. 10th, 1902; Educ., B.Sc. (E.E.), 1926; 1926-28, asst. sales engr., Northern Electric Company, Montreal; 1928 to date, elect'l. designer, Fraser Brace Engrg. Co. Ltd., Montreal, Que.

References: J. B. D'Aeth, G. C. Clarke, L. N. Jenssen, T. W. W. Parker, C. D. Norton.

WRIGHT—HAROLD SINCLAIR, of Georgetown, British Guiana, S.A., Born at St. Peter's, N.S., April 14th, 1905; Educ., B.Sc. (Mech.), N.S. Tech. Coll., 1927; 1923 (summer), dfting etc., Hollingsworth & Whitney; Dec. 1923 to Feb. 1924, engrg. dept., Dominion Coal Company, Glace Bay, N.S.; 1924 (Feb.-Aug.), chem. lab., British Empire Steel Corpn. Ltd.; 1925 (Mar.-Sept.), production dept., Northern Electric Co. Ltd.; 1926 (summer), geol. survey, Ottawa; 1927 (June-Oct.), gen. engrg. work, Montreal Engineering Co. Ltd.; Nov. 1927 to May 1929, asst. supt. of steam power plant, Venezuela Power Co. Ltd., Maracaibo, Venezuela, S.A.; June 1929 to date, chief engr., steam power plant, Demerara Electric Company, Ltd., Georgetown, British Guiana (operated by the Montreal Engineering Co. Ltd.)

References: C. W. Allen, R. W. Tassie, F. R. Faulkner, H. W. McKiel, G. B. Lomer.

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Road Building in Ontario

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Paper read before the Montreal Branch of The Engineering Institute of Canada, March 20th, 1930.

Realizing that the progress of civilization, commerce and wealth is impossible without means of communication, we necessarily find highway construction prominently written in the history of Canada's growth.

During the early days of Canada, transportation was by water, portages being used between waterways; then came trails to inland forts and trading posts; then military roads for the transportation of troops; then the establishment of toll roads, and from then on the progress has been in widening, straightening, and bridging until we have arrived at the period when the combined efforts of the federal and provincial governments are linked with that of the counties, townships and towns, in the ever increasing movement of "Good Roads."

Railways, waterways and highways are the three great contributors to the development of Canada, as that development is applied to our national resources, population and industrial life. Nor should highways be considered the least of these, but rather the very arteries through which the life of the nation flows to the other two.

In the general organization of the roads of Ontario, there are three groups—township roads, or strictly farm roads acting as feeders to main transportation routes,—county roads leading from the agricultural districts to centres of population, and connecting our local towns and villages,—and the provincial highways connecting the larger provincial towns and cities.

The methods of financing the various systems of roads might be described as follows: The township road money is derived by direct taxation of the people in the townships, and forty per cent of the total annual expenditures is refunded by the provincial treasurer. The county road systems derive their money from the municipalities included in the systems and receive a refund of fifty per cent from the provincial treasurer on its annual expenditures. The provincial highways are built by the provincial highway department and twenty per cent of the cost is refunded to the provincial treasury by the counties benefited. (Previous to 1924 the province received forty per cent from the federal government through the Canada Highway Act.)

It is often said that the money that comes from the provincial treasury in the form of aids is contributed by everybody, but this is not the case as the term "everybody" is implied. The provincial revenue is derived mainly from lands and forests, mines, game and fisheries, public institutions, succession duties, automobile licenses, gasoline and amusement taxes, fines, etc.

Federal grants were derived from the consolidated revenue funds of Canada, which is made up largely of customs duties, crown lands, income and business taxes, etc.

Probably the oldest road building organization in Ontario is the Toronto and York Roads Commission dating from 1911. Then the Toronto-Hamilton Highway Commission started in 1914.

The first surveys were made in the county of York in 1791, and Yonge street was surveyed and partly cleared in 1794. In this year $900 only was spent in road improvement in the county of York, whereas upward of $750,000 is spent by the Toronto and York Roads Commission annually.

In 1894 the Ontario Good Roads Association was formed, which organization has brought about all the progressive road legislation since. In 1896 they had the late A. W. Campbell appointed as a road building instructor. In 1901 the Highway Improvement Act was passed. In 1915 the Department of Public Highways was formed. In 1919 federal aid was granted and in 1924 provincial aid was granted to county bridges.

Provincial Mileage (Southern Ontario)

Provincial highways	2,416 miles
County roads	8,095 "
Township roads	41,477 "
Total	51,988 "

Expenditures and Grants 1929

	Province	Counties
Provincial highways	$11,485,499	$ 2,280,973
County roads	4,321,162	4,700,000
		Townships
Township roads	1,802,640	4,500,000
	$17,609,301	$11,480,973

Grand total about $29,000,000.

Motor Vehicle Revenue 1929

Motor vehicle and gasoline tax	$16,346,042

The total highway expenditure for 1930 is estimated at $35,000,000.

Figure No. 1.—Lindsay-Downeyville Road (1928) Mixed Macadam 6 inches Thick, 18 feet Wide.

Economics of Highway Improvement

Railways and canals are necessary for the carrying of passengers and merchandise over long distances, but the primary channels of traffic are the rural roads.

The economics of highway improvement are of course the essential points which constitute the policies of the various provincial and federal highway schemes throughout Canada. It may be suggested that economy in highway transportation reacts to the detriment of rail transportation, that highway improvement increases the traffic of the pleasure vehicles to the detriment of production, or even that taxation resulting by the cost of the improvements, far exceeds the benefits derived. Be that as it may, it has long since been proven that the progress of civilization demands improvements in all things, and that competition is the life of trade.

From a financial point of view, good roads lower the cost of hauling; they widen the range of distribution; they increase the areas that may be devoted to the production of high priced products; they increase the value of lands and properties everywhere; they decrease the cost of operation of vehicles, and they foster to our lands our share of the biggest business in Canada today—the tourist traffic.

From a social point of view, good roads help the growth of rural populations; they develop the rural mail delivery service; they foster educational administrations; they increase school attendance; they better social conditions; they promote mutual understanding and union and allow for better health by minimizing the dust nuisance, and enable the medical and nursing professions to extend their fields of operation.

The highway branch of the Department of Railways and Canals made arrangements with the Dominion Bureau of Statistics in December 1919 to collect from the crop correspondents statistical information as to the cost of haul of crops and other products over the unimproved and the improved roads with the following results:

"The average cost per ton-mile of hauling over unimproved dirt or earth roads was found to be 37 cents, over the improved dirt roads 35 cents, over gravel roads 34 cents, and over macadam roads 25 cents. It will therefore appear that if, for instance, an improved dirt road over which the cost of hauling per ton-mile is thus shown to be 37 cents is to be graded, and given a surface, the gain to the users of every mile of the road so improved will amount for each ton carried, over each mile, to 12 cents or 32½ per cent.

"Most of the hauling of the crops in Canada is done at seasons of the year when the roads are best, hence the cost per ton-mile of hauling over unimproved roads is the lowest possible rate during the year. Still the extent to which the individual farmer is affected by high hauling costs may be seen from a single illustration:

"Supposing a farmer marketed during the season 10,000 bushels of wheat, in a town ten miles from home, his product as marketed, expressed in ton-miles, is 3,000. Consequently if the road now improved which he follows from his gate to the elevator were macadamized, his saving during the season would amount to 3,000 times 12 cents or $360.00."

The prodigious losses annually through poor highway transport facilities to the different agricultural sections of this country, and the possible gains from improvement of roads generally, may be seen from another calculation.

The Dominion Bureau of Statistics reported that the total yield of wheat in Canada for the year 1920 was 263,189,300 bushels, or 7,895,679 tons, and that the total yield of oats for that year amounted to 530,709,700 bushels or 9,022,064 tons. The total yield of these two grains alone in 1920 amounted to 16,917,743 tons. Now the average distance of haul is found by the questionnaire to be 7.6 miles. Assuming that all of this tonnage is marketed in the same form, the total ton-mileage for these grains amounted to 128,574,846. The average difference between hauling over unimproved and the improved roads is 4 cents per ton-mile. Consequently for this total ton-mileage, the possible saving to be effected by improving to the standard of the ordinary earth road, all the roads in the country used by agriculturists was $5,142,933.87 in 1920.

While the above deals only with the saving effected by team hauling it does not take into consideration the important question of upkeep cost as applied to the motor vehicle. The recognized average saving in the operation of every motor car over improved roads as against unimproved roads is 5 cents per mile, this item being made up of three important factors, depreciation of value, gasoline and oil consumption and wear and tear on tires.

Depreciation takes place by the crystallization and fatigue produced on all metal structures by constant shock and vibration and by the definite wearing of all movable parts.

Gasoline and oil consumption of heavy trucks are reduced 50 per cent while for lighter vehicles this waste is reduced 25 and 30 per cent. This fact shows the actual expenditure of energy involved in the continual raising of the vehicle out of pot holes and the diminished efficiency due to jerky motion.

Wear on tires is in direct proportion to their actual contact with the road over a given length of run. Broken contact under engine power means the destruction of the resistance of the rubber, and the bursting of the walls of the fabric or cords.

To this might be added the extra strain put upon the attention and endurance of drivers, and the tendency to accidents, but the results of this analysis will show that there is undoubtedly a waste going on all the time in the system of commerce as it affects human life, which can be reduced in the item of improved highway transportation.

Then considerable discussion is heard on the subject of highway transportation in competition with railway transportation, and as Canada has a vast system of public-owned railways, this question must be solved and the two methods of transportation co-ordinated. It is realized that transportation is the very blood-stream of civilization, yet there is evidence where the railroads have replaced the river and stage traffic, and once famous steam boat and stage routes are now no more. Even in summer resort communities it is found that lake traffic is struggling for its existence against the motor traffic which is found to be more convenient although not always more economical.

Railway transportation has for itself a distinct class of business, that of long distance haulage, which cannot be interfered with by highway transportation, while short distance haulage never was economically handled by the railroads, and perhaps never will be.

This is most apparent in congested railway terminals where delays are unavoidable, and the railway equipment not designed for L. C. L. class of business. The motor class of transportation for less than car load lots to suburban centres and country stores is desirable even at an increased transportation rate.

Suburban farms have flourished as a direct result of improved roads and land that could be bought for $500.00 per acre is sold for $10,000 or $12,000 per acre when subdivided into lots. The increased assessment of the land along the Toronto-Hamilton highway due to the highway improvement is about ten times.

Then again there are millions of men who must have work and the money with which to buy the products of the farm, and to this end the "Good Roads" movement is a God-send. The cost is distributed over the entire nation, giving employment in actual construction, in quarries, cement mills, and factories of all kinds producing road material.

Economics of Hill Cutting

That a definite economic value is derived from hill cutting is apparent in the item of transportation. Traffic census returns show that country roads are travelled by an average of 140 vehicles per day, 120 being motors and 20 horse driven, which will be assumed as correct for a period of 183 days. For the balance of the year, or 182 days, it is safe to assume this at one-half or 70 vehicles per day. It could also be safely assumed that the traffic on highways will increase from year to year at a rate of about 10 per cent.

The average speed of an automobile running on high gear is four times the running speed of low gear, and the wear and tear on the engine and parts is in about the same proportion.

As previously stated, if 4 horses can operate a 6 per cent grade, it takes 9 horses to operate a 15 per cent grade with the same load, so that the actual difference in the cost is 2¼ times.

Taking the average cost of operation of motor cars at 4¾ cents per mile and the depreciation value at about the same rate, or a total of about 9½ cents, there is an actual loss of 4¾ cents for every car that operates a 15 per cent grade on low gear for a quarter mile run. Also if the statistical value is taken of the cost to haul one ton one mile at an average of 31 cents as given by the Department of Highways, Ottawa, a loss occurs of 35 cents every time a horse drawn vehicle operates a 15 per cent grade for a quarter mile run.

Traffic

Motor traffic is created on a road after construction and not before, and the increase or decrease in the same is in direct proportion to the conditions of the driving surface. That is, the value of a traffic census in order to determine the importance of a road is comparatively nil, while the route and service rendered between established market places and beyond them are the essential features that determine the type, the status and the standards.

In the same manner also the proper widths of roadway should be determined, not in the light of what we see to-day, but within the economical life of the type of surface decided upon. Traffic does not even follow distance routes, but rather surface routes as practised by the tourist, and the owners of heavy motor trucks. Then again traffic does not produce a constant flow and may range from 100 vehicles to 1,000 per day at the different seasons or even different days. One day of heavy and particularly fast traffic will destroy the surface of a well graded gravel road if it is subjected to a 25-mile per hour gale at almost any angle across it.

Traffic in Relation to Road Surface

The traffic on highways is largely controlled, if not entirely controlled by the condition of the road surface, so that present day traffic over an unimproved surface becomes merely an indication of what might be expected over an improved surface. Narrow single track roads soon become obsolete, and the scheme of building half at a time is losing favour because of the additional cost when complete.

It is interesting to study the origin of traffic. County traffic might safely be classed in the following manner:—

50 per cent is from farm to town and return.
30 " " is from town to town.
20 " " is through traffic or from other countries.

In the manner of determining a suitable road surface to carry traffic the following table might be used as a guide:

1 to 10	vehicles per day	natural earth.
10 " 50	" " "	graded earth.
50 " 200	" " "	gravel.
200 " 500	" " "	macadams of various types.
500 and up	" " "	permanent pavements of various types.

Again in considering the ratio of traction on these various types of road surfaces, it is found that if natural earth requires 218 pounds pull on the draw bar, then it requires 92 pounds for graded earth, 78 pounds for gravel, 64 pounds for macadam of various types and from 30 to 50 pounds for various types of permanent pavements.

Also in considering grades; if one horse can draw a load on a 1 per cent grade, then it requires two horses to draw the same load on a 2 per cent grade, 3 on a 4 per cent, 4 on a 6 per cent, 6 on a 10 per cent and 9 on a 15 per cent.

Tourist Trade and Traffic

It is a difficult matter to establish the value of the tourist traffic in any particular section of the country, and therefore one must be content with the reflections received from observations, from the traffic census and estimates of the average spending power of the tourists.

From the report of the highways branch of the Department of Railways and Canals, Ottawa, for 1927, valuable information is obtained with regard to the highway, the motor vehicle and the tourist in Canada. For instance, the total amount spent on all roads for 1927 was $45,750,000, and 34,230 persons were employed on the work. This represents the construction of 6,020 miles, and the maintenance of 44,416 miles by the patrol method.

The total registration of all vehicles in Canada was 946,858, showing an increase of 107,933 or 13 per cent over the total for 1926, as compared with a 15 per cent increase in 1926 over 1925. Passenger vehicles numbered 827,518 and commercial trucks 101,421 for 1927. Imported vehicles are included in the figures above, and on such importations

Figure No. 2.—Lindsay-Little Britain Road (1928) Mixed Macadam 6 inches Thick, 18 feet Wide.

Figure No. 3.—Fenelon Falls-Lindsay Road (1929) Asphalt Mixed Macadam 6 inches Thick, 18 feet Wide.

of vehicles and parts the federal government has collected $21,649,778.68 in the same year, while the provincial governments have collected $22,994,424 in motor licenses, registrations, fines and gasoline taxes.

The parks branch of the Department of the Interior has calculated that the tourist traffic in Canada for 1921 represented an expenditure in Canada of $108,000,000 and for 1927 an expenditure of $276,000,000, or more than double in six years.

This figure $276,000,000 is greater than Canada's annual mineral production, greater then Canada's pulp and paper production, and next to Canada's greatest industry, export wheat.

Canada admitted 3,153,800 automobiles for touring purposes in 1927 and 4,508,808 automobiles in 1929 and sent out for touring purposes only 620,572.

The 1,076,819 automobiles registered in Canada in 1928 covered about 4,000,000,000 miles, and carried about 600,000,000 passengers. This showing represents twenty times that of the combined totals for the steam and electric railroads for the same period.

From the 145 ports of entry where "American" cars are recorded, in 1929,

1,206	cars entered for a 6-months visit.
1,091,014	" " " " 60-day visit.
3,416,588	" " " " 24-hour visit.
4,508,808	"

The first item shows a decrease of 65 per cent, the second an increase of 44 per cent and the latter an increase of 42 per cent over the 1927 figures.

The estimated value or outlay of the foreign motor tourists in Canada during 1929 is $397,806,760 figured on the basis of four persons to each vehicle, and a spending power of $5.00 per day for each person, considering that the 24-hour tourist stayed the full time, the six-months tourist stayed half time and the sixty-day tourist stayed one-quarter time. On the same method of calculation the Canadian tourist spent $90,000,000 in the United States.

Transportation

In adding to what has already been said on this subject under the heading of "Economics of Highway Improvement," it is interesting to note that about one-half the cost of the food supply is taken up in the item of transportation in which the motor truck plays a very large part, but the fact that 95 per cent of this road destruction is caused by 5 per cent of the traffic, and also that the value of the road construction to carry the 5 per cent is about double the value required to carry the other 95 per cent, is not considered in the problem of food supply.

Straight and wide roads, easy grades, and hard surfaces are therefore essential to the economic life of any country or district.

Of the three most rapid means of transportation, the aeroplane and airship take first place, the railway train second, and the motor car third. In comfort it depends entirely upon the length of the trip and the state of the road bed, but the ultimate order will probably be time first, comfort second and cost last, but for cost, the motor car is the most expensive for long distance travelling, the train second and the aeroplane the cheapest.

Commercial aviation dates from the Armistice in 1918 and is making wonderful strides, and while war flying was conducted regardless of cost and dangers, it is now settling down in the commercial channels of speed, economy, ease and safety.

Design

The increased volume of motor car traffic has gradually changed the design of our more important marketing roads, and methods that were of standard practice in the past have given away to more modern ideas.

A few years ago nearly all pavements were built to a crown of one-quarter inch to the foot of width, whereas they are now never over one-eighth and sometimes as light as one inch in twenty feet. Gravel roads were once given an inch to the foot whereas now they are seldom over one-quarter that amount.

Curves at corners seldom had more than a twenty-five foot radius whereas now they have seldom less than two hundred feet, and on provincial highways the radius is from three hundred feet up.

Alignment is becoming straighter. Crooked roads that were safe enough a few years ago are dangerous to-day, and the idea of deviation to avoid hills is giving away to extensive hill cutting in order to keep the roads straight.

Grades too are becoming more flat and regular, and the once familiar undulations of the road which conformed to the natural waves of the land are taken out by the cut and fill method. Nothing is more dangerous to a driver than an unexpected and sudden volume of bright light over the crest of a hillock at night.

Super-elevation and widening of curves are now practised for safety. At first the road was simply tilted by taking out the crown and affording drainage, whereas now a super-elevation of two feet and over is given on all curves of two hundred feet radius. Widening on curves is also practised, and stones painted white, or cable guard-rails are placed on the outer edge to mark the curves at night.

Guard railing along fills, deep ditches and at bridges are more common. Wire cable has taken the place of wood, and stones painted white are used to mark the shoulder where possible danger might exist.

Shoulders that at one time formed the bank of the ditch by a regular contour to the crown of the road, now have a distinct angle at the shoulder line, and cars are kept in an upright position when driving on them. The width of grade shoulder to shoulder has remained about the same for the past five years, but the width of pavements in the country has been increased.

Railway crossings are now before the public eye as the most important factor in the interest of public safety. The elimination of the grade crossings entirely is desirable but the improvement of the approaches and sight lines are constantly going on where improvement can be made. By-pass roads around towns and villages are now being talked of.

In types, the roads conform to the local conditions regarding materials, and the extent of the finances to build them. Traffic, of course, plays a big part, but it is found that the maintenance cost of gravel roads that carry from three to five hundred vehicles a day, are proportionately too high. Grading to uniform elevations and alignments, and metalling with local materials until a foundation is procured, and its value realized by use, is the popular method for the present at least.

Generally speaking, it is found that the various road organizations are keeping well up with the increased motor traffic from year to year. The average daily traffic has increased about one hundred per cent during the last five years, but the mileage of constructed roads has increased about four hundred per cent in the same length of time.

Construction

The construction of roads should be by stages. First, the grading to the proper and ultimate grade and final alignment which also establishes the drainage system. Second, a reasonable coat of gravel, followed by efficient dragging, patching and general maintenance. Then when the surface will no longer handle the traffic without resurfacing, it should be paved.

Pavements are undoubtedly the most economical, even on roads carrying as few as 500 vehicles per day. To maintain such a gravel road so that the driving surface is fit for the legal speed limit with comfort, it costs fully $750 per mile per year or $7,500 for ten years. To this must be added a cost of resurfacing twice in the ten years, say $6,000. At the end of ten years the cost has been $13,500 and the asset is a road worth about $1,500 and besides the public have had a dusty road in dry weather, and a sloppy road in wet weather, both uneconomical conditions. Now suppose the same mile is paved at a cost of $25,000 and spread the payments over ten years. The asset at the end of ten years is a road worth $20,000 and besides the public have had clean, pleasant and economical driving all the time.

In the first case $9,500 is lost by maintaining a gravel road (allowing $2,000 for grading common to both cases), and in the second $5,000 is lost by maintaining a pavement. A difference of $4,500 saved and maintaining the superior riding qualities of the road besides for ten years, to the credit of the pavement, not to forget the increased life of motor vehicles.

Severe climatic conditions is the most serious question Canadians have to contend with in the construction of permanent roads. Drainage of course must be adequate, but the best safeguard of all is a cushion of clean, fresh gravel or crushed stone under a new pavement. This cushion need only be a matter of two or three inches or just enough to take up the expansion of the frost. If the cushion is properly provided for no longitudinal side drains are required. Blind drains made of field stone or four-inch quarry stones from the edge of the pavement to the ditch are helpful in conducting the water that may flow along the edge of the pavement to the ditch, and in every case where small washouts occur in the shoulder, they should be filled with clean stones rather than dirt.

In the matter of general drainage it is not necessary to find outlets that may or may not mean the formation of the drainage district, but rather a matter of building the road up so that the crown will be at least eighteen inches above the high water in the ditches, and in no case should a road be paved that does not have this provision.

Farm drains crossing the road is another matter that should be carefully inspected, and if inadequate, or old, they should be relaid in concrete, and man-holes or catch-basins built at each fence line having the pipe line between laid in a straight line, and to a uniform grade. They can then be inspected by light reflection, and the annoyance of opening up the road and pavement at some future time avoided.

Figure No. 4.—"Standardite" on Concrete Base.

In general, highway construction along primary roads is rapidly becoming a matter of engineering, with definite plans and profiles, and more and more along the lines of railway building. Humps and hollows are being removed to allow the motorist to drive with ease and speed, without undue strain, or fear as to what the conditions ahead may be.

The Motor Car

In order that the road building programme may be continued in proper tune with what is going on, and what evidently must be expected as a result, first of all the automobile industry must be considered, for after all that industry is the one, if not the only one, that has thrown the road building game ahead by leaps and bounds.

Within the past twenty-five years, the motor car has revolutionized roads, and in itself has grown from an eccentric luxury to a vehicle of necessity in every day life. The motor industry has grown until it has become an economic factor in the commercial life of the country, and so too the roads must keep pace with the requirements of the motor industry in order that that industry shall flourish.

Then again, to the credit of this industry must be added the development of oil, cement and other industries which derive a large percentage of their trade from the automobile, and which when all taken together make up the prosperity of the country. Even with regard to railways the automotive freight is one of the most important, if not second in importance, to the grain shipments of Canada.

All this has been written to point out the tremendous strides in rapid transportation, in order that one may learn the lesson that an organization for road building must keep abreast of the times and realize that the future means of transportation will be more rapid than ever, that the motor car will be more powerful, and roads must be built more closely along the lines of railroad construction and of a better and more lasting type than ever before.

Traffic follows the best roads from one point to another, regardless of distance, and there are examples of the division of traffic from old established routes to better constructed roads, even miles away. Therefore there are primary and secondary roads in every part of the country, and every organization should recognize this fact and lay down the policy of road building to meet these requirements. Continuity of service is therefore essential as no man can render his best service to a community or cause by one year of service, and no organization can be expected to function with any degree of efficiency if it is broken up and changed from time to time.

There is both a need and a necessity for strong road organizations throughout the length and breadth of Canada and more particularly just now when the country needs the best that is in the individual to see that expenditures are classed as investments and not as foolhardy speculations.

The Construction, Operation and Maintenance of Unit Cars

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Paper read before the Moncton Branch of The Engineering Institute of Canada, December 12th, 1929.

A unit car might be defined as any self-propelled rail car which can operate in regular revenue train service either alone or coupled to one or more trailer cars. In some cases the car circuits are so designed that two or more unit cars may be operated coupled together, and controlled from one car, usually the leading one.

Outline of Causes for the Development of this Equipment

There is an old law which states that every effect must have a cause, and this applies to the particular case under discussion. Among the causes for development of unit cars we will mention:

(1) Losses in operation of most branch lines with steam train operation.

(2) Increased cost of ton mile operation due to:
- (*a*) Increasing wages of train crews.
- (*b*) Increasing cost of repairs.
- (*c*) Increasing cost of new rolling stock.
- (*d*) Increasing cost of fuel and water.
- (*e*) Improved service demanded by the public, both in type of equipment and frequency of service.
- (*f*) Increasing taxation.

Revenue has failed to keep pace with the increasing costs, due to:

(*a*) Failure of freight, passenger and express revenue to increase in proportion to the increase in operation costs. (Average freight rates in this country are stated to be less than in the United States where conditions are such that costs are usually less than in Canada.)

(*b*) Decrease in passenger revenue due to increasing competition from busses and private autos: the bus competition often being quite unfair as the bus does not usually pay a tax, or license, which represents the actual wear and tear on the road, and, in a case of unprofitable service the bus company can abandon the service while the railway cannot do so without permission of the Board of Railway Commissioners.

(*c*) Canal, and other water-borne traffic for freight, and to a lesser extent for passengers. This is also an unfair competition as canal charges are not paid, therefore, the canal traffic travels on a roadbed, if one might call it so, that they do not have to keep in condition.

Due to the above, and other causes, it becomes increasingly difficult to make earnings balance expenses.

A continuous effort is made to improve the efficiency of the motive power in use or being built. This has produced numerous changes in locomotives, both in size and in gadgets, as they are sometimes called. Labour-saving, and fuel-saving equipment, have been added to all modern locomotives, and boiler pressures have increased considerably, as a result of the development of special alloy steels; however, it would seem that the limit in size has almost been reached, and, when we consider the efficiency of the average steam locomotive, we can readily see that this type of equipment must either be improved enormously or it will eventually be superseded by something better. It is considered that the overall efficiency of the modern steam locomotive is in the vicinity of 5 per cent and its availability for service is just over 40 per cent.

Steam turbine locomotives are being experimented with in Europe.

For main line service the problem was solved, at least in districts of heavy traffic, by the adoption of electric locomotives and the multiple-unit car. This results in a much heavier train being hauled by a locomotive that is quite simple, of high efficiency, and capable of increased efficiency due to regenerative braking.

For the branch line and local main line service, various types of equipment have been tried with varying amounts of success.

(1) *Gas-Mechanical.*

This is a type of car using an engine similar to an automobile engine, in fact, in some cases it was an auto engine with a gear drive to one or more axles. Not many cars of this type are now being sold in the smaller sizes, but the J. G. Brill Co. of Philadelphia are still making a four-cylinder and a six-cylinder engined car of this type, using a four-speed gear shift with a drive to both axles on the forward truck. This type of car has been quite a success where used in a service that is suitable. A four-cylinder car of this type is in service between Stellarton and Sunny Brae and a six-cylinder one on the line between Mont Joli and Matane. These cars require little attention and are quite economical, giving an average of about eight miles per gallon of gasoline.

(2) *Gas-Electric.*

As the gas-mechanical car, in the hands of inexperienced or careless drivers, can produce an objectionable jolting during gear shifting, and, as the acceleration could be quite uneven, the electric drive was considered, and we find that, as far back as 1907 this drive was being used. It differed from the straight gas-mechanical drive in that it had the mechanical connection between the engine and the driving wheels replaced by an electrical drive made up by coupling a direct current generator to the engine; the current from this generator was supplied to series motors mounted on the axles and geared to them through a gear and pinion; the current being carried through the necessary control equipment, so that the proper connections might be made, and proper supervision exercised over the operation of the power equipment. This method of connection of the power to the driving axles resulted in a smooth jar-free acceleration, as there was no mechanical gear-changing to do, the variations in speed being obtained by varying the voltage on the motors, either by varying the engine speed or by varying the generator field excitation, or both. On some types of cars a regrouping of motor connections to provide various series and parallel arrangements is also used. It might be noted here that the speed of a series motor is directly proportional to the voltage impressed on it. For this reason, and also for its high starting torque, it is admirably adapted to traction service.

This addition of the electric drive made the car much more expensive and also caused an increase in maintenance, as motors, generators, exciters, compressors and a number of other control devices, as well as much wiring, had to be maintained; however, the drive proved much more satisfactory than the gear type, although it did not become very popular until after 1918, as the manufacture was discontinued during the war. Shortly after, however, a few enterprising young men who saw the possibilities of this type of car developed a much more reliable engine, and a

Figure No. 1.—Gas-Electric Car, Canadian National Railways.

very simple type of electrical control, and have now been marketing a very satisfactory car for some years. Other manufacturers have followed with somewhat similar equipment, some being very elaborate internally, with all sorts of gadgets to add to the first cost and to the worry of the maintainer and others, but which add little to the efficiency and reliability, while one company eliminate everything they possibly can and provide a wonderfully reliable car with little excess material to keep up.

Complete figures have not yet been received for 1928 but, in 1927,

150 gas-electric cars were purchased for use in the United States.
8 gas-electric cars were purchased for use in Cuba.
2 gas-electric cars were purchased for use in Canada.

and in 1929,

117 gas-electric cars were purchased for use in the United States.
1 gas-electric car was purchased for use in Canada.
9 gas-electric cars were purchased for export.

At that time the B. & O. had 17 in service and other roads nearly as many. Recently the General Electric Co. announced a total of 383 gas-electric cars equipped by it were in service, and, of this number, the Burlington leads with 46 and the Chicago and Northwestern follow with 37.

Cars of this type are turned out with double power plants rated at 550 horse power, and it is understood they can now be obtained with 800 horse power rating if desired.

(3) *Storage Battery Cars.*

While the gas-electric car was in its infancy, the electric storage battery car was developed, and it has been quite a success in its limited field. It was a somewhat radical departure, as it carried no engine of any sort and depended for its propulsion on the energy stored in a large battery. This battery is charged before the start of the run and the car is then operated by using current from the battery to turn the traction motors. The first available record of this type of car dates back to 1911, and it appears that the type originated about that time. There is in service in this region a car of this type which entered railway service in 1913 and has probably operated over half a million miles and is good for a few more miles.

The standard car of this type has a battery of 250 cells of Edison nickel-alkaline battery of 450 ampere-hour rating, which on good roadbed should provide about 80 miles operation on one charge of the battery.

The cleanliness and quietness of this car make it attractive, but it has some disadvantages. Its charging supply has to be direct current, and, to obtain this, some type of converter is usually necessary, as there are few places where direct current can be purchased. This conversion entails some loss, and, usually power rates are rather excessive, making the cost of operation high. The speed is limited and the mileage is also limited, and, as the car usually operates over a run where her battery capacity is nearly all needed to make the trip in fair weather, there is little reserve of power for bad weather.

Until the cars had been in service some time, their capabilities were not well known, and some of them were badly abused by excessive mileage and continuous service which kept the battery temperature so high that the plates rapidly deteriorated and the expected six or seven years' life did not materialize. The cost of a replacement battery is quite high, as is the cost of new battery solution.

As the batteries operate at a fairly high temperature, a large quantity of water is driven off from the cells, and this has to be replaced with distilled water, and, when it is known that as much as 90 gallons of distilled water may be used in one battery in one week, it can readily be seen that, if the water is not 100 per cent pure, the impurities will gradually increase in the cells, thus causing loss of efficiency and other battery ills. For this reason every effort is made to keep the distilled water pure.

(4) *Distillate Electric Cars.*

The cost of fuel for various gas cars has always been a deterrent to their use in Canada especially, and also to a less extent in the United States, and we find one western road experimenting with a distillate engine. They use a modified gas engine and fit it with a carburetor for each cylinder, and they find that their fuel costs are much less, but it is also understood that what they have been saving in fuel costs has, so far, been nearly balanced by the increased cost of maintenance, as the engines have more valve trouble, require more frequent decarbonizing and require very accurate setting of the carburetors.

(5) *Oil-Electrics.*

Canadian National engineers realized the limitations and disadvantages of these various cars, especially for long runs and for heavy service, and decided that something more economical and satisfactory should be available and so a search was instituted.

It was known that a Swedish firm had been producing an oil-electric equipment since 1913, and had had good success with it. Three leading electrical and mechanical officials of the Canadian National Railways went to Sweden and examined this car, and found it quite satisfactory for the type of service it was used in, but not at all suitable for conditions here.

They found that a very heavy slow speed engine was used and they decided that the engine was too massive to be useful here. They were operating their cars with several trailers, but their trailers were rigid axle types with only four wheels, and very light bodies. A search was then made for a Diesel type engine that would be satisfactory, and, when it looked as though they were not going to be success-

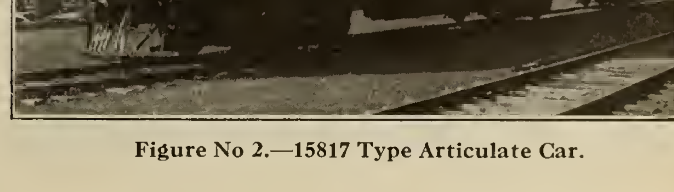

Figure No 2.—15817 Type Articulate Car.

Figure No. 3.—"9000" Type Oil-Electric Car.

ful, they heard that the Wm. Beardmore Co. of Glasgow and London were developing an engine for lighter than air craft. On looking into this development they found an engine that, with slight modifications, appeared to offer a solution of their difficulties. Beardmores, who had been making Diesels for submarines for the British Government, had had excellent experience with the Diesel, and the result was that they made a very satisfactory job of remodelling their aero engine. The resulting engine was somewhat heavier per horse power developed, but much more rugged and reliable for service. As a result, in 1925, the Canadian National manufactured 7 four-cylinder cars and 2 eight-cylinder ones, the four-cylinder ones being 60 feet long and the 8-cylinder ones being articulated cars of 120 feet length. The Beardmore engine is a 4-cycle engine cold starting, with solid injection, and with ignition of the fuel obtained by the temperature of compression (1,200 degrees F.) Each cylinder head is fitted with 2 inlet and 2 exhaust valves as well as a fuel atomizer, which sprays the fuel in to the cylinder in a fine mist.

In the four-cylinder type, which is the only type in service in this region at present, the engine is direct-connected to a 105 kw. direct current generator and an exciter. The main generator leads are carried to a controller in each end of the car where the various connections to the motors are made. The motors are two of about 100 h.p. each mounted on the forward truck.

The engine room contains the necessary fuel, water and lubricating tanks, and switch gear. The driver's cab, in the right hand forward corner of the engine room, contains the air gauges, voltmeter, a pilot light connected to the lubricating and cooling circuits (this light only lights when the water or oil pressure drops); headlight and number light and marker and cab light switches, valve for air-operated bell ringer and one for horn; master controller, engine throttle and engineer's valve for operation of the air brakes. The air for brakes, bell and horn is provided by a motor-driven air compressor operated from the main generator current. The operator's cab in the rear end is similarly fitted.

In this car the motors are connected in series for starting, thus giving maximum starting effort, the engine is gradually speeded up by the throttle, then, when the speed has reached about 15 m.p.h., the throttle is closed and the controller moved to the second notch connecting the motors in parallel, the speed is again increased by the throttle; for still higher speeds the throttle is again closed and the controller moved to the third notch, called the field shunting position. In this position, the motors are still in parallel, with the fields shunted with a resistance. This weakens the field and the weaker the field, the higher the speed. With the controller in this position, the throttle can be opened again and the car's speed increased to its maximum, which is about 65 m.p.h. on level tangent track with normal adjustment of the electrical circuits and with new wheels. A slightly higher speed can be obtained by certain adjustments but it is not considered advisable to make them for a car in ordinary service.

The eight-cylinder car has a slightly different type of control, and has four motors, but the engine is similar except that it is a straight eight.

It might be interesting to note that the R 101 is powered with Beardmore 8-cylinder engines, using superchargers, which increase the output considerably.

Many outstanding records were made by the first lot of cars, which is all the more wonderful when it is considered that this particular equipment was new and untried. The first and most spectacular record was the non-stop run of unit car 15820 from Montreal to Vancouver, 2,937 miles in 67 hours non-stop, a transcontinental record made in November 1925 and still unbroken.

Another record that is really more important but not so spectacular, is that of 15822 on this region. This car made a record of over twenty-one months of 100 per cent service, i.e., was not out of service one day in that time, and hopes were entertained of making it a two-year record, but the Maritime Express put an end to those hopes by side-swiping the car.

These first cars were scattered from the prairies of western Canada to the wilds of Prince Edward Island and spare parts were mostly carried at Toronto, but, in spite of this and also of the fact that nobody knew a lot about the equipment and the troubles that might be expected, the record made and savings shown were so great that a new order of five 73-foot 9-inch cars powered with a six-cylinder engine of the same type was placed in 1927 and, early this year, an additional seven six-cylinder cars were ordered and will soon be delivered, while a shunting engine is also being built.

The biggest development, of course, is the 9000 class locomotive, which, of course, is not a unit car, but which must be touched on as it is a development of the oil-electric car. This locomotive is a two-unit engine, 4-8-2 and 2-8-4 type, each unit containing a V-shape 12-cylinder engine of 12-inch bore and 16-inch stroke, each engine developing 1,330 h.p. at normal rating, but designed for the use of a supercharger should it be considered necessary. The locomotive has a maximum tractive force of 100,000 pounds, while the 6000 steam locomotive is rated at 49,600 pounds. Many new and radical ideas are embodied in this engine, among which might be mentioned an exhaust muffler, which is also a boiler for generating steam for train heating. The exhaust gases pass through this boiler and give up their heat and at the same time they lose their velocity and this results in a very quiet operating engine.

To come back to cars again, some of these cars operate over 300 miles a day, and some have now operated a total mileage of over 200,000, and the total mileage of 4, 6 and 8-cylinder cars is now over 2,250,000.

The average miles per gallon of fuel oil is between five and six for the 4-cylinder cars, although some cars have a frequent consumption of over 7, and, when it is considered that the type of fuel used costs less than half the cost of gas one can well see that the fuel charges are the small part of the cost of the service; in fact, the average cost per mile of operation is roughly 28 cents of which 19 cents is for the crew's wages. The cost of operation of a gas-electric in similar service would be 38 to 40 cents and a storage battery car 40 to 42 cents, and of a steam train about $1.35. (NOTE:—These figures are approximate and are given for comparison.)

The average availability for service is considerably over 80 per cent while that of a steam engine is generally given as about 40 per cent.

The oil-electric car is admirably adapted to branch line and main line local service, while the 9000 locomotive is suited for either freight or passenger service on main line.

Figure No. 4.—Installation of 50,000-pound Engine in the New Oil-Electric Locomotive.

Figure No. 5.—Car 15830, 6-Cylinder Engine.

The oil engine has many points of superiority over the gas engine, not only for traction, but stationary and semi-portable power plants, ship propulsion, etc. In marine service the Diesel is rapidly displacing the steam engine and turbine, so much so that about 65 per cent of the tonnage under construction at the present time is designed for Diesel engine operation. Is it reasonable to expect that the oil engine will gradually retire the steam engine from railway service?

In passing it might be mentioned that some other unit car developments have also been tried: namely, the steam car. At one time a high pressure steam car was tried out in this region, and at the present time the International Harvester Co. are manufacturing a unit car using a high pressure boiler to generate steam, which operates an 8-cylinder uniflow engine mounted under the car frame. It appears complicated and it does not appear to have a very bright future.

An English company, the Sentinel-Cammell, manufacture a unit car using a small upright self-feeding boiler, which supplies steam to a small vertical two-cylinder engine, which drives through a silent chain to the two axles of the forward truck. Cars made by this firm have been marketed throughout the Empire and are giving satisfactory service, but are not designed to suit Canadian conditions.

In case the impression is conveyed that the Canadian National Railway has developed the only oil-electric, it should be mentioned here that the Ingersoll-Rand, in conjunction with the General Electric and the American Locomotive, developed an oil-electric locomotive about the time Canadian National first cars were being designed. Their first locomotives were 300 h.p. shunters. They then developed a 600 h.p. main line and freight transfer locomotive and they have now made additional types in 750 and 880 h.p., but none of them compare with the Canadian National No. 9000 in size.

The Putnam division of the New York Central has in service a locomotive with a V-12 MacIntosh and Seymour engine with cylinders 14 inches by 18 inches. This engine is rated at 900 h.p. and the locomotive is used in fast passenger service.

The New York Central uses a locomotive that is a very wonderful combination of all types of electrical equipment. It is called a storage battery oil-electric locomotive, and is used in terminal service. It has an Ingersoll-Rand engine with the usual generator and motors; in addition to this it has a large capacity storage battery, an overhead collector shoe and a third rail shoe. This locomotive is designed in this manner so it may be operated from the overhead trolley wire in sections electrified with that type of line, and the third rail shoe is used for collecting its propulsion current in sections using an electrified third rail; the oil engine is used in non-electrified sections to provide the necessary power for operating, while the battery is used to assist the engine on peak loads and it is the sole means of propulsion while shunting in many of the enclosed sheds around the New York terminals. The New York Central must be well satisfied with this engine as they have placed one of the largest single equipment orders for 35 more of similar design. The original locomotive was fitted with metering equipment which showed the total amount of power used from each source. Incidentally it might be mentioned in passing that this locomotive will probably be a nightmare for the maintenace staff as it will have very complicated wiring.

Fuel

As the fuel pumps on all oil engines using mechanical injection are very finely adjusted mechanisms, a very clean grade of fuel with little variation in viscosity is necessary, and it must be free from water.

A business man recently criticized the Canadian National Railway for using oil engines in a coal mining country, and being dependent on a foreign country for fuel supply. However, the author is glad to hear that his fears will soon be groundless, as the Bergius process of low temperature reduction of coal to produce fuel oil etc. is in a fair way to be successful, and Canada may in time produce most of her fuel in this way. It is understood about 35 gallons of fuel oil are produced from one ton of coal and there are other more valuable by-products including 30 gallons of gasoline.

Maintenance

A maintainance man is assigned to each car, and he has to be that combination, not easily found, of a first class electrician and a good fitter. The regular maintenance is governed by a set of rules which outline the daily, weekly, and monthly work, and the work is usually so organized that each day brings about the same amount of work, accidents excepted.

When heavy repairs, which cannot be done at the car's terminal are necessary, the car is taken to the nearest roundhouse or shops, and when it is realized that every day out of service means a loss of probably $50.00 to the road, it is evident that the work should be rushed.

Remarkably few large troubles have developed and this is the more astonishing when it is considered that any new development usually has to have numerous changes before it is really satisfactory.

In conclusion the author would say that this is the day of the oil engine and it will make rapid strides in the future, and it may not be long till the oil engine for autos will be common.

It might be added that an effort has been made to sketch the development of the unit car and its descendant the oil-electric locomotive, without the necessity of quoting many figures, as a multiplicity of figures tends towards confusion.

The order of seven Westinghouse-Beardmore 6-cylinder, 350-h.p. cars have been delivered to the Canadian National Railways and also one switching engine powered with a similar engine and some additional cars of a similar type are under construction.

The Westinghouse Company have recently turned out in the United States a new car of 800 h.p. fitted with two 6-cylinder power plants and are now demonstrating it on the Erie railway.

During the early summer the Canadian Pacific Railway purchased two gas-electric cars of 400 h.p. which are stated to give an economy of one mile per gallon of gasoline. No definite operating statistics on these two cars are yet available.

Coal Mining — Past, Present and Future

T. L. McCall,
Chief Mining Engineer, British Empire Steel Corporation, Limited.

Paper read before the Cape Breton Branch of The Engineering Institute of Canada, March 11th, 1930.

One of the earliest references to coal is that of Theophrastus, a Greek writer who lived about two hundred years before the Christian era. He published a work entitled "The Book on Stones," in which he discusses an earthy material that would burn and which was used by smiths.

The early inhabitants of Britain appear to have had knowledge of the value of coal, for in Monmouthshire a flint axe stuck in a vein of coal was discovered on the crop of a seam. Again, axes and picks of solid oak have been found in old excavations near Stanley, in Derbyshire, and at Ashby-de-la-Zouch stone hammer heads and wedges of flint have been found in ancient coal workings.

The object of all these workings was to obtain fuel for warmth and in the old Roman camps in parts of England heaps of cinders have been found. One of the first records of coal mining in England dates back to 853 A.D. and is to be found in a deed in which the Abbey of Peterborough made a grant of lands.

By the year 1281 it is reported that Newcastle had a considerable trade in coal, although its use met with opposition as witness when in 1306 the citizens of London petitioned King Edward I to prohibit the use of coal in London.

During the Elizabethan period the ruling powers began to be alarmed at the rate at which the forests of oak were being devastated for use in the iron industry and the best brains in the country set to work to devise ways and means of using coal for smelting. Lord Dudley spent a lifetime experimenting on this, but it was not until some seventy-five years later that his dreams were realized, when Abraham Darby in 1735 first successfully used coke for the smelting of iron at Colebrook Dale Iron Works in Shropshire.

So far coal had been obtained from shallow workings usually driven in the side of a hill where free drainage could be obtained but with the exhaustion of coal accessible through level tunnels, recourse was had to shallow shafts up which women carried the coal in baskets strapped to their heads and backs.

Shafts with adit drainage were next used and horse-gins were introduced and the coal, still loaded into baskets at the face, was trammed out to the pit bottom on flat cars with iron rim wheels running in stone tracks.

With the deepening of shafts, the water problem became more and more pressing and, in 1698, Savery developed his steam engine for pumping water. This pump acted on much the same principle as the present day pulsometer, with the exception that, steam pressure being absent, the pump acted as a suction pump only. Thus its application was very limited.

In 1711 Newcomen devised his improved atmospheric engine driving spear rods which lifted the water out of the mine. The valves on this engine were operated by hand for each stroke of the engine, but in 1713 a youth named Humphrey Potter, being apparently lazy by nature, devised

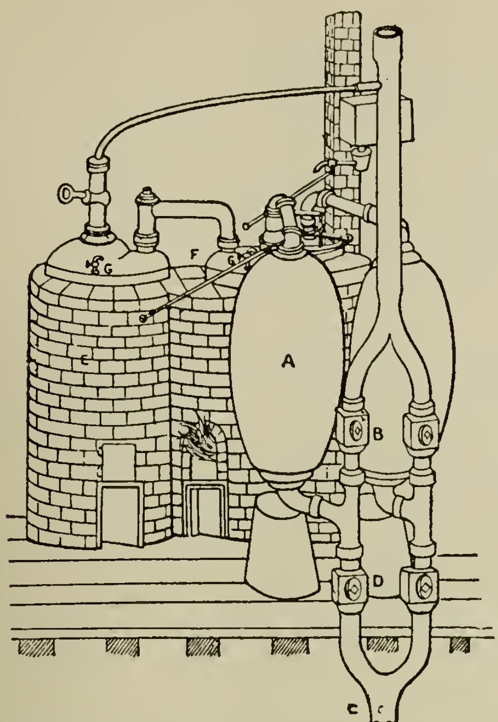

Figure No. 1.—Savery's Pumping Engine, 1698.

a rig of cams and ropes which did the work for him. This engine in its improved form continued in common use and held the field until about 1800.

Thus with the introduction of power derived from fuel, coal came into industrial use and the first real impetus was given to its production, which increased so marvellously during the nineteenth century.

With the power now available, science began to devise ways and means of lightening the manual labours of the miner and in 1761 Michael Menzies proposed to replace the miner by a machine swinging a heavy pick actuated by power transmitted from the surface through spear rods and chains. Thus was conceived the first mechanical coal cutter, but it was not until the use of compressed air became available that this branch of the industry made any progress.

Mines were now getting deeper and more extensive through the conquering of the water problem, but the miner was again faced with a fresh difficulty—that of preventing explosions of gas. For some time now the mines had been ventilated by furnaces placed at the shaft bottom, but gas would continue to accumulate and explode. At first these small accumulations of gas were cleared out of the places by the simple expedient of setting fire to them. The "fireman," as he was then known, would enter the mine before the miners and, clad in padded heavy clothes and armed with a long pole with a torch tied to its end, would go about the mine and at any place where the presence of gas was suspected, would lie down and in that position poke the torch up to the roof and so ignite any gas which happened to be present.

Numerous were the safety devices tried to light mines. Mirrors were used to reflect the light from the surface; the glow of fish skins was also tried, and the steel mill, which consisted of a steel disc made to revolve rapidly against a piece of flint so as to produce a shower of sparks. In 1815 Sir Humphry Davey and George Stephenson, independently and almost simultaneously, hit upon the principle of the safety lamp, which, with modifications, still holds good to this day. Of late years electric lamps have been introduced to the great advantage and greater safety of the miner, due to the improved illumination. Rapid strides have been made in increased candle power and more rugged construction of these lamps.

With safety lamps coming into more general use, explosions became less frequent, though more devastating when they did occur due to the larger scale of operations, but it was not until the eighties that scientists began to realize that the disastrous explosions in mines were in many cases due to something more than gas. Eventually this agency was traced down to coal dust and Sir W. E. Garforth originated the idea and put into practice the use of stone dust as an agent to dilute the coal dust down to an extent to render it inert and harmless.

The first method of working coal was developed on the pillar and stall system, in which roadways were driven in the seam with pillars of coal left in for support. These roadways were braced against falls of stone with the most readily available material, namely, wood.

Later on the extraction of these pillars was undertaken and mining had made a further advance. With the gradual exhaustion of the thicker and accessible coals, recourse was had to the thinner seams and frequently the superior quality of these thin seams rendered their prior working desirable even with the thicker seams available. This development led to the introduction of longwall mining, with the object in view of complete extraction of the coal and reduced costs of mining.

Subsequently in the deeper mines it was found that roadways could not be maintained in the solid workings and the operators were driven to use the total extraction method whereby the roadways leading to the coal faces were formed in the rock in the excavated areas. For many years after the inception of longwall, the coal at the working face was shovelled out to the cars at the roadhead, the roadways being spaced to suit conditions, but usually about thirty to forty feet apart. To give the necessary height to these roadways the rock in the roof was blown down (brushed) or else the pavement was shot up and in either case the waste rock was packed or stowed away in the excavated area next to the roadway. These packed areas formed a support for the roof which, gradually settling, squeezed them tighter and tighter until they resisted further settlement of the strata and owing to the close spacing of these packwalls control of the roof presented few difficulties.

In the thicker seams, especially those containing bands of dirt, rail tracks were laid right along the face of the working and the coal was loaded straight from the face into

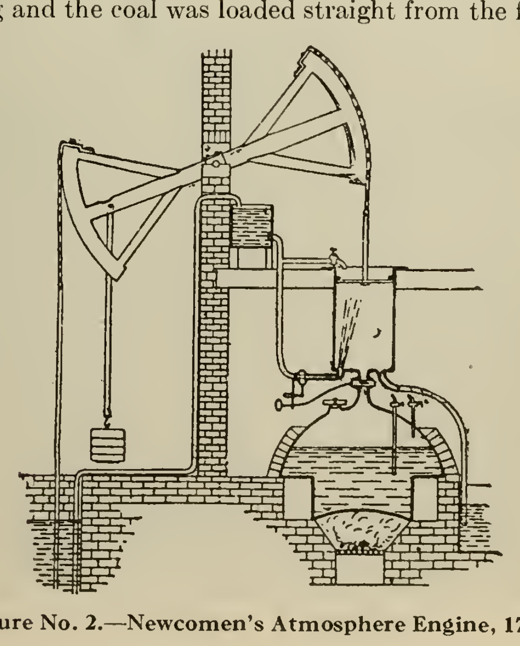

Figure No. 2.—Newcomen's Atmosphere Engine, 1705.

Figure No. 3.—No. 2 Colliery, Dominion Coal Company Limited, Glace Bay, Cape Breton, N.S.

mine cars. This system worked well, provided there was enough dirt in the seam or coming away with the seam to stow the waste.

In recent years mechanically driven face conveyors have been introduced on to which the miner shovels the coal direct from the face. The coal then passes down the conveyor to the cars at the loading point. This system embraced conveyors up to three hundred feet in length and advantage was taken of this fact to dispense with all the brushed roadways through the waste into the face. The roof had now no supports on which to rest and gradually settle, with the result that the face timbers had to bear the whole brunt of the load and not being strong enough collapsed, allowing the roof to fracture right up to the coal face. Under these conditions roof control was non-existent, roof troubles over the face were endless and the conveyor system got a bad name. Pioneers, however, persevered and finally evolved the method of building packwalls in the waste from the fallen roof stone and so the roof, now having supports on which to rest and gradually settle on, behaved better and roof control was re-established. The latest development of roof control at the face is the use of steel props of such strength that they will resist the first bending movements of the roof and will sustain the roof until the face is sufficiently advanced to permit of one or two rows of props being drawn, those remaining in place being strong enough to hold the roof, whilst the unsupported area breaks off in the waste at the last row of props.

The conveyor system has been extended beyond the coal face and mines now exist in which all the coal mined is brought out to the surface by conveyors. Such an installation is extremely costly and necessitates large outputs to justify the outlay.

As the shallow seams have been worked out it has been necessary to search deeper and deeper after coal and each increase in depth implies a concomitant increase in capital expenditure for shaft sinking and equipment. This capital increase requires a larger mine output and this in turn necessitates a larger area being made tributary to the mine than was formerly the case. In short, the deeper the mine the larger must be the scale of operations.

The method of supporting main roadways has undergone changes to meet the altered conditions brought about by the greater depth at which mining is now being carried on. The plain wood timbering, consisting of a horizontal member supported by an upright leg at either end, which sufficed for the shallower workings, was found to be too light for the deeper mines and the cost of replacing broken members became an exceedingly heavy burden on the industry. Various modifications of wood have been worked out, but the trend is towards something more substantial. Some roadways, especially those near the pit bottom, are supported by brick or stone arches, but this is expensive and serves only for roadways which will be required for the lifetime of the mine. Steel cross members supported by wooden legs are now in frequent use and in many mines the wooden legs are replaced by brick walls running the whole length of roadways. Of recent years shaped steel girders of H-section are being used. These are made of the horseshoe shape, or semicircular with straight legs. They are spaced along the roadway and the intervening spaces are frequently filled with brickwork or concrete. Their use has been attended with most satisfactory results. Contemporaneously with this has been developed a system

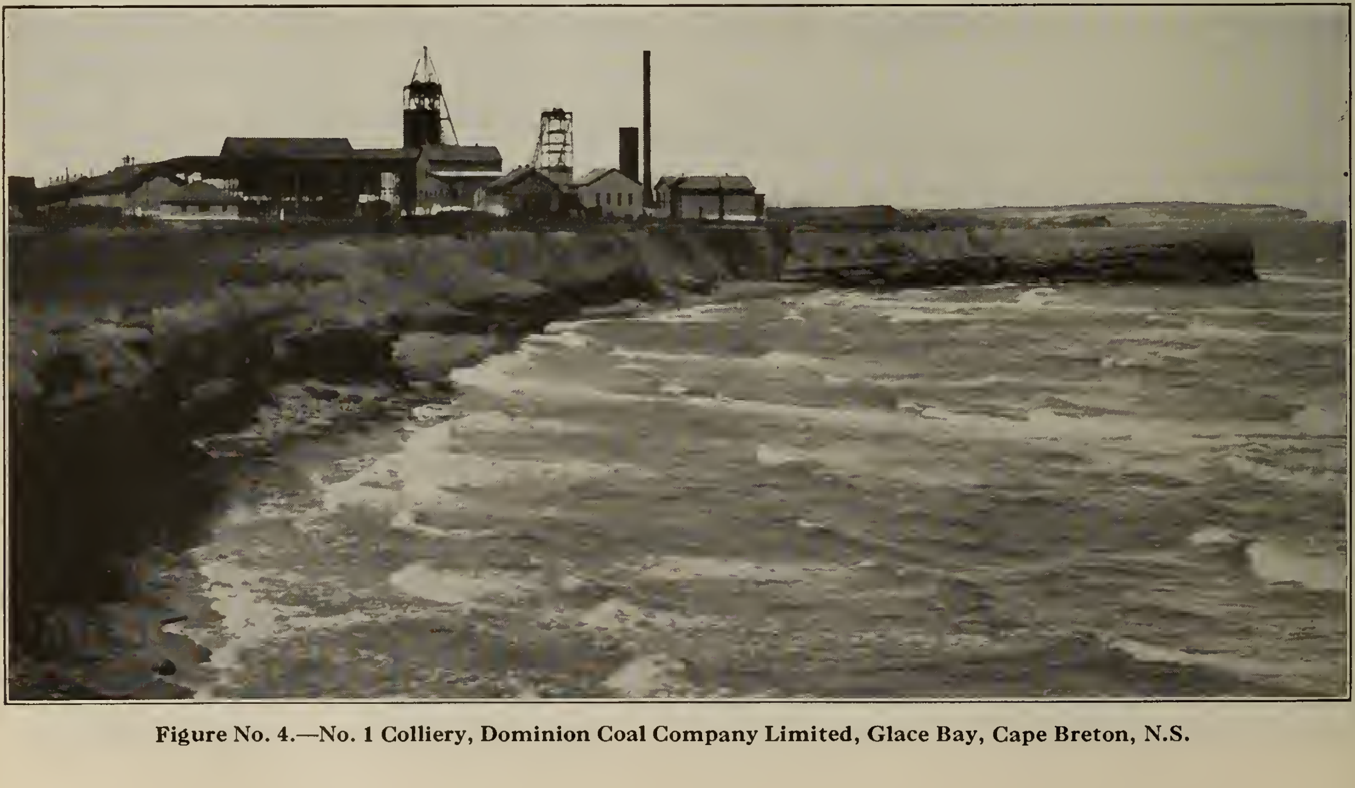

Figure No. 4.—No. 1 Colliery, Dominion Coal Company Limited, Glace Bay, Cape Breton, N.S.

of lining roadways with pre-formed reinforced concrete blocks. This method has also yielded good results.

The mechanization of underground equipment began with the introduction of compressed air which still, in spite of its low efficiency, holds a large place in mining, though it had to yield to the ever growing improvements in the use of electricity underground.

The machines for producing compressed air have undergone radical improvements and have grown from small reciprocating machines to the giant turbo-compressors producing no less than 45,000 cubic feet of free air per minute.

Each year sees some improvement in the design of machines for undercutting or shearing the coal, the boring of the holes for blasting, the machines for loading the coal and the design of the conveyors, etc.

Machines, known as entry drivers, are now made which dig and load out the coal, but these are large and cumbersome and require excellent physical conditions in the mine.

The underground haulage systems have kept pace with the march of science. We have shown how coal was first of all carried out of the mine, then wheeled out in small corves running on stone tracks. Then the corves were hoisted bodily. Horse haulage began to replace manual labour, which in turn was displaced by rope haulage or, where possible, now by electric trolley or electric storage battery locomotives. The mine cars from holding only a few hundred weights of coal have increased to cars of 4 to 5 tons capacity. Roller bearings are replacing the old open type bearing and nowadays the underground haulageways in a large modern mine are run with the precision of modern railways.

With the ever increasing size of mines the transportation of men to and from their work is receiving closer attention—especially is this the case in our submarine areas where workings extend for three miles seawards.

Ventilation has grown from natural ventilation, through the furnace shaft up to the present day large fans electrically operated on the surface, the largest which has come to the author's notice being one in South Africa, which passes no less than 900,000 cubic feet per minute.

The explosives used in mines for bringing down coal or rock have been steadily improved from the black powder days to the modern permitted explosive.

Some of the explosives, on detonation, have been found to yield nitrogen peroxide and recently it has been discovered that small quantities of this gas when added to

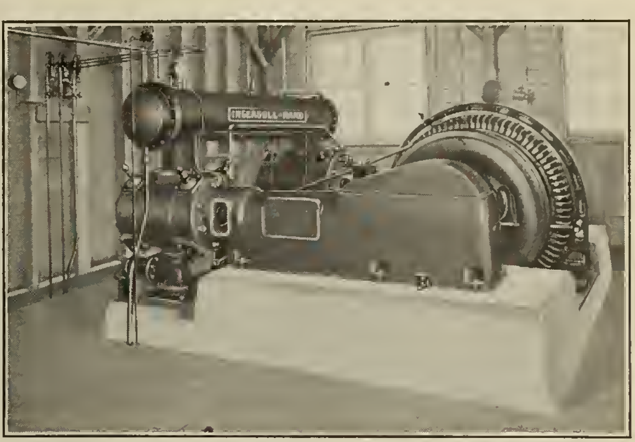

Figure No. 5.—A Direct-Connected Synchronous Motor-Driven Air Compressor of the Type Found in Canadian Collieries.

an air-methane mixture render that mixture more sensitive to explosion or, in other words, act as an accelerator. This is now being closely investigated and as an accelerator has been found, why should not a retarder be discovered!

Liquid gases are being tried out as explosive agents, the two outstanding examples being liquid oxygen and liquid carbon dioxide. These gases are held in a container and exploded by electrically fired detonators.

To sum up briefly, modern practice is all towards obtaining the largest possible outputs from the smallest possible amount of development work, or what is known now as "intensive mining." This is obtained by the thorough mechanization of the mines and establishing a system of work in which workers are allotted special duties to perform, in a similar manner to mass production in a factory. These duties or cycles of operations are repeated day after day and eventually the workers become highly skilled in the performance of the allotted duties.

With regard to the future of mining there can be no doubt that intensive mining will be further and further developed as means are devised for the more rapid execution of the deadwork, such as brushing, making roadways, etc., which must keep pace with the extraction of the coal. Indeed, it is beyond doubt that systems of working will be evolved which will materially decrease this amount of deadwork.

Actual manual labour will be continuously lightened as machines are invented to replace human muscle and ultimately fewer and fewer men will be required per unit

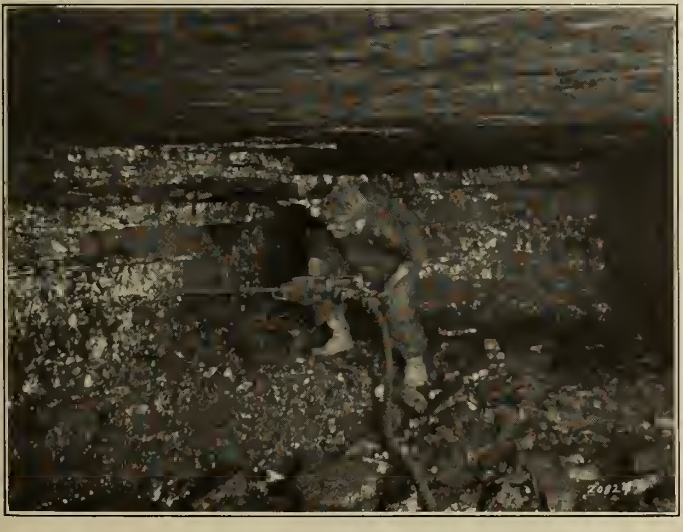

Figure No. 6.—Jackhamer Drill of the Type Used in Coal Mines.

Figure No. 7.—Overcutting with a Radialaxe Type Coal Cutter.

of tons produced but such men will require to have a continuously improving technique of the handling of machinery. These machines must of necessity be smaller, lighter, and highly flexible in operation to permit of their working in mines whose physical conditions do not lend themselves to the use of present day machines.

One of the difficulties already encountered in intensive mining is the evolution of large bodies of gas due not to the greater amount of gas liberated by the coal, but to the larger tonnage of coal produced in a limited time from a limited area. This serious factor is already causing concern to mining men. It is suggested that sooner or later science will evolve a catalyst—which could be placed at various points in the mine—that will change this dangerous gas into its innocuous components of carbon dioxide and water.

Coal dust, as we have already pointed out, can be rendered harmless by dilution with stone dust. Were such a catalyst as above found for gas, then mines could be rendered safe from devastating explosions.

Along with the problem of gas goes that of ventilation or of conducting air for long distances underground —a problem that is now beginning to rear its head in our own coalfield in Cape Breton. One solution is, of course, large airways and plenty of them, but that would involve prohibitive capital expenditures, for after all coal is only worth what it can be sold for. Several solutions offer themselves. One would be to pump the air through large air mains at high pressure and then release it when in the workings, or the air might be liquefied, transmitted through pipes and again released in the workings. Yet again, it is possible that science may evolve simple and economical methods of purifying the air and after supplying the deficiency of oxygen keep it recirculating in the mine. Along with this problem would go that of cooling the air in deep mines where the natural temperature of the strata is high. This is already being done in one deep ore mine. None of these problems are beyond the reach of science.

Electricity will continue to play its part increasingly in the mining of coal, though compressed air will still hold its own for years to come in many operations about the mine, especially where large volumes of gas are to be found.

It is also suggested that in mines whose physical conditions are such as to prohibit the profitable extraction of coal that a use will be found for the coal by burning it *in situ* and collecting the produced gases so formed by means of boreholes. These gases will be employed in gas engines for the production of electrical energy.

Discussion on "A Short Monograph on Nomography" Paper by F. M. Wood, A.M.E.I.C.[1]

H. B. Muckleston, M.E.I.C.[2]

The author's treatment of the alignment nomograph is complete as far as it goes; but, by considering particular types instead of analyzing the general case, he has made the subject appear to be a much more complex business than it really is. By attacking the general case, the whole subject can be boiled down into a few very simple formulae.

Any formula can be plotted as an alignment nomogram, provided it can be made to plot in the cartesian system of co-ordinates as three families of straight lines. This condition is satisfied if the expression can be tortured into the form

$$f_1g_3+f_2h_3+f_3=0 \qquad (1)$$

in which f_1 is any function whatever of the variable Z_1; f_2 is any function whatever of the variable Z_2, and g_3, h_3 and f_3 are any functions whatever of the variable Z_3. In order to plot this equation in any system of co-ordinates, it is first necessary to choose a modulus for each of the functions f_1 and f_2. The modulus is defined as the scale length of the variable when the value of the function is unity, *e.g.* log 10 or sin 90°. Let these moduli be M_1 and M_2; the equations of the three families of lines in the cartesian system will be

$$x-M_1f_1=0;\quad y-M_2f_2=0;\quad \frac{g_3x}{M_1}+\frac{h_3y}{M_2}+f_3=0$$

each of which, being in the first degree in x and y, will plot as a family of straight lines. Equation (1) will, therefore, plot as an alignment nomogram.

In determinant notation, the three equations are

$$x\begin{vmatrix} 1 & 0 & -M_1f_1 \\ 0 & 1 & -M_2f_2 \\ \frac{g_3}{M_1} & \frac{h_3}{M_2} & f_3 \end{vmatrix}=0 \qquad (2)$$

To reduce this to the required form for alignment plotting, add the second column to the first, divide through each row by the quantity in the first column, multiply column two by L and column three by minus one, giving:

$$x\begin{vmatrix} 1 & 0 & M_1f_1 \\ 1 & L & M_2f_2 \\ 1 & \frac{h_3M_1}{g_3M_2+h_3M_1}L & \frac{-M_1M_2f_3}{g_3M_2+h_3M_1} \end{vmatrix}=0$$

in which L is any arbitrary distance. The co-ordinates of the three systems of points forming the alignment nomogram are:

$$\left.\begin{array}{lll} \text{For variable } Z_1; & X_1=0; & Y_1=M_1f_1 \\ \text{For variable } Z_2; & X_2=L; & Y_2=M_2f_2 \\ \text{For variable } Z_3; & X_3=\dfrac{h_3M_1L}{g_3M_2+h_3M_1}; & Y_3=\dfrac{-M_1M_2f_3}{g_3M_2+h_3M_1} \end{array}\right\} \quad (3)$$

It will be seen that the systems Z_1 and Z_2 plot on two parallel lines at the arbitrary distance L measured on the axis of x. The support for Z_3 will be straight or curved depending on the nature of the functions of Z_3 which appear in the expressions for X_3 and Y_3. In more general terms, Z_3 plots on a curve of which the radius of curvature may be infinite. Some of the functions of Z_3 may be unity or missing altogether. If g_3 and h_3 are both unity, X_3 is evidently a constant and Z_3 plots on a straight line parallel to Z_1 and Z_2; which is generally called the "III" type. If f_3 is zero, Y_3 is zero and the nomogram is the so-called "N" type, though it sometimes appears in the form of I L or H. From inspection of the expression for X_3, it is evident that Z_3 will come between the other two if $\frac{g_3}{h_3}$ is positive. This position can always be assured, if required, by proper attention to the signs of g_3 and f_1 or of h_3 and f_2.

When the expression to be plotted is put into the form of equation (1), f_1 and f_2 may appear as reciprocals, in which case, the scale value of the variables will be very short and the graduations very close together as the functions approach zero. In such a case we may write:

$$\frac{g_3}{\phi_1}+\frac{h_3}{\phi_2}+f_3=0; \qquad (4)$$

The three equations will then be

$$x-\frac{1}{M_1\phi_1}=0;\quad y-\frac{1}{M_2\phi_2}=0;\quad g_3M_1x+h_3M_2y+f_3=0$$

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(1) This paper was published in two parts in the June and August 1930 issues of the Journal.

(2) Consulting Engineer, Vancouver, B.C.

From which

$$x\begin{vmatrix} M_1\phi_1 & 0 & 1 \\ 0 & M_2\phi_2 & 1 \\ \dfrac{-g_3M_1}{f_3} & \dfrac{-h_3M_2}{f_3} & 1 \end{vmatrix}=0$$

And the co-ordinates of the three systems of points are:

$$\left.\begin{array}{ll} X_1 = 0; & Y_1 = M_1\phi_1 \\ X_2 = M_2\phi_2; & Y_2 = 0 \\ X_3 = -\dfrac{h_3M_2}{f_3}; & Y_3 = -\dfrac{g_3M_1}{f_3} \end{array}\right\}\quad\ldots\ldots\ldots\ (5)$$

Evidently, Z_1 is on the axis of y; Z_2 is on the axis of x, and Z_3 lies between the axes. This type is frequently known as the "broad arrow" type. There is nothing in either equations (3) or (5) which defines the angle between axes of co-ordinates in plotting as an alignment nomogram. It may be anything we choose, which, in most cases, means whatever will make the whole drawing nearly square.

The above two sets of equations (3) and (5) contain the whole mechanism of the alignment nomogram. The difficulties in their practical application arise mainly in recognizing that the expression to be plotted can be twisted into one of the forms (1) or (4) and in the choice of the best values for the moduli. These moduli determine the length of their respective scales for the ranges required and, together, they fix the position and size of the system of points for Z_3. No useful rules can be laid down; cut-and-try is the only precept and experience the only effective teacher. Occasionally, there is a choice of type; formulae which finally appear in the shape $g_3f_1-h_3f_2=0$ can be plotted in either the III or N types. The form of the functions involved will generally dictate the choice.

While the above sets of formulae give the co-ordinates of the Z_3 system, it is seldom necessary to calculate them as simpler and less laborious methods of plotting that system are available. The most generally applicable is the method by cross isopleths. For every possible value of Z_3 there is an infinite number of pairs of values for the other two and the isopleths for all these pairs must intersect in the correct position of the point representing the particular value of Z_3. Unless f_3 is zero, there is an obvious advantage in choosing Z_1 (or Z_2) so that f_1 (or f_2) will be zero. This gives one easily calculated series of isopleths and a similar treatment of the other will give a second series. However, the intersections may be so flat as to be useless, in which case, some other method must be used. In many cases, one co-ordinate is simple and the other complex. The simple co-ordinate can replace one series of isopleths. Many commonly used formulae have been tabulated; if Z_3 is an argument, the data for cross isopleths are ready to hand. The same is true if a cartesian nomogram for the formula is available.

A formula containing four variables will plot as two scales for two of the variables with a net or grid for the other two if it can be put into the form

$$f_1g_{34}+f_2h_{34}+f_{34}=0\ \ldots\ldots\ldots\ldots\ldots (6)$$

in which g_{34}, h_{34}, f_{34} are simultaneous functions of the two variables Z_3 and Z_4. To plot such a formula, let Z_3 be given any selected value; the formula reduces to a three variable formula and could be plotted as such with the usual system of points for Z_4. Of course, a separate nomogram for Z_4 would be required for every selected value of Z_3 but as scales for Z_1 and Z_2 would be the same for the whole collection, all these nomograms might be combined into

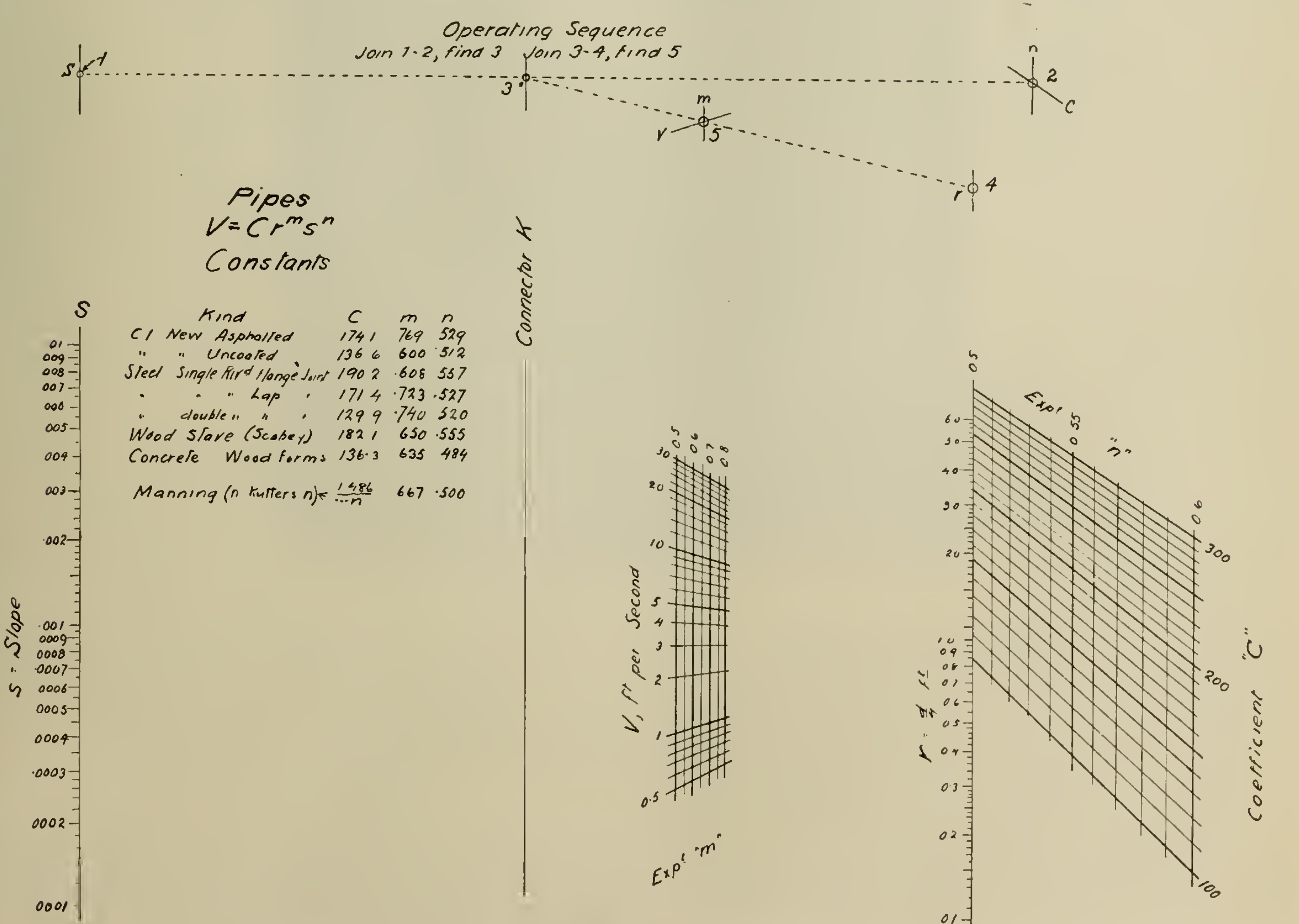

Figure No. 19.

one with the usual scales for Z_1 and Z_2 and a family of scales for Z_4. We could obviously do the same thing treating Z_4 as the constant and get another nomogram with a family of scales for Z_3. As the scales for Z_1 and Z_2 would be alike in both nomograms, the two might be superimposed and the lines for Z_3 would then form the graduations for Z_4 and vice-versa. That is, such a formula will plot as a grid or net.

As an illustration of what can be accomplished with the alignment nomogram, consider the formula

$$V = Cr^m s^n$$

a general formula for the flow of water in closed channels containing six variables.

This formula can be split into

$$\log K + m \log r - \log V = 0$$

and

$$\log K - n \log s - \log C = 0$$

Both are in the form of equation (6) and will therefore plot with a net. They are alike in form and the description of one plotting will serve for both. K is an arbitrary auxiliary and serves as a connector between the two.

Let $M_1 = M_2 =$ any convenient log scale.

Taking the first expression, put

$$Z_1 = K \quad f_1 = \log K \quad X_1 = 0 \quad Y_1 = m \log K$$
$$Z_2 = r \quad f_2 = \log r \quad X_2 = L \quad Y_2 = m \log r$$
$$\left.\begin{matrix} Z_3 = V \\ Z_4 = m \end{matrix}\right\} \begin{matrix} g_{34} = (Vm)^\circ = 1 \quad h_{34} = V^\circ m = m \\ {}_{34} = -m^\circ \log V = -\log V \end{matrix}$$
$$X_{34} = L\frac{m}{1+m} \qquad Y_{34} = \frac{m \log V}{1+m}$$

X_{34} does not depend on V so that the lines for m are parallel to Z_1. When r is unity, $\log r$ is zero and $\log V = \log K$. The lines for V are all straight and all pass through $r = 1$ and $K = V$.

The other plots in the same way except that, in this case, K is the unknown and is, therefore, best made the middle scale. This requires that X_{67} be negative, wherefore the negative sign of the second term is given to n and $X_{67} = \frac{-nL}{1-n}$. The complete nomogram is shown in figure No. 19.

With some formulae, all attempts to reduce them to the form of (1) result in an expression with Z_1 appearing in two terms instead of one and plotting as an alignment nomogram is apparently not possible. The difficulty can often be by-passed by treating the extra appearance as if it were a separate variable and plotting as a four-variable formula. It is a mistake to try for too great a range in one chart. For instance, 4,000 second-feet and a twelve-inch pipe could not possibly occur in the same problem, and there is no very good reason why they should ever appear on the same chart. It is far better to make a number of charts, each of which covers only those ranges which can occur together, and to let the various charts overlap about half the range of each.

F. M. Wood, A.M.E.I.C.[3]

With reference to the discussion by H. B. Muckleston, M.E.I.C., the author felt when he was preparing the original article that the average reader might not be familiar with the determinant notation, and would in any case appreciate some refreshing of memory. He therefore arranged the paper with a view to leading up progressively from the simpler examples to those more complex. Much of the apparent complexity is due to the discussion of choice of moduli, and of the position of the various scales, to suit particular requirements. When the significance of the determinant method of attack has been grasped, the keys given in Appendix B should materially simplify the labour involved in studying the more elementary formulae.

The author agrees with the statement made in the second paragraph that any formula may be plotted as an alignment chart provided it can be expressed as three families of straight lines. He does not agree, however, that Mr. Muckleston's equations (1) and (4) represent the general case. The general form for such formulae may be expressed.

$$\begin{vmatrix} f_1 & g_1 & 1 \\ f_2 & g_2 & 1 \\ f_3 & g_3 & 1 \end{vmatrix} = 0,$$

as was mentioned in the article. Expressing this as a "collinear" chart, we see that this gives the three families of straight lines

$$\begin{cases} f_1x + g_1y = 1 \\ f_2x + g_2y = 1 \\ f_3x + g_3y = 1 \end{cases}$$

each family representing one of the variables Z_1, Z_2, and Z_3.

Equation (1) is seen to be a particular case of this more general form, in which $g_1 = f_2 = 0$. If we consider this general formula as an alignment chart, we find that each variable is represented by a curved line, whereas equation (1) gives us two straight lines and one curved line. It should be noted also that functions of Z_1, Z_2, and Z_3 each appear in more than one term, instead of functions of Z_3 alone. Mr. Muckleston refers to this type of equation in his last paragraph. Examples of this general type for three variables were not studied in the monograph, because they are not very tractable, and do not lend themselves willingly to the application of moduli. A simple example like

$$\begin{vmatrix} P & P^2 & 1 \\ Q & 0 & 1 \\ R & R^3 & 1 \end{vmatrix} = 0$$

where P, Q, and R are the three variables, will serve as an illustration of this statement.

The use of isopleths in plotting the functional scales, as mentioned by Mr. Muckleston, furnishes indeed a more simple and rapid method than that of calculation of co-ordinates. The author must confess, however, that he seldom uses this method except in conjunction with the method by calculation, i.e., he generally calculates at least one of the co-ordinates, and obtains the other co-ordinate by either analytical or graphical means, using isopleths as a final check on the work. Some engineers may disagree with this, but the author has found that in most cases more time is wasted in obtaining good intersections for the isopleths, or in changing from one method to another when the intersections become poor, than if calculations were made in a straightforward way. The author is also naturally sceptical as to the accuracy of the chart when completed in the purely graphical way. Firstly, there is the chance of error in marking the end points of the isopleths; secondly, in obtaining the intersections; and thirdly in the operation of inking in; in addition, there is the final opportunity afforded (in all charts) of exercising the human privilege to err, when coming at last to the actual solution of specific problems.

Mr. Muckleston's treatment of the equation $V = Cr^m s^n$ shows what may be accomplished by the use of auxiliary or "pivot" scales in cases involving a great many variables. It is interesting to compare this chart with one that would be obtained when no pivot scale is used. The elementary determinant form for such a chart is

$$\begin{vmatrix} 0 & \log V - \log c & 1 \\ 1 & \frac{1}{2}\, m \log r & 1 \\ 2 & -n \log s & 1 \end{vmatrix} = 0$$

This will give three binary scales along parallel straight lines; one of the scales is dependent on a network for the variables V and C, the second scale is dependent on a network for the variables m and r, and the third scale is dependent on a network for the variables n and s.

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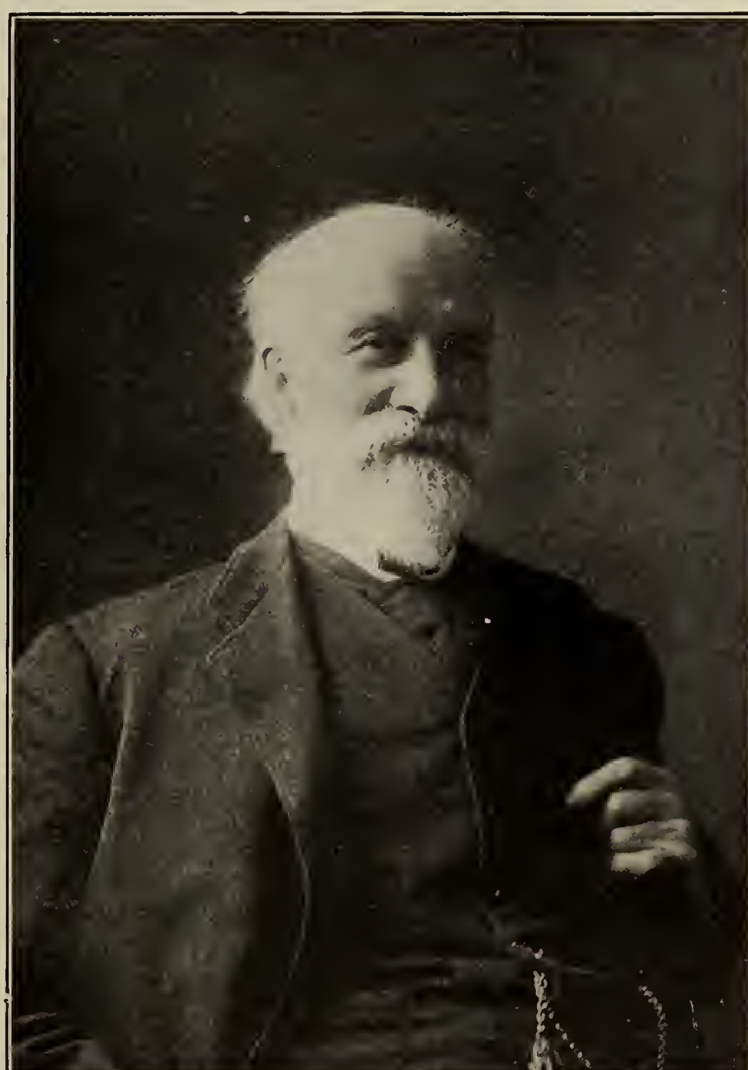
Sir Sandford Fleming — A Biography

By the late Professor Peter Gillespie, M.E.I.C.

Presented before the Niagara Peninsula Branch of The Engineering Institute of Canada, May 19th, 1925.

How often has it been said that while the engineer as a technologist may be capable, he is not usually a citizen in the enlarged sense of the word! His structures may be safe, his work may display an ingenuity that compels admiration; his integrity may be above question, but outside of his professional work his influence is not felt. Those engineers who have received recognition are the exceptions, and they have won it largely through widening their contact with the pulsating life of their time. They made their contribution in service but in addition they added something to the life of their day in constructive thought or needed reform. The thanks of a grateful posterity were often their sole reward.

Of Canadian engineers, the most outstanding in this exceptional class is perhaps Sandford Fleming—Fleming the product of a Scottish parish school who became the chancellor of a great university; Fleming the youthful surveyor who became the chief engineer of the Intercolonial and the Canadian Pacific Railways; Fleming the founder of the Canadian Institute, promoter of standard time and the "All Red Line," advocate of parliamentary reform, apostle of a united empire, scientist, plenipotentiary, litterateur, publicist, citizen. And while it is true that few engineers can be what Fleming was, there must be in the contemplation of his unique career, some measure of inspiration for all.



SIR SANDFORD FLEMING

Sandford Fleming was born in Kirkcaldy, Fifeshire, Scotland, in 1827. Until he became apprenticed in his early teens to John Sang, an engineer and surveyor of Kirkcaldy, he attended the local parish school. In 1845, seized with the desire for adventure in the New World, he sailed for Canada in a sailing ship, landing in Quebec after a six weeks' passage on June 5th. A few weeks later he had arrived in Peterborough by way of Ottawa, the Rideau canal and lakes, Lake Ontario and Cobourg. Peterborough at that time contained about 2,000 people, and it was here that young Fleming obtained his first employment. This was as draftsman with a local surveyor, Richard Birdsall. The next year he compiled and published a map of Peterborough town, the lithographing work having been done by his own hands. In 1847 a similar map of Cobourg was issued by Fleming, although this latter, singularly enough, bears no date. In 1849, he obtained his commission as a surveyor of lands after presenting himself for examination by the then commissioner of lands in Montreal. After this he made Toronto his permanent residence.

Fleming at 22 was one of that small number of enthusiasts who in 1849-50 launched the Canadian Institute. Intended originally as a professional society for engineers, surveyors and architects, it was first proposed and its organization discussed at a small meeting in the office of the late Mr. Kivas Tully at the corner of King and Yonge streets, Toronto, on June 20th, 1849. After many vicissitudes, a meeting to adopt a constitution was called for February 8th, 1850. At this meeting only two were present, Mr. Fleming and Mr. Passmore. After much silence and waiting in vain for a larger attendance, it was decided that Fleming should take the chair and Passmore should act as secretary, and with rather more unanimity than regularity, they proceeded to adopt a series of resolutions one of which provided that the first subject for discussion at the proposed weekly meetings "be the act for regulating the admission of land surveyors and the survey of lands throughout the province."

In the work of the Institute for over fifty years Fleming maintained the keenest interest. To its transactions he contributed at least thirty papers, and to his influence exerted in a hundred ways, a very considerable measure of its success was due. His address at that meeting in 1899 which commemorated the completion of fifty years of the Institute's history concluded with an expression of the hope, so characteristic of Fleming the Canadian and Imperialist, that Canada's contributions to letters, science and art would enable her to take her place worthily among the nations constituting the British Empire.

From the Canadian Society of Civil Engineers, organized in 1887, the predecessor of The Engineering Institute of Canada, Fleming appears to have remained aloof until 1908, when he became an honorary member.

Fleming believed that the Canadian Institute because of its character as a scientific and literary body, was in a peculiarly favourable position to consider the question of electoral and parliamentary reform. In 1892, he addressed to that society a note in which he pointed to the majority vote method of electing legislators and the party system of government as the two outstanding evils of the parliamentary system. In relation to the former, he averred that electors who vote for defeated candidates, together with those who do not vote or have no vote, remain unrepresented; that thereby one-half of the population is disfranchised, and that in effect there results government of the major part by the minor, instead of government of the whole by the whole. The party system in addition makes for instability and militates against continuity of policy; through it passions are inflamed, antagonisms are stimulated and relentless warfare results; the expression of independent conviction is stifled because devotion to party replaces devotion to the state.

The problem was to devise a method of electoral representation by which the whole electorate might be duly recognized in one deliberate body, so that every interest within the nation might be fairly represented in its government; where representatives would not be expected to echo conclusions dictated by whim, passion or party exigency, or formed on immature judgment or insufficient evidence, and where each member would feel himself free to speak and vote as his clear convictions directed. He quoted from the author of "The British Commonwealth" to the effect that "party is a rude and barbarous instrument of legislation only less bad than legislation by despotic power which it supplanted." The author looked for the dawn of a new day when in place of the evils above referred to "there would be scope and encouragement for the awakening of a calm patriotism" and when "men of capacity, wisdom, and of good conscience, with minds evenly balanced, would be preferred and generally would be chosen as representatives." In place of "divisions and weakness and instability with a long train of evils, there will be unity and strength and security which proceed from wisdom and peace and concord."

Fleming had previously given expression to similar sentiments in an article entitled "A Problem in Political Science" published in Volume VII of the Transactions of the Royal Society of Canada, in 1889, and in an address on "Parliamentary vs. Party Government" delivered at Queen's University in 1891. These views, so vigorously expressed over thirty years ago, are of special interest today in the light of recent tendencies in practical politics in Canada.

To none of the causes which received his support did Fleming devote himself with more patience and determination than to reform in the reckoning of time. It was in 1876 that he began his advocacy of standard time and for over twenty years he continued it. In his first paper, among other things, he illustrated the inconvenience and confusion arising from the then unsatisfactory methods of time keeping by the case of a traveller proceeding from Halifax to Detroit by rail. He stops at Saint John, Quebec, Montreal, Ottawa, Toronto and Hamilton. At the beginning of the journey he sets his watch by Halifax time. As he reaches each place in succession, he finds a considerable variation in the clocks by which the trains are run and he discovers that at no two places is the same time used. It was to regularize these differences that standard time was proposed.

In a subsequent paper, he pointed out the advantages, geographically and commercially of selecting as the universal prime meridian the anti-meridian of Greenwich through the Pacific ocean since such a line would avoid practically the land of all nations.

On the initiative of the Canadian Institute, Mr. Fleming's proposals were officially communicated to the leading governments of the world with a view to securing an international unification of the method of designating time for common use. In 1881 he attended an international geographical congress in Venice as a representative of Canada and the United States, and there read a paper on "The Regulation of Time and the Adoption of a Prime Meridian." In 1883 he brought the question before the American Society of Civil Engineers, which body responded by appointing a special committee on standard time of which Fleming was chairman.

Largely as a result of his indefatigable work, the railways of Canada and the United States adopted standard time in 1883. In 1885 Greenwich observatory adopted the 24-hour system and a similar action was taken by the Canadian Pacific Railway with respect to its entire system the following year. By 1890, standard time was in general use in Canada, the United States, Mexico, Great Britain, Sweden and Japan and was on the eve of adoption in Austria-Hungary, Germany and Belgium.

Fleming's first large-scale engineering undertaking was the completion of the construction of the Northern Railway between Toronto and Collingwood, the position of chief engineer of which he assumed in 1855 and retained until 1863. His engagement with this road, known at first as the Ontario, Simcoe and Huron Railway, began in 1851.

In 1853, when he was assistant engineer, he prepared a paper on the geology of the valley of the Nottawasaga river describing the location of various ancient lake beaches which pointed to a time in the distant past when Lake Huron stood at much higher levels than now. His theory was that this condition obtained until the waters of Lake Erie had forced a passage between that lake and Lake Ontario after which the water in the upper lakes subsided to something like their present levels. The Nottawasaga beaches, he thought, therefore antedated the beginnings of the Niagara river.

It should be mentioned that this theory is not now accepted in the form in which Fleming advanced it, that the phenomena are more complex than he had supposed, and that present-day belief in the influence of great overburdens of ice in what is now eastern Ontario on lake and land levels does not seem to have been entertained by him.

Fleming's second engineering undertaking of magnitude was the location and construction of the Intercolonial Railway to connect Quebec with the Maritime provinces, which project had been under consideration since 1827. The first survey of a line had been conducted in 1837 by Captain Yule, but as this was through disputed territory, now the state of Maine, opposition to the proposed location developed in certain sections of the United States, and nothing further was then attempted. In 1846-8 other surveys were completed by Captain Pipon and Major Robinson, but mainly because of the difficulty experienced by the provincial legislatures and the Imperial government in reaching an understanding, the enterprise was advanced but little. In 1863 the project was again revived, and for the position of chief engineer Sandford Fleming was the common nominee of the provinces of Upper and Lower Canada, the provinces of New Brunswick and Nova Scotia and the Imperial government. This position he held until the completion of the work in 1876.

The conflict between Fleming and his commissioners respecting the material of which the Intercolonial Railway bridges were to be constructed illustrates the unrivalled pertinacity of the man. These commissioners were appointed in 1868 to assume the management of the railway, Mr. Fleming still retaining the post of engineer-in-chief. At the first meeting following their appointment, they announced their intention of constructing the bridges of wood instead of iron as recommended by Fleming. To Fleming it appeared advisable to employ metal, so that fire hazard and natural decay might be eliminated. For although the first cost might be greater, the heavy repair and replacement charges to be expected where timber is employed would not have to be met. In addition, the location of the line permitted the delivery of material from sea-going vessels at several convenient points. The commissioners however dissented, and decided that the bridges should be built of wood.

Fleming's opinion had not been hastily formed and the more he considered the matter, the more convinced he was of the correctness of his position. In January 1869 he made his first appeal to the then Prime Minister, Sir John A. Macdonald, in which he submitted at length the arguments as to why iron and not wood should be used. This letter was referred in due course to the commissioners but was never replied to and remains unanswered to this day. The commissioners notwithstanding were sustained and the order was given that all bridges should be built of wood. In the following year Fleming in a statement prepared for Parliament gave a list of all the bridges on the line and their estimated cost in wood and in iron, which showed that the cost of the latter would be only slightly in excess of the cost of the former. He again recommended that iron be used. The commissioners in a majority report reiterated their former ruling that wood should be used, but excepted therefrom five structures which they conceded might be built of iron. Fleming appealed again to the Premier and again to the commissioners. In reply one of the latter, Mr. C. J. Brydges. addressed a communication to the Privy Council in which he stated that the fear of wooden bridges catching fire was groundless, and that in his experience of 18 years as a railway manager no instance of a wooden bridge having been injuriously affected by fire had come under his notice, and that the cost of iron bridges would be $300,000 to $500,000 more than the cost of wooden structures. Fleming's reply cited two instances of bridges on the Grand Trunk Railway under the management of Mr. Brydges himself which had been very recently destroyed by fire, and challenged examination as to the accuracy of his estimates of cost. The commissioners then conceded the point partially, and recommended that all bridges over 60 feet span should be built of iron. But this did not satisfy Fleming. He believed he was right and refused to compromise. He persisted and in 1871 an order-in-council was passed authorizing that all bridges even to the shortest span of 24 feet be built of iron, and all but three were so constructed. The actual cost of the iron superstructures was some $19,000 less than Fleming's estimate.

As stated above the first reconnaissance for an Intercolonial Railway passed through what is now the state of Maine, then disputed territory. Subsequent to this, the Ashburton award, interpreting the treaty of 1783, decided this as United States territory. In the "Concluding Remarks" of the "History of the Intercolonial Railway" 1876, the chief engineer in his characteristic way, refers to this unpleasant event in Canada's national history as one which "converted undoubted British territory into foreign soil, which alienated the allegiance of thousands of British subjects and made a direct connection between central Canada and the Atlantic impossible." Further on he asserts that no Canadian can reflect on this sacrifice of British interest without pain and humiliation, and attributes the fault, not to the Washington government, but to the "ignorance of the merits of the case and an indifference to the interests at stake on the part of the Imperial representative who had been entrusted with the protection of the rights and the honour of the Empire." Fleming's moral sense rebelled against what he considered to be great national injustice.

Elsewhere in the same volume, Fleming eloquently and somewhat prophetically says "I feel that I am performing the last act of duty in the office I have long held, and that I am separating myself from a work to the prosecution of which, with many friends and fellow-labourers, I have devoted for many years the best energies of my life. A connection of this kind is not broken without an effort, but any personal considerations must disappear in view of the completion of a work which realizes the national aspirations of half a century by bringing within a few hours, the old fortress of Halifax and the older citadel of Quebec, and which must form an important section of the railway, destined ere long to extend from east to west through the entire Dominion."

Fleming's greatest engineering undertaking was as chief engineer of the Canadian Pacific Railway, which position he assumed in 1871. On the 20th of July in that year, British Columbia entered confederation, one of the conditions being that a railway should be constructed within ten years from the Pacific to a point of junction with the existing railways of Ontario and Quebec. On the same day survey parties left Victoria for various points in the Rocky Mountains, and from the upper Ottawa westward and all along the line surveys were begun. The reports of these were laid before the Canadian House of Commons in April 1872. In the summer of the same year, the chief engineer, in order to see the main features of the country with his own eyes, travelled across Canada by such facilities as were then available. His party included Dr. Moren, physician, Mr. John Macoun, botanist, and Rev. Geo. M. Grant, Presbyterian clergyman of Halifax, N.S. who was the secretary of the expedition, and who afterwards became Principal of Queen's University, Kingston, Ont.

They travelled from Toronto to Collingwood by rail, and by steamboat from Collingwood to Prince Arthur's Landing, then a settlement of a hundred houses. "Silver Islet" in Lake Superior was then the world's most wonderful silver camp, producing, it was said, $1,200,000 worth of silver per year, and this was considered by the travellers a circumstance worthy of extended remark. The existence of a Cobalt silver camp in the same province which a generation subsequently would produce fifteen times as much annually was not then suspected. The road from Prince Arthur's Landing, now the flourishing city of Port Arthur, to Fort Garry, now the city of Winnipeg, was over the famous Dawson route, in the history of which more of the romantic has probably been found that in that of most of Canada's early highways. The first white man known to have travelled it was Radisson, who in 1663 passed eastward from Lake of the Woods to Lake Superior on his way to Montreal. In 1731 Verendrye, while commandant of a trading post at Nipigon, traversed it from east to west as far as Lake Winnipeg. It was over this route by canoe and portage that the North West and Hudson's Bay Companies for many years were wont to transport their supplies and furs. In 1860 Mr. Simon J. Dawson, an engineer in the employ of the Department of Public Works, Canada, was commissioned to find a waterway from the head of Lake Superior to Fort Garry, to constitute a link between the east and the west. The thought of a railway across that rock-ribbed land was almost too bold then to be entertained. Mr. Dawson selected the route which Verendrye and the fur traders had followed, and ten years later the government endorsed his decision. Dams were built, roads cut and corduroyed, steamers and other craft supplied, and rest houses erected. It was over this route that Sir Garnet, afterwards Lord Wolseley, conducted the Red river expeditions 1,200 strong in 1870 for the suppression of the first Riel rebellion.

The first 45 miles from Lake Superior to Lake Shebandowan was by wagon to a height of land 1,000 feet high. After this, the route was by steamboat, canoe and portage through the Rainy lake, Rainy river, and Lake of the Woods to the "North West Angle" of the latter, thence by wagon road to Fort Garry.

At the banquet given to Chancellor Beatty and Principal Taylor three years ago by the Queen's University Alumni Association of Montreal, Professor John McNaughton told the following story respecting a single incident of that historic journey through the wilds of Canada fifty-three years ago.

"One night in the course of their toilsome journeys, it is said, they had put up their tents on the shores of one of those innumerable lakes of ours, whose waters they were the first white men to stain with the crimson glow of their camp-fires. A storm blew up during the night and loosed all the boats from their moorings. Without boats nothing could be done. So there was nothing for it but to swim out after them. Grant, you remember, had only one arm that was fully serviceable. But that one was as good as most people's two arms. He could wield it like a flail. With it he swam out and brought one of the boats in, then another and another. How did he attach himself to the boats having but one arm? In a very primitive way. He took the rope in his teeth and struck out for the shore. Fleming then and there made up his mind once for all that this man could bite his way through anything, and from that time, I fancy, there was nothing at all that came into Grant's head that Fleming did not support and push with the whole weight of all his body."

At Winnipeg the travellers were astounded by the amount of drunkenness, and the remark was made that while the clergy do all in their power by precept and example to check it, the saloons appear to be stronger than the churches. Manitoba then had a population of fifteen thousand people. At Silver Heights, six miles up the Assiniboine from Fort Garry, lived Mr. Donald A. Smith, M.P., head of the Hudson's Bay Company in America, afterwards Lord Strathcona.

From Fort Garry to Edmonton, via Fort Ellice, Fort Carlton and Fort Pitt, was by pony and Red river cart through the lands of the Cree, Blackfeet and Salteaux Indians. At Fort Edmonton there were noted with much interest the outcrops of coal from the river bank two feet thick, and an attempt to burn it was attended by some measure of success. From Edmonton to Jasper House at the entrance of the Yellow Head Pass required two weeks. Here they were met by Mr. Moberly, who was in charge of the British Columbia surveys, and who had come up from Victoria with pack trains and supplies for his various parties. From the Yellowhead to New Westminster, the route was via the Thompson river to Kamloops and Lytton, thence by the Fraser to tide water. This is substantially the route through British Columbia which Fleming, after nine years of exploration, finally recommended, but which was not adopted by the Canadian Pacific Railway after his resignation. It is, however, practically the one selected by the Canadian Northern Railway now the Canadian National. From Toronto to the British Columbia coast consumed exactly three months.

On Sundays, worship was conducted from a service compiled especially for survey parties, at the instance of Fleming, by clergymen of the churches of Rome, England and Scotland. From its pages such sacred songs and canticles of the Christian faith as Gloria Patria, Adeste Fideles, Hursley and Old Hundred were sung in camps on the windswept plains of the great lone land, in the fastnesses of the Rocky Mountains, and the desolation of the Ontario hinterland, by men of all faiths and no faith at all, whose sense of things spiritual had been quickened by their very isolation.

It should be remembered that in 1872 no complete surveys of Canada west of Ontario existed, and that both latitude and longitude could be known only approximately. Fleming carried a watch which kept local time for Montreal whose longitude is 73° 33′ west of Greenwich. By observing the hours of sunrise and sunset, he was able to determine his own local time on the plains and thence his longitude with respect to Montreal whose time he knew. The following illustration will make clear his method:

Time of sunset 9h. 34m.
Time of sunrise 7h. 26m.
Interval of daylight 14h. 08m.

Adding half of this to the time of sunrise will give the local noon as indicated on Montreal timepieces. This is seen to be 2h. 30m. p.m. But 2h. 30m. is the equivalent of 37° 30′ since 15° is equivalent to one hour. The longitude of the observer is therefore 73° 33′ plus 37° 30′ or 113° 03′ west. The method of course takes no account of sun time being either fast or slow.

The greatest difficulties in the location of the Canadian Pacific were encountered in the province of British Columbia, eleven routes in all having been examined by the engineers up to the year 1877. These eleven lines all came through the Yellow Head Pass, at which point they separated more or less, and terminated at various places on tide water from Port Essington at the mouth of the Skeena, the most northerly, to Port Moody on Burrard Inlet the most southerly. These surveys were attended by all kinds of difficulties, many of them due to the exceptionally rugged character of the country, some to the difficulty of transporting supplies, some to the severity of the climate, and some to the attitude of the native Indians. The reports of the engineers who directed these explorations are stories of adventure and heroism hardly surpassed in fiction anywhere. The names of Smith, Moberly, Jarvis, Hunter, Cambie, Horetsky, Macleod, Ruttan and others, as long as the thrilling story of the location of the Canadian Pacific continues to be read, will stand for courage, endurance, resourcefulness and fidelity. The various reports by the engineer-in-chief up to and including that of 1880 are filled with stories of the successful completion of tasks of almost superhuman difficulty in a way that is well-nigh inspiring. An illustration is taken at random from Fleming's report for 1877.

In the autumn of 1874, Mr. Jarvis was selected to make a winter exploration of the Smoky River Pass through the Rocky Mountains, roughly in the latitude of Athabasca Landing and the mouth of the Skeena river. His assistant was Mr. C. F. Hanington and Alec. Macdonald was engaged to take charge of the dog trains. As this was the only way of transporting supplies, it was necessary to limit the number of the party and to dispense with all unnecessary commodities. The outfit for each man consisted of a pair of snow-shoes, a pair of blankets and some spare moccasins, while a piece of light cotton sheeting was taken in lieu of a tent, the latter having been considered too cumbersome. The supplies consisted of dried salmon for the dogs, and bacon, beans, flour and tea for the men, and were intended to last for two months. The start for the pass was made from Fort George on the upper Fraser early in January 1875 with the thermometer on occasions registering 53° below zero. The narrative as told by Jarvis then continues:

"The party now consisted of three white men, three indians, and three trains of dogs, and the order of march was as follows: two men in front to 'break track' or beat down the snow with the snowshoes to make a road over which the dogs could travel, then the three trains, with a man driving each—the lightest being placed first—and, lastly, Hanington or myself alternately bringing up the rear and making what is called a 'track survey' of the route travelled. The bearings were taken with a pocket compass, and the distance measured by pacing, forty paces to the chain being found a good average on level ground or ice, and this was continued the whole of the distance to Lake St. Anne, fifty miles above Fort Edmonton. The intense cold continued until the third week in January, and camping out under these circumstances had its drawbacks. Many were the frozen noses and ears during the day's march, but then the exercise helped to keep us warm; while in the camp at night the largest and most roaring of fires scarcely did more than burn the side turned towards it, the other being made thus more susceptible to the cold. One curious effect of the extreme lowness of the temperature was to cause the fire to steam rather than smoke, and this with the very driest wood that could be found.

"The cold was also not without its effect on our four-footed companions; they frequently had frozen toes, and we were obliged to make moccasins of flannel and leather to protect their feet. One old dog, the leader of the Cariboo train, suffered a great deal from frost-bite, and on the third day out he was noticed to be very lame all the morning. A halt was called at noon to drink a cup of tea, and 'Marquis' lay down with the rest, but when a start was made the poor dog made a feeble effort to rise, gave one spasmodic wag of his tail and rolled over dead. His legs were frozen stiff to the shoulder; the minimum thermometer, exposed to the sun on top of the sled at the same time, registered forty-six below zero. A hole in the snow on the bank was the only grave we could make for him, and a spare dog being harnessed in his place the expedition pushed on, not without sincere regret at our loss. The travelling was good on the main river, there being only four or five inches of snow on the new and smooth ice, and we made pretty long marches, but the snow began to get deeper when we turned up the north branch of the Fraser, at the head of which it was hoped that a pass through the mountains would be found. Six days after leaving Fort George, the cache was reached, and found not to have been disturbed either by Indians or wild beasts. Here the sleds were unloaded, and Hanington, with two trains and two Indians, went back to the main river, thence to go to Bear river, where one of the Indians had a salmon cache, and to bring two sled loads of dried fish—about six hundred—back with him. Alec. and I, with the other train, went forward up the north branch to explore and break track; and six days later the whole party reunited at the cache, less the one Fort George Indian, who, having handed over the salmon, had returned overland to his village. A heavy fall of snow during two days rendered the return journey tedious, and Hanington had to adopt the old plan of doubling up. The snow falls soft and moist here, and has a wonderful faculty of adhering to the sleds, as well as piling up under the bows, making killing work for the dogs." And so the story continues page after page in a similar strain. The party reached Winnipeg on May 21st, having been five and a half months on the trip.

By 1880, nine years after the commencement of the work, the line had been located westward from Fort William to the Red river, which it crossed at Selkirk, a branch extending therefrom to Winnipeg. West of the Red river, the location of 1877 which crossed the narrows above Lake Manitoba had been abandoned for one lying south of that lake. Thence, the direction was generally northwesterly to Battleford and Edmonton, crossing the south Saskatchewan river not far from the present city of Saskatoon. It crossed the Rocky Mountains via the Yellowhead Pass, descended the North Thompson to Kamloops, thence by way of the Thompson and Fraser rivers to the Pacific.

From 1871 until 1880, when Sir Sandford severed his connection with the enterprise, the work had been carried on as a national undertaking. Some sixty-seven separate contracts had been entered into comprising grading and ballasting, steel rails, station buildings, wooden ties, bridges, rolling stock, etc., on account of which some $9,486,000 had been paid. The cost of explorations, surveys, engineering and supervision of construction was nearly $5,000,000, so that the cost to the country up to December 31, 1879, was over fourteen million dollars.

A comparison of the prices paid over 40 years ago with those obtaining to-day is very interesting. In 1879 John Ryan was paid 16 cents per cubic yard for earth embankments on the Manitoba prairie. Steel rails weighing 57¼ lbs. per yard, supplied by the West Cumberland Iron & Steel Co. Ltd., cost the country $24.05 per ton in 1879 delivered at Montreal. It may be remarked here that the present-day steel rail weighs nearly twice as much as that purchased for the Canadian Pacific Railway in 1879. On the Fort William-Shebandowan section, Messrs. Sifton & Ward, contractors, were paid in 1875 $1.25 per cubic yard for solid rock excavation, $22.00 per M for bridge timber 16″ by 12″, $20.00 per M for hard wood and pine plank, and 26 cents apiece for wooden ties. In 1880 Andrew Onderdonk was paid the following prices for work in the province of British Columbia:

Solid rock, $1.50 per cubic yard
Concrete, $6.00 per cubic yard
Bridge timber, 12″ by 16″, $18.75 per M
Wooden ties, 30 cents apiece.

In the same year, James Crossen Cobourg was paid $4,746 each for first class passenger coaches carrying sixty-four passengers each. In comparison with this, it may be remarked that a modern steel passenger coach seating seventy-nine persons will cost today something like $33,000.

The locomotive which was adopted for passenger and way freight had cylinders 17 inches by 24 inches, four driving wheels 62 inches diameter, and weighed loaded 75,000 pounds. It had an overall wheel base of 44 feet 6 inches. It is interesting to note that the weight of the locomotive used at the present day is nearly seven times as great as that proposed for the Canadian Pacific Railway in those early days. This gives some conception of the changes that have taken place in the weight of rolling stock in the interval.

That Fleming realized to the full the great responsibility resting upon one entrusted with the selection of a route for a great railway is quite apparent from his reports. With a desire to be quite sure that no reasonable uncertainty existed as to the conditions existing in British Columbia, he prosecuted his explorations in that province for nine years, examining in all as said above, some eleven routes.

Respecting this particular problem he states in his report on the Canadian Pacific Railway for 1880—"It was a serious responsibility for any engineer to assume to recommend that construction should be commenced on the line to Burrard Inlet without first having exhausted all the sources of enquiry open to us. I felt that we should clearly and unmistakably understand the capabilities and possibilities of the northern region, that we should obtain data to determine if a railway line could be obtained through it, that we should know the characteristics of the route and that we should possess full information with regard to the climate, soil and capability for settlement, before the government became irrevocably committed to the large expenditure attendant on the adoption of any route."

"It is easy to understand that if, subsequently to construction of the railway on the southern route, it should be discovered that a northern line could have been undertaken at a greatly reduced cost and through a country in respect of soil and climate suitable for prosperous settlement, a gross and irremediable error would have been committed, possibly ever to be deplored."

In June 1880, the government of Canada appointed a commission to enquire into the facts connected with the prosecution of the Canadian Pacific Railway from its inception. This enquiry was a result of discussions in and out of parliament respecting the propriety of and responsibility for the large expenditure incurred and of certain allegations as to irregularities on the part of officers and others employed in connection with the explorations, surveys and construction. The commission consisted of Judge Clark of Cobourg, Samuel Keefer, civil engineer, and Edward Miall, assistant commissioner, Department of Inland Revenue of Ottawa. Two years later this commission, after having conducted a rather searching enquiry into the matters of reference, issued its final report. This report took exception to many of Mr. Fleming's methods of conducting his work. It contended for example that more reconnaissance and less detailed survey in the early stages of exploration would have cost less and would have produced quicker and better results; that when contracts were let the data respecting quantities were not available in sufficient detail for estimating purposes; that a special class of excavation for muskeg should have been created; that information as to the character of the soil generally was very meagre, and that the work had been carried on "at a sacrifice of money, time and efficiency."

It must be remembered, however, that the undertaking was one of stupendous magnitude, that the chief engineer was hampered by a pernicious patronage system, that he was obliged to obtain his information in a hurry, that his work was often hampered and delayed until parliamentary appropriations were forthcoming, and that he was overworked because he was obliged to divide his time between the Intercolonial and the Canadian Pacific during the first five of his nine years of service on the great transcontinental enterprise. These circumstances were recognized by the commission, as indeed they will be by all reasonable persons. And while there were differences of opinion as between Mr. Fleming and the commission, and while he, being human, doubtless made mistakes, no shadow of doubt as to his integrity ever existed. In one place in the report, referring to the engineering staff and its service generally, it is stated that they "have shown ability, zeal and the strictest integrity in the supervision of the work. . . . They have fought inch by inch and day by day against what they thought to be attempted encroachments on the part of the contractors' engineers."

In the same year the Canadian Pacific enterprise was taken over by a syndicate headed by George Stephen and Donald A. Smith, and the route west of Winnipeg was entirely changed, the line running much farther south and crossing the Rocky Mountains by the Kicking Horse Pass. The last spike on the through line was driven in 1885 at Craigellachie by Sir Donald Smith. At this ceremony Fleming was an interested spectator.

To Fleming the Pacific cable, with the larger related project of a world encircling state owned British telegraph system, was primarily a means of uniting the scattered members of a great and powerful empire. In addition it was a sound commercial enterprise and for upwards of twenty-five years he gave himself unsparingly to its advocacy. Of his services in that regard, Earl Grey, Governor General of Canada, said in Ottawa in 1907 that their recital suggested the missionary fervour of Saint Paul. "He has without hope of personal gain visited five continents; he has traversed all the great oceans, the Atlantic many times, and has given himself, his time and his substance ungrudgingly and without stint to the service of the Empire." Fleming hoped for an Imperial intelligence system serving the press of the Empire, whereby all its readers would be supplied with trustworthy information on all matters of prime concern to Britishers the world over. Fortunately he lived to see the realization of many of his fondest dreams.

It was in 1758 that the first meeting of the legislative assembly of Nova Scotia was held. The matter was brought to the attention of the members of the legislative council of that province during the session of 1908, noting that that was the one hundred and fiftieth anniversary of that important historic event, and of the beginning of autonomous government in the overseas possessions of the British Empire.

The significance of this fact appealed to Fleming's imperialism. Then a resident of Halifax, he addressed to the mayor of that city a public letter in which he suggested the marking of the event by the erection through popular subscription of a monument in the city of Halifax which to succeeding generations would stand as a tangible reminder of their inestimable heritage of self-government Subsequently he took the matter up with the lieutenant-governor of the province, suggesting that it be undertaken as a provincial enterprise, and offering a suitable site on his own estate for the purpose. Further reflection led to the belief that its erection should be made a national rather than a provincial matter, and finally that its historic importance warranted its being undertaken as an Imperial affair. The various governments of the self-governing possessions of the Empire were communicated with. Their response was hearty and general and on August 14, 1912, the monument was formally dedicated on behalf of the people of the British Empire by His Royal Highness the Duke of Connaught, Governor General of Canada, "as an embodiment of the spirit which animates the people of the Empire in both hemispheres—an attestation of the partnership of the sisterhood of nations all under one Crown." "We may rest assured," says Fleming, "that the British Empire, built up on the principles of freedom, justice, equal rights and the self-government of all its autonomous parts, is not destined to pass away like the empires of history. The new empire is inspired by a spirit unknown to the empires founded on absolutism. It is a union of free and enlightened communities, dedicated to the cause of commerce, of civilization and of peace; and who can doubt that such a great political organization is destined to endure. Every improvement in transportation, in postal arrangements and in telegraphy by land and sea, is calculated to facilitate inter-communications and to foster friendships among kindred people, and thus to perpetuate their attachment to the cradle of the British race, to the source of that unequalled constitution which is their highest inheritance "

Fleming's views as to the function of a modern university were expressed in his first address as Chancellor of Queen's University which position he assumed in 1880 and held until his death in 1915. University federation as against independence so far as Queen's was concerned, mental discipline as against the imparting of knowledge, the humanities as against the natural sciences were all discussed in succession, and after asserting that the aim of education is "to ennoble the propensities and tastes, to strengthen the moral sense and to fit man to discharge his duties as an intelligent being," he concluded by expressing his own opinion that a curriculum in which Latin and Greek do not predominate is one best suited to the needs of a young nation.

During the seventy years of his active life in Canada, Fleming witnessed the growth of the impotent colony of British North America into a proud and self-reliant nation. When he arrived in 1845, it possessed sixteen miles of steam railroad; when he died, it had completed three lines of transcontinental railway, which lines were exchanging traffic with Canadian-owned steamships on both oceans consigned to the ports of the seven seas. He saw the laying of the first trans-Atlantic cable to Canada in 1858, the construction of the Victoria tubular bridge at Montreal in 1859, and its replacement by a series of through trusses in 1898. He saw the Niagara suspension bridge erected in 1855 and its replacement by a magnificent steel arch 42 years afterwards. He witnessed the completion of two successive enlargements of the Welland canal in 1850 and 1883 respectively, and the commencement of the Welland ship canal whereby the usefulness of this historic waterway is to be still further extended. He saw the completion of the Sault Ste. Marie canal in 1895, the opening of the St. Clair tunnel in 1891, and the Detroit river tunnel in 1911, and those important improvements in internal navigation through terminal elevators, harbours, lake carriers and deepened canals which facilitate the transport of Canada's wheat to the markets of the world. He saw the beginnings of national conservation in Canada, a very material progress made in the utilization of the nation's magnificent waterpowers; and observed the stimulus given thereby to Canadian industry. He even lived to see the Great Lakes and deep waterways project within measurable distance of realization.

He witnessed the evolution of the electric telegraph and the telephone, the beginning of wireless, the introduction of electricity for illumination and power, and the perfection of its economical long distance transmission. The development of the internal combustion engine and its application to vehicle and aircraft propulsion in peace and in war was another epoch-making incident of his times. He observed the development of the superdreadnought, the submarine and the modern explosive. He saw the scientific method supplant empiricism in medicine, agriculture and industry, and observed the development of a sense of community responsibility in such matters as prison reform, child welfare and industrial relations. In all of these, he maintained an active and intelligent interest, and to many of them he made substantial contributions.

He lived through the stormy times preceding and following confederation, the Fenian raids of 1866, the north west rebellions of 1870 and 1885, and followed the acrimonious controversies respecting commercial union with the United States with which the names of Richard Cartwright, Erastus Wiman and Goldwin Smith were associated, but lived to see the day most gratifying to his Imperial sympathies, when this country became a united Canada and when sentiment favouring annexation with the great nation to the south had practically ceased to exist.

To what endowments of nature, habits of mind or traits of character did this career owe its success? What was there in the personality or abilities of Sandford Fleming that distinguished him from hundreds of engineers who have done good and honest work in the development of this country but who have won no place in science, in statecraft, or in epochal and national affairs? There are many things that might be mentioned. Fleming was a man of prodigious energy and indomitable perseverance and possessed almost limitless capacity for arduous work. His interests outside of his daily work were innumerable. In the furtherance of his objects he possessed endless patience, most of his major accomplishments being the result of years of persistent effort. He was an easy and comfortable speaker and possessed a facile pen. He was not hampered by undue modesty, for he knew his capabilities and used them to the full. In rather strange but probably unconscious contrast with this characteristic were some of his remarks concerning the work of engineers generally, on the occasion of a dinner given him in Ottawa by the engineers who had been associated with him in the survey and construction of the Canadian Pacific Railway. "Silent men such as we are" said he "cannot hope for profit or peace in law, cannot look for fame in press or pulpit, and above all things must keep out of politics . . . . Although we deal largely with figures, they are not figures of speech." His mind was of the analytical, incisive type which detects the impractical features in every scheme and never espouses a visionary one.

Like J. J. Hill, he possessed boundless industry and a capacity for handling large scale undertakings; like George Stephen and Donald Smith, he had, fifty years ago, a vision of and a faith in Canada's future which few men of the time possessed; like Cecil Rhodes he believed the British Empire to be a force in world politics making for ordered liberty, human progress and international peace—something to be consolidated, extended and perpetuated at almost any cost. His mentality however, was of a more delicate texture than that of any of the four. His tastes were catholic, his sympathies broad, his patriotism inspiring, his imagination magnificent, and no finer ideal for the young engineer aspiring to serve his time and country, is to be found in the history of Canada's material development than the career of this illustrious Empire builder.

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Recent Progress in Steam Production

The advance in steam power engineering practice during the last twenty years has been a striking one. In order to take advantage of the possibilities of the steam turbine, permitting a great increase in the size of individual power units and the employment of steam of high pressure and temperature, radical changes in boiler construction and operation have been necessary. Their introduction has involved prolonged experimental work, for the practical difficulties experienced in handling steam at 1,500 pounds pressure and at temperatures up to 1,000 degrees F. have not been easy to surmount. Designs and methods of construction which formerly gave acceptable results fail completely under the new requirements, and the problem of burning successfully the large amount of fuel required for a boiler evaporating as much as 400 tons of water per hour (the capacity of the units installed in a recent station) and the handling of the resulting ash requires very different treatment from that customary in the smaller units of the past.

As a result, there are many boilers now in operation which utilize in steam production from 85 to 90 per cent of the available heat of the fuel. This greatly increased efficiency has been made possible by adopting more scientific methods of combustion, by using more effectively the radiant heat of the fuel, by developing satisfactory methods of air preheating, and more particularly by the employment of very large boiler units.

At present the limit of pressure to be used commercially on a large scale in North America is about 1,500 pounds per square inch, although in Europe pressures considerably higher than this have been successfully employed. At such pressures special materials and methods of construction have been necessary, particularly as regards superheaters and steam drums, and it is possible that in the future for pressures of 2,000 to 3,000 pounds per square inch, drumless boilers will be developed. The seamless forged steel steam drums now in use for large high-pressure boilers present difficulties in construction and are costly. A drum* recently made for a working pressure of 1,405 pounds per square inch had to be forged from an ingot weighing over 300,000 pounds. The finished drum, 60 inches outside diameter, 52 inches inside diameter and over 40 feet long, weighed more than 106,000 pounds when machined to its finished dimensions.

Developments as startling as those in the steam-containing parts of the boiler have been made in the furnace. The principles governing the combustion both of pulverized and solid fuel are now better understood, and the economy to be obtained from air preheating is fully realized. Troubles arising from ash and flue-gas dust in large units have been successfully overcome, and progress in these respects has not been confined to boilers for stationary service. Several successful installations using pulverized fuel have been put in service for sea-going vessels.

It is well to note the present extended use of oil firing for boilers, experience with which has thrown light on many questions of combustion and heat transference which were previously imperfectly understood. Marked advances have been made in the difficult task of increasing the power and efficiency of the locomotive boiler, in which the unavoidable limitations of space and weight make it particularly difficult to secure the large output of steam required to haul modern passenger and freight trains. Locomotive boilers are now in daily use capable of evaporating as much as thirty tons of water per hour, with pressures up to 500 pounds per square inch, and using mechanical stokers.

Reference may also be made to the wider appreciation by steam users of the necessity for adequate records of boiler performance, and the resulting more general use of measuring instruments, such as thermometers, pyrometers, flowmeters and CO_2 recorders. All these factors have contributed to the general improvement in boiler operation and practice which is becoming evident.

There is still room for improved economic performance in many of the smaller boiler plants for heating and industrial purposes, in which so large a proportion of the world's fuel consumption takes place, but it seems certain that in the near future increasing use will be made in these installations of the experience obtained in the larger plants, thus leading to more scientific and careful operation, and more satisfactory results for the owners.

The Chute-à-Caron Obelisk

The Chute-à-Caron power plant is being constructed in a rocky section of the Saguenay, and in order to complete the large dam across the gorge it was necessary to excavate a diverting canal and turn the river through this new channel, while the dam foundations were constructed across the deep original channel. This diversion naturally required the damming of the original channel and local conditions and the extreme depth and high velocity of the water rendered the construction of a cribwork dam impracticable. It might be mentioned here that the Saguenay

*See Mechanical Engineering, August 1930, p. 751.

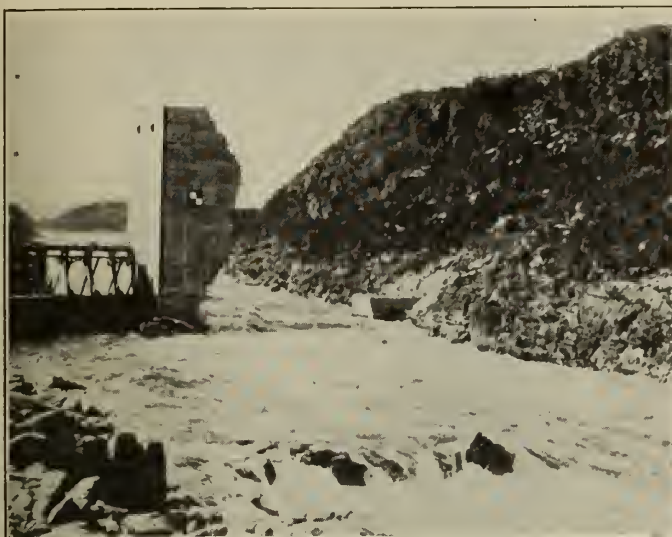


Figure No. 1.

Figure No. 3.

river has a flow varying from 35,000 to 225,000 cubic feet per second. It was therefore decided on the suggestion of James W. Rickey, M.E.I.C., Chief Hydraulic Engineer of the Aluminum Company of America, to close the channel by dropping a large reinforced concrete tower or obelisk into the channel. This operation has now been successfully completed and is illustrated in the accompanying photographs, furnished through the kindness of Mr. Rickey.

The obelisk was 92 feet high, 45 feet wide, and contained 5,500 cubic yards of concrete; one side was shaped so as to fit as nearly as possible the bottom of the river, and figure No. 1 shows the obelisk in its vertical position, a few moments before it was tipped into the river, which at that time was discharging about 35,000 cubic feet per second, with a maximum depth of 25 feet. The ragged edges on the contour side of the obelisk are pieces of heavy form timber that were left in place.

The obelisk was built several months beforehand and rested on the top of a concrete pier arranged so that by means of suitable blast holes the river side of the pier could be shot off, thus leaving the obelisk unsupported on that side. It was necessary to leave a heavy stream of water flowing down the old channel in order to form a cushion for the obelisk to fall into so as to avoid breakage. This precaution worked perfectly.

Figure No. 2 shows the obelisk in an inclined position, about three seconds after the supporting pier was shot away.

Figure No. 3 shows the conditions after a few seconds, when the obelisk had either just come into contact with the bottom of the river or was just about to do so. The small specks are the form timbers which were carried nearly 200 feet into the air as the water shot out from under the obelisk. The water was shot upward nearly 300 feet and went over the hill shown at the right of figure No. 1.

Figure No. 4 shows the obelisk in its final position, and was taken about five minutes after figure No. 3.

The obelisk landed in its final position within one inch of its calculated location. It was practically undamaged, there being only hair-line cracks on the top face in the prone position and on the downstream vertical face. One of the construction joints opened up about one-thirty-second of an inch. The obelisk was about 3 feet out of level, measured along a diagonal from the highest to the lowest point.

It will be noted that water is passing from the opening at each end of the obelisk. The opening at the left was unavoidable owing to the configuration of the supporting piers. That on the right was about 6 feet wide and was intentionally made so, in the absence of any previous experience of a similar type. As a matter of fact, in similar work in the future it would not seem necessary to allow more

Figure No. 2.

Figure No. 4.

than a two-foot opening, in which stop-log grooves could probably be left. There was, however, no difficulty in stopping the openings and within 72 hours of the felling a railway trestle had been built across the obelisk, both of the end openings were closed and the obelisk cofferdam was practically tight.

The total cost of the operation was less than $75,000, whereas, owing to the depth of the water, i.e., 25 to 40 feet deep, depending upon flood conditions, and the velocity of the current 20 to 30 feet per second, building the usual type of crib cofferdam would have involved a cost of some three to four hundred thousand dollars, and the cribwork might have been washed out by floods of 100,000 second-feet which have occurred since the obelisk was felled. In other words, the cost of cofferdamming a stream by this method can be determined in advance very accurately, whereas under the former methods one could not even make a shrewd guess as to the cost of cofferdams, particularly where heavy floods must be encountered after the building is commenced.

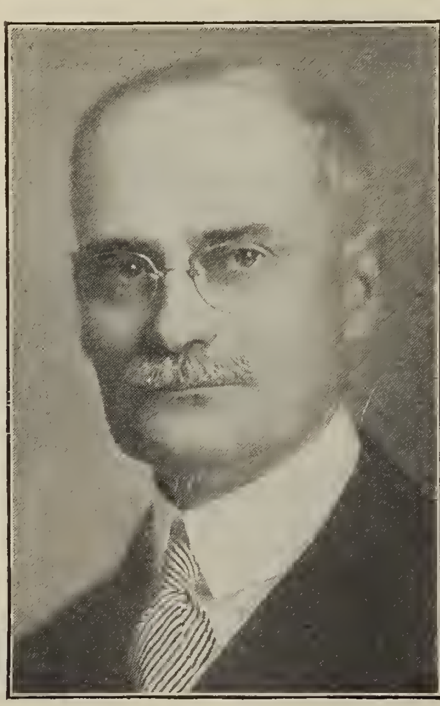
Application has been made for patent covering this operation in construction.

OBITUARIES

George Frederick Porter, M.E.I.C.

Members of The Institute will learn with regret of the death of George Frederick Porter, M.E.I.C., which occurred in Detroit, Mich., on September 19th, 1930.

Mr. Porter was born at Detroit, Mich., on October 7th, 1862, and received his early education at Detroit public schools. In 1886 he entered the engineering office of Mason L. Brown, and until 1894 was in charge of surveying parties. In 1894-1895 he was employed on a survey of the St. Clair and Erie ship canal, and in 1895-1896 he was with the Detroit Bridge and Iron Works as draughtsman. The following year was spent with the Keystone Bridge Company of Pittsburgh, Penn., after which time he returned to the Detroit Bridge and Iron Works for three years. In 1900 Mr. Porter became one of the founders of the Canadian Bridge Company, Ltd., at Walkerville, Ont., remaining there in charge of draughting until January 1909, at which time he joined the staff of the board of engineers appointed by the Dominion government in that year to design and supervise the construction of a bridge across the St. Lawrence river near Quebec to replace the one that collapsed during construction in August 1907. Mr. Porter remained in charge of the draughting department until the official design was completed in June 1910. In 1911 he was named as engineer of construction of the St. Lawrence Bridge Company, a corporation organized to carry out the construction of the Quebec bridge. In 1919 Mr. Porter returned to the Canadian Bridge Company at Walkerville, Ont., as chief engineer and in 1927 he was appointed consulting engineer of the company.



GEORGE FREDERICK PORTER, M.E.I.C.

On October 13th, 1921, on the occasion the of centenary celebration of McGill University, Mr. Porter was awarded the honorary degree of Doctor of Laws. In 1919 he was awarded the Gzowski Medal of The Institute with G. H. Duggan, M.E.I.C., and the late Phelps Johnson, M.E.I.C., for a paper entitled "The Design, Manufacture and Erection of the Superstructure of the Quebec Bridge."

Dr. Porter was a member of the Detroit Athletic Club, the Grosse Isle Golf Club, the Detroit Automobile Club, the American Society of Civil Engineers and the American Railway Bridge and Building Association. He joined The Institute as a member on April 17th, 1909, and took a keen interest in Institute affairs, having represented the Border Cities Branch on the Council in 1923.

William Grant Matheson, M.E.I.C.

It is with much regret that the death of William Grant Matheson, M.E.I.C., which occurred at New Glasgow, N.S., on September 12th, 1930, is reported.

Mr. Matheson was born at Albion Mines, N.S., on August 1st, 1848, and received his education at the public schools of Chatham, N.S., and the University of New Brunswick. In 1868 he went to Scotland, where he was apprenticed as a machinist to Baxter Brothers, Dundee, and to R. Napier and Sons, Glasgow. Returning to Canada in 1871, he entered the employ of I. Matheson and Company, New Glasgow, in January 1872. In 1874 he became manager of this firm, holding this position until June 1914, at which time he joined the Nova Scotia Steel and Coal Company. In 1921 Mr. Matheson's health compelled him to give up all active work and he retired.

Mr. Matheson took a great interest in steam boilers, which he made his specialty, and as the representative of Nova Scotia, he took a prominent part in the formulation of a uniform code of regulations for their construction and inspection in the various provinces of Canada. He took an active part in municipal affairs, particularly in connection with the construction of public works, and also in connection with the school board on which he served for ten years. Mr. Matheson was a member of the American Society of Mechanical Engineers and of the Association of Professional Engineers of Nova Scotia.

He was one of the oldest members of The Institute, having joined as a Member on February 3rd, 1887. He was placed on the retired list in April 1922.

William Falconer McKnight, A.M.E.I.C.

Members of The Institute will learn with deep regret of the death of Professor William Falconer McKnight, A.M.E.I.C., which took place in the Jordan Memorial Sanatorium, Riverglade, N.B., on August 25th, 1930.

Professor McKnight was born at Douglastown, N.B., on May 30th, 1884. From the local schools at his home he went to normal school, following which he taught school for

WILLIAM FALCONER McKNIGHT, A.M.E.I.C.

one term. Becoming interested in electricity, he served an apprenticeship with the Robb Engineering Works at Amherst, N.S., and entered the engineering school at Mount Allison in 1905. After two years he continued his studies at McGill University where he took the degree of B.Sc. with honours, in 1909.

Following his graduation Professor McKnight was associated with the Canadian General Electric Company in electrical design and transformer testing. He was next engaged with the Northern Electric Company in sales work and was later appointed director of the Educational Department of that company in Montreal. Following a year's recuperation from illness, in August 1921 he was appointed head of the electrical department of the Nova Scotia Technical College at Halifax, a position which he held until his death.

In addition to the general field of his activities, from time to time he took up special research and installation work which gave scope for his many interests and abilities. He served as acting secretary to the Board of Engineering Standards under the Research Council of Canada and helped to compile the first edition of the Canadian Electrical Code. Professor McKnight was a member of the American Institute of Electrical Engineers, the Association of Professional Engineers of Nova Scotia, and the committee on engineering physics of the National Research Council.

Professor McKnight joined The Institute as an Associate Member on April 27th, 1920, and took a keen interest in Institute affairs. He represented the Halifax branch on the Council in 1929 and was chairman of the same branch in 1925.

Arthur Knox Mitchell, M.E.I.C.

It is with regret that the death is recorded of Arthur Knox Mitchell, M.E.I.C., on April 27th, 1930.

Mr. Mitchell was born at Marietta, Ohio, on June 9th, 1887. He received his early education at preparatory schools in Massachusetts, and graduated from the Massachusetts Institute of Technology in 1909 with the degree of B.Sc.

Following graduation Mr. Mitchell was for a short time engaged on sewage disposal investigations with the Sanitary District of Chicago, later being connected with the Central Foundry Company, New York City, as engineer of pipe lines. He was for a time in charge of sewerage installation at Puebla, Mexico, and in 1910-1911 he was chief engineer in connection with the Ashcroft, B.C., irrigation project for the Quaker Oats Company, Ill., and in 1901 he became a member of the firm of Canavan and Mitchell, consulting engineers, Victoria, B.C. During the World War Mr. Mitchell was secretary of the War Industries Board and in 1919 he became associated with the St. Joseph Lead Company, New York, which position he held at the time of his death. In 1920 he invented an underground shovel used in mining and subway excavating.

Mr. Mitchell joined The Institute as an Associate Member on October 14th, 1913.

John MacKenzie Moore, M.E.I.C.

Deep regret is expressed in recording the death of John MacKenzie Moore, M.E.I.C., which occurred at London, Ont., on June 19th, 1930.

The late Mr. Moore was born at London, Ont., on October 1st, 1857. He received his early education in that town and serve five years' apprenticeship in the offices of Robinson and Tracy, architects and provincial land surveyors. From 1891 to 1910 Mr. Moore was engineer in charge of the waterworks system of the city of London and from that time on was engaged in private practice as a consulting engineer and architect.

Mr. Moore was a member of the Ontario Association of Architects and the Royal Architectural Institute of Canada, and was responsible for many prominent buildings in London. He took an active interest in civic affairs, having served as city controller for the year 1916-1917 and as mayor in 1926 and 1927.

Mr. Moore joined The Institute as an Associate Member on April 18th, 1922, and was transferred to the class of Member on October 24th, 1922.

PERSONALS

W. A. Madeley, S.E.I.C., is now a draughtsman with the Pacific Great Eastern Railway at Squamish, B.C.

Arthur Fraser, A.M.E.I.C., is now located at Launceston, Tasmania, Australia. Mr. Fraser was at one time with the Geodetic Survey of Canada, Department of the Interior, Ottawa.

Ezra B. Rider, A.M.E.I.C., formerly engineer with the Water Department of the City of Los Angeles, Calif., is now assistant engineer of the Metropolitan Water District of Southern California, Los Angeles.

J. A. Simmers, A.M.E.I.C., has joined the engineering staff of the Ontario Paper Company, Ltd., and is located at Thorold, Ont. Mr. Simmers was formerly structural engineer in the office of the architect, city of Toronto.

C. R. Townsend, Affil.E.I.C., formerly of the forestry department, Canadian Power and Paper Corporation, at Three Rivers, Que., is now chief forester of the Anticosti Corporation at Port Menier, Anticosti Island, Que.

H. R. Montgomery, S.E.I.C., who graduated from McGill University in 1929 with the degree of B.Sc., is with the Atlas Construction Company, Ltd., and the Standard Dredging Company, Ltd., on the West Saint John, N.B., harbour improvements.

Clyde B. Joy, Jr.E.I.C., is now designing engineer and estimator with the London Structural Steel Company, Ltd., London, Ont. Mr. Joy was formerly estimator with the Austin Company, Philadelphia, Pa. He is a graduate of the University of Toronto of the year 1924.

A. G. Graham, A.M.E.I.C., has been appointed city engineer of Nanaimo, B.C. Mr. Graham was at one time assistant engineer in the municipal engineer's office at Point Grey, B.C., and prior to his present appointment was on the engineering staff of the city of Vancouver, B.C.

W. S. McDonald, A.M.E.I.C., is now with the chief engineer's branch, Department of Railways and Canals, Ottawa, Ont. Mr. McDonald is a graduate of the University of Alberta of the year 1915, and prior to accepting his present position was with the Department of the Interior at Calgary, Alta.

D. C. Bryden, S.E.I.C., has joined the staff of the Winnipeg Hydro-Electric System, Winnipeg, as power sales engineer. Mr. Bryden, who graduated from the University of Alberta in 1928 with the degree of B.A.Sc., has been with the Canadian Westinghouse Company, Ltd., at Hamilton up to the present time.

A. T. Perrin, A.M.E.I.C., has been appointed chief engineer of the Whiting Corporation (Canada) Ltd., Toronto. Mr. Perrin was at one time with the mechanical department of the Dominion Bridge Company at Lachine, Que., and prior to accepting his present position was with E. A. Turner and Company, Toronto.

John H. Legg, S.E.I.C., has joined the staff of the Hudson Bay Mining and Smelting Company, Ltd., at Flin Flon, Man. Mr. Legg graduated from McGill University in 1929 with the degree of B.Sc., and since that time has been with the British Metal Corporation (Canada) at Montauban, Que., and Stirling, N.S.

Donald E. Burnham, S.E.I.C., has accepted a position as assistant engineer with the Hydro-Electric Power Commission of Ontario at Hamilton, Ont. Mr. Burnham, who graduated from the Nova Scotia Technical College in 1928 with the degree of B.Sc., was formerly with the Canadian Westinghouse Company at Hamilton.

T. H. Winter, A.M.E.I.C., has been appointed lecturer in engineering at the Memorial University College, St. John's, Nfld. Mr. Winter graduated from the Nova Scotia technical College in 1923, and prior to accepting his present position was with the New Jersey State Highway Department, Metropolitan Division, Newark, N.J.

D. H. McDougall, M.E.I.C., is president of the McDougall Engineering Company, Ltd., Toronto. Mr. McDougall was at one time president of the Nova Scotia Steel and Coal Company, Ltd., New Glasgow, N.S., and vice-president of the British Empire Steel Corporation, but has more lately been located in Toronto where he has been carrying on a practice as a consulting engineer.

Major C. A. Scott, A.M.E.I.C., for many years first assistant engineer, roadway section, Department of Works, and since 1928 with the contract department of the Robert Simpson Company, Ltd., of Toronto, has joined the staff of the Adams Furniture Company Ltd., Toronto, as manager of the contract department. Major Scott is a graduate of the School of Practical Science, University of Toronto, of the year 1909.

A. F. Bryant, M.E.I.C., who since 1927 has been manager of the Nashwaak Pulp and Paper Company at Saint John, N.B., is now technical director and adviser of the Canadian Pulp and Paper Association, and is located in Montreal. Mr. Bryant is a graduate of the University of New Hampshire, and has been in Canada for the past sixteen years. From 1914 to 1918 he was with the pulp and paper division of the Forest Products Laboratories of Canada, in 1918-1920 he was chemical engineer with Bennett Ltd., at Chambly Canton, Que., and from 1920 to 1927 Mr. Bryant was chemical engineer for the Laurentide Company Ltd., at Grand'Mere, Que.

W. H. Abbott, A.M.E.I.C., has become connected with the Newfoundland Light and Power Company, on the Pierres brook development, and is located at St. John's, Newfoundland. Mr. Abbott, who was formerly with the Foundation Maritime Company at Montreal, was at one time assistant superintendent for the Foundation Company of Canada, Ltd., on the construction of the Ghost power development for the Calgary Power Company. He was overseas from 1914 to 1919, and following his return to Canada in 1919 he was chief engineer of the Hull Electric Company. In 1922-1923 Mr. Abbott was on the engineering staff of the Gregory Commission on the Ontario Hydro-Electric enquiry, and from 1923 to 1927 he was principal assistant engineer with Beaubien Busfield and Company of Montreal, and later with Busfield, McLeod Ltd.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 5th, 1930, the following elections and transfers were effected:

Members

BREED, Charles B., B.S. in C.E., (Mass. Inst. Tech.), consulting engineer. 6 Beacon Street, Boston, Mass.

KAYSER, Nicholas James, B.Sc., (Univ. of Wis.), director, Fraser Brace Engineering Co. Ltd., Montreal, Que.

McCALL, Thomas Lockhart, (Heriot Watt Coll.), chief mining engineer, British Empire Steel Corporation, Ltd., Glace Bay, N.S.

Associate Members

‡BUCHANAN, Walter S., gen. supt., elect'l. contractor, Goulet & Belanger, Quebec, Que.

FERGUSON, William Patterson, B.Sc., (McGill Univ.), in charge of Sydney office, Peacock Bros. Ltd., Post Bldg., Sydney, N.S.

‡MacMILLAN, Kenneth L., engrg. dftsman., Canada Cement Company, Ltd., Montreal, Que.

‡PLATOU, Otto Stoud, concrete designer, Power Corporation of Canada, Montreal, Que.

WEICKER, Julius John, B.A.Sc., (Univ. of Toronto), consulting engineer, Cobourg, Ont.

Juniors

BRUMBY, Walter William, (City and Guilds of London), engrg. student, Canadian General Electric Co. Ltd., Peterborough, Ont.

COBBOLD, Robert James, (Assoc. City and Guilds Inst.), students' test course, Canadian General Electric Co. Ltd., Peterborough, Ont.

EVANS, Charles Durward, B.Sc., (McGill Univ.), 303 Milverton Boulevard, Toronto, Ont.

JONES, Arthur R., B.Sc., (Univ. of Alta.), test dept., Canadian General Electric Co. Ltd., Peterborough, Ont.

MORRISON, George Hawley, B.Sc., (N.S. Tech. Coll.), 27 Rupert Street, Halifax, N.S.

Transferred from the class of Junior to that of Associate Member

‡BRADLEY, Robert A., 65 Lowell Avenue, St. Catharines, Ont.

COOKE, Norman Melville, B.Sc., (Queen's Univ.), district engr., municipal roads, Department of Public Highways, Ontario, Ottawa, Ont.

‡HOLDER, George William, in charge of hydraulic dept., Abitibi Power & Paper Co., Sturgeon Falls, Ont.

HVILIVITSKY, Jakov, B.A.Sc., (Univ. of Toronto), struct'l. engr., Truscon Steel Co. of Canada, Montreal, Que.

PARKE, Charles Sager, B.Sc., (McGill Univ.), chief engr., The Harshaw Chemical Company, Cleveland, Ohio.

PLOW, John Foss, (Grad. R.M.C.), asst. to the secretary, The Engineering Institute of Canada, Montreal, Que.

Transferred from the class of Student to that of Associate Member

ARMSTRONG, Lawrence Henry, B.Sc., (McGill Univ.), in charge of operation of Madrid-Buenos Ayres radio telephone link, Compania Telefonica Nacional de Espana, Madrid, Spain.

McINTOSH, John Cameron, B.Sc., (Queen's Univ.), asst. to res. engr. on constrn. of Cedar Rapids storage dam on Lievre River, Notre Dame du Laus, Que.

SMITH, Hamilton Ellesmere, B.Sc., (McGill Univ.), secretary and engr. in charge of constrn. work for F. H. McGraw, 51 East 42nd Street, New York, N.Y.

‡Elected after passing Institute's examinations under Schedule "C."

Transferred from the class of Student to that of Junior

SCADDING, Simcoe Crawford, B.A.Sc., (Univ. of Toronto), statistician, The Bell Telephone Company of Canada, Montreal, Que.

Students Admitted

GRANT, Donald Seafield, estimating dept., Eugene F. Phillips Electrical Works, 5795 de Gaspe Avenue, Montreal, Que.

FOSTER, Eldon Barry, B.Sc., (Univ. of N.B.), student engr., Canadian General Electric Co. Ltd., Peterborough, Ont.

HAWKE, Charles Edison, (Undergrad., Univ. of Toronto), 1206 Mackay Street, Montreal, Que.

MIDDLETON, Oliver, B.A. (Eng.) Cambridge Univ., (Undergrad., McGill Univ.), 3559 University Street, Montreal, Que.

PERLSON, Ellsworth Hartland, (Grad. R.M.C.), (Undergrad., McGill Univ.), 99 Cedar Avenue, Pointe Claire, Que.

RECENT ADDITIONS TO THE LIBRARY

Proceedings, Transactions, etc.

Presented by the Societies:
- Institution of Civil Engineers of Ireland: Transactions, vol. 55, 1930.
- Cleveland Engineering Society: Membership Directory and Constitution, 1930.
- National Electric Light Assoc.: Public Relations, National Section: Proceedings of the First National Home Service Conference.
- The Institution of Civil Engineers: Minutes of Proceedings, Vol. 228, 1928-29.
- American Institute of Electrical Engineers: Transactions, Vol. 49, No. 3, July, 1930.
- Empire Council of Mining and Metallurgical Institutions: Third (Triennial) Empire Mining and Metallurgical Congress, South Africa, March 24th to May 9th, 1930.
- University of Toronto, Engineering Society: Transactions and Year Book, April, 1930.

Reports, etc.

Department of Mines, Mines Branch, Canada:
- Investigations of Mineral Resources and the Mining Industry, 1928.
- Investigations in Ore Dressing and Metallurgy, 1928.

Department of National Defence, Canada:
- Report on Civil Aviation and Civil Government Air Operations for the Year 1929.

Topographical Survey, Canada:
- Map of Selkirk, Manitoba.

Department of Mines, Ontario:
- Bulletin No. 73: Mineral Production of Ontario for the first six months of 1930.

Bureau of Mines, United States:
- Bauxite and Aluminum in 1928.
- Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1928.
- Gold, Silver, Copper, Lead and Zinc in Nevada in 1928.
- Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1928.
- Gold, Silver, Copper, Lead and Zinc in Montana in 1928.
- Lead in 1928 (General Report.)
- Cement in 1928.
- Asphalt and Related Bitumens in 1928.
- Coal in 1928.
- Mica in 1928.
- Petroleum in 1928.
- Coke and By-Products in 1928.
- Rare Metals in 1928.
- Lime in 1928.
- Natural Gasoline in 1928.
- Silica in 1928.
- Abrasive Materials in 1928.
- Fluorspar and Cryolite in 1929.
- Fuel Briquets in 1929.
- Technical Paper 461: Salvage of Material in the Oil Industry.
- 465: Analyses of Maryland Coals.

National Research Council, Division of Engineering and Industrial Research, United States:
- Five Years of Research in Industry, 1926-1930.

Treasury Department, Public Health Service, United States:
- Observations on the Possibility of Methyl Chloride Poisoning by Ingestion with Food and Water.

International City Managers' Assoc., Chicago:
- Recent Trends in American Municipal Government.

Sewerage and Water Board, New Orleans:
- Sixtieth Semi-Annual Report, Dec. 31, 1929.

State Board of Engineering Examiners, South Carolina:
- Eighth Annual Report to the Governor, Year Ending June, 1930.

University of California, Department of Geological Sciences:
- Bulletins: [1.] Osteology and Affinities of Borophagus.
  - [2]. A New Genus of Soricidae from the Barstow Miocene of California.
  - [3]. Allocyon, A New Canid Genus from the John Day Beds of Oregon.
  - [4]. The Quartz Basalt Eruptions of Cinder Cone, Lassen Volcanic National Park, California.
  - [5]. The Classification and Correlation of the Pre-Cambrian Rocks.

University of Michigan, Department of Engineering Research:
- The Surface Water of Michigan: Hydrology and Qualitative Characteristics and Purification for Public Use.
- Formation and Properties of Boiler Scale.

Rensselaer Polytechnic Institute:
- Engineering and Science Series No. 29: A Short History, [Hundredth Anniversary of the Foundation of Rensselaer Polytechnic Institute].

Public Library of The City of Boston:
- Seventy-eighth Annual Report, 1929.

Iron and Steel Institute:
- Advance Papers: [1]. High-Frequency Steel Furnaces.
  - [2]. Permanence of Dimensions Under Stress at Elevated Temperatures.
  - [3]. The Heterogeneity of an Ingot made by the Harmet Process.
  - [4]. A Contribution on the Constitution of the Fe-C-Si System.
  - [5]. A Contribution to the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.
  - [6]. The Magnetometric Determination of the Curie Points.
  - [7]. What Reasons Compelled the Prague Ironworks Company to Introduce Thin-Walled Blast-Furnaces?
  - [8]. The Effect of Contamination by Nitrogen on the Structure of Electric Welds.
  - [9]. The Quantitative Analysis of Steels by Spectrum Analysis.
  - [10.] The Mechanism of the Solution of Cementite in Carbon Steel and the Influence of Heterogeneity.
  - [11]. Open-Hearth Furnace Steelworks.

Technical Books, etc.

Presented By M. L. de Angelis, A.M.E.I.C.:
- Machinery's Mechanical Library:
  - Vol. 1: Turning and Boring, by F. D. Jones.
  - Vol. 2: Planing and Milling, by F. D. Jones.
  - Vol. 3: Drilling Practice and Jig Design, by F. D. Jones.
  - Vol. 4: Advanced Grinding Practice, by F. D. Jones.
  - Vol. 5: Modern Toolmaking Methods, compiled and edited by F. D. Jones.
  - Vol. 6: Diemaking and Die Design, compiled and edited by F. D. Jones.
  - Vol. 7: Tools, Chucks and Fixtures, by A. A. Dowd.
  - Vol. 8: Heat Treatment of Steel, compiled and edited by Erik Oberg.
  - Vol. 9: Spur and Bevel Gearing, compiled and edited by Erik Oberg.
  - Vol. 10: Spiral and Worm Gearing, compiled and edited by Erik Oberg.
  - Vol. 11: Automatic Screw Machines, by D. T. Hamilton and F. D. Jones.
  - Vol. 12: Oxy-Acetylene Welding, by S. W. Miller.

Presented by E. & F. N. Spon, Ltd:
- Arrol's Reinforced Concrete Reference Book, by E. A. Scott.

Presented by Morgan Bros. (Publishers), Ltd.:
- The Engineer's Year-Book of Formulae, Rules, Tables, Data and Memoranda for 1930, Thirty-seventh Annual Issue, revised under the direction of the Editor of "The Engineer."

Presented by McGraw-Hill Book Company, Inc.:
- Piping Handbook, by Walker and Crocker.

Presented by D. Van Nostrand Company, Inc.:
- Colloid Chemistry, by J. Alexander.

Presented by American Railway Association, Signal Section:
- American Railway Signaling Principles and Practices: Chapter 12: Semaphore Signals.
- American Railway Signaling Principles and Practices: Chapter 13: Light Signals.

Presented by Poole Engineering and Machine Co., Baltimore, Md.:
- Flexible Couplings.

Presented by Highway Education Board, Wash., D.C.:
- Highways Handbook, 1929 edition.

BOOK REVIEWS

Industrial Accounting for Executives

By J. R. Bangs, Jr. McGraw-Hill Book Company, New York, 1930, buckram, 6 x 9 in., 449 pp., figs., tables, $5.00

This book deals principally with features of industrial accounting relating to the manufacturing and cost problems confronting the factory accountant, and also contains several chapters on corporate accounting dealing with the structure of balance sheets and the fundamental book entries necessary to set up typical financial transactions.

The subject of distribution of factory expense is concisely and fully covered, with particular reference to the operation of machine rates. The relationship of factory cost systems to the financial books is also explained and standard costs, the use of which are being more generally adopted, are dealt with at some length. The various methods of accounting for depreciation, obsolescence and depletion are also discussed and the advantages and disadvantages of each method set forth.

That part of the volume dealing with corporate accounting illustrates in a very simple manner the various accounts common to the majority of industrial organizations, and the book entries and principles of double-entry bookkeeping are explained by the use of chart illustrations. The preparation of a balance sheet and the explanations of fixed assets, current assets and liabilities, capital, etc., are dealt with and the procedure necessary to close the financial books of a business at the end of a fiscal period is outlined. The methods of analyzing balance sheets so as to determine the financial standing of a company are also touched upon. Other chapters deal with various phases of accounting practice of general interest.

This book can be recommended as being a presentation of the fundamentals of accounting, drawn up in a concise manner suitable for those desiring a text-book free from detailed explanations found in more comprehensive volumes on accounting practice.

K. W. Dalglish, C.A.,
General Auditor,
Northern Electric Company, Limited,
Montreal, Que.

Strength of Materials

Part I: Elementary Theory and Problems.
Part II: Advanced Theory and Problems.

By S. Timoshenko. Van Nostrand Company, New York, 1930, buckram, 6 x 9 in., 735 pp., figs., tables, Part I, $3.50, Part II, $4.50.

The preface to Part I states that "the first volume contains principally material which is usually covered in required courses of strength of materials in our engineering schools. The more advanced portions of the subject are of interest chiefly to graduate students and research engineers, and are incorporated in the second volume of the book. This contains also the new developments of practical importance in the field of strength of materials."

" .... in deriving the theory of the deflection curve, the area-moment method is used .... in discussing statically indeterminate systems, the method of superposition is applied.... For explaining combined stresses, use is made of Mohr's circle .... "

Part I contains ten chapters covering tension and compression within the elastic limit, combined stresses, torsion, stresses in beams, deflection of beams, statically indeterminate problems in bending, beams of materials which do not follow Hooke's Law and beams of two materials, stresses due to direct and bending loads, combined bending and twist, and energy of strain. An appendix deals with moments of inertia of plane areas.

Part II consists of seven chapters. Six are devoted to about fifty problems encountered in structural design and machine design. The seventh chapter discusses mechanical properties of materials.

There are an author index and a subject index to each volume.

Frequent footnotes contain references to sources (mainly European).

The preface to Part II contains the suggestion that this part may be used as a basis for three advanced courses: one for students interested in structural engineering, one for students interested in machine design, and a third in testing of materials of construction.

The author has maintained throughout the point of view of *applied* mechanics.

Topics are presented in concrete form which enables the student to appreciate in each case its applications to practical design and makes the book a valuable one for the reference shelf of the designer.

There is a good variety of practice problems without useless repetition.

R. S. L. Wilson, M.E.I.C.,
Dean, Faculty of Applied Science,
University of Alberta,
Edmonton, Alberta.

Photoelectric Cells

By N. R. Campbell and D. Ritchie. Sir Isaac Pitman & Sons, London, Eng., 1929, buckram, 5½ x 8½ in., front., figs., charts, 15/- net.

This book is a comprehensive treatise on the theory, uses and practical application of the photoelectric cell, and is written in such a way that it can be read with pleasure by any one interested in the subject. The authors have dealt with all the phases of this novel and interesting device, and have subdivided the theoretical and practical aspects in such a way as to make the book useful both as a text and as a work of reference. A considerable amount of experimental data is given which would be useful for any one engaged either in development or research. There are numerous reference to articles on allied subjects so that fundamental information dealing with almost any phase of photoelectric emission can be found very readily. There is also considerable information dealing with methods of associating photoelectric cells with such auxiliary devices as amplifiers or recording instruments.

With the advent of sound pictures and television the photoelectric cell has found a wide field and, in fact, cannot be replaced by any other device known at the present time. As yet, the average layman, like a good many engineers and physicists, has not had much occasion to delve into the technical aspects of the photoelectric cell, which will undoubtedly find application in a great many places where present needs are served by crude and inadequate devices. Electron emission from light sensitive surfaces provides a phenomenon which is ideal for effecting remote control by changes in light intensity, and a number of recording devices, other than for sound recording on films, have already found practical application. This book, therefore, comes at a very opportune time and engineers, physicists and amateurs will find in its pages a large amount of useful information.

H. J. Vennes, A.M.E.I.C.,
Transmission Engineer,
Northern Electric Company, Ltd.,
Montreal.

Kempe's Engineer's Year Book for 1930

Revised under the direction of the Editor of "The Engineer." Morgan Bros. (Publishers) Ltd., London, W.C. 2, 1930, morocco, 4¾ x 7 in., 3042-xlv pp., figs., tables, £1-11s.-6d., net.

A single volume of over three thousand pages, which is well bound, opens easily for reference, lies flat, is adequately indexed and contains a compendium of data on "civil, mechanical, electrical, marine, gas, aero, mine, and metallurgical engineering" is something of an achievement in bookmaking. Such is the 37th annual issue of "Kempe." Its principal difference from earlier editions is the omission of Section I, containing mathematical tables readily found elsewhere, and the use of the space thus saved for additional purely technical information. The work is now published under the direction of the Editor of "The Engineer," and fully maintains its high original standard.

The sources from which the information has been drawn are given in most cases, but in some instances, as for example the article on detonation in automobile and aero engines, the date of the article is not stated, though it could of course be ascertained from the reference. The selection of subjects is admirable and the book can be recommended as an excellent work of reference on almost every conceivable engineering topic.

American Railway Signaling Principles and Practices

Chapter XII: Semaphore Signals.
Chapter XIII: Light Signals.

Published by the Signal Section, American Railway Association, New York, 1930, paper cover, 6 x 8¾ in., 84 and 47 pages, respectively, figs., charts, tables, $0.25 each.

The American Railway Association Signal Section have now published two additional chapters, XII and XIII, in their series of Manuals of American Railway Signal Practice. This series was reviewed in the July number of The Engineering Journal, and, when complete, will cover all phases of American Signalling Practice. A complete list of the chapters now available is as follows:

Chapter II: Symbols, Aspects and Indications.
" V: Batteries.
" VI: Direct Current Relays.
" VII: Direct Current Track Circuits.
" VIII: Transformers.
" X: Alternating Current Relays.
" XI: Alternating Current Track Circuits.
" XII: Semaphore Signals.
" XIII: Light Signals.
" XXIII: Highway Crossing Protection.

The chapters now issued deal respectively with semaphore and light signals, and give the latest authoritative information on the equipment for these which is now standard on American railways. They are, of course, descriptive, and are fully illustrated so as to give those concerned in the use of this apparatus all necessary instructions for erection and operation.

Semaphore signalling on railways dates from 1841, when its development began in England, the mechanically operated type of semaphore having been gradually replaced by power operated signals actuated either by compressed air with electrically operated valves, or by electric motors operating on either direct or alternating current.

The obvious advantages of a signalling system having the same aspect by day or by night led to prolonged experiment on light signals of various types, and the efficient means of illumination now available have led to the development of luminous signals, lamps of sufficient brilliancy, with lenses and reflectors of proper design, making it possible to use such signals in daylight as well as at night. All the regular types of light signals are discussed, and the pamphlets form a striking illustration of the remarkable change in railway signalling methods which has taken place during the past ten years.

Like the other pamphlets in the series, the chapters now published are provided with a series of questions covering the principal topics dealt with, thus making the booklets very useful for instructional purposes.

Piping Handbook

By J. H. Walker and S. Crocker, with contributions by others. McGraw-Hill, New York, 1930, leather, 4¾ x 7¼ in., 763 pp., figs., tables, $5.00.

This volume adds another to the long list of handbooks dealing with specialized branches of engineering, its purpose being to provide authoritative and accurate information for the engineer interested in piping work. It is no mere collection of rules and tables. For example, the authors, in chapter II, have dealt briefly but adequately with such portions of the theory of the flow of fluids as are needed in the design of piping systems, and have given in chapter VII an excellent résumé of the elastic properties of straight piping and bends, giving methods for computing the expansion stresses and anchor thrusts in pipe lines. On some of the subjects treated, such as oil piping (chapter XIV), but little information has hitherto been available.

The authors have been aided by other contributors, whose assistance is duly acknowledged in connection with their specialized subjects, and free use has been made of the more recent specifications for material, valves, fittings, etc. The illustrations are numerous and clear, and include many charts and nomograms. References to authorities quoted are given throughout. There is a good index, and the volume is not too large or heavy for convenient use.

The general scope of the work is wide, covering, in addition to the topics already mentioned, such branches as the metallurgy of piping materials, the requirements due to high temperature and pressure, heating insulation, pipe supports, heating and plumbing systems for buildings, underground steam piping, piping for fire protection and water supply, and gas plant piping.

The book can be recommended as a work of reference for any engineer responsible for the design or construction of modern piping systems.

Arrol's Reinforced Concrete Reference Book

By Ernest A. Scott. E. & F. N. Spon, Ltd., London, S.W. 1, 1930, buckram, 5½ x 8½ in., 283 pp., illus., diagrs., formulae, graphs, tables, 16s. net.

Any manual summarizing the methods of calculation, and giving the specifications and tables for detail designing, which are employed in regular practice by a contracting firm of the standing of Sir William Arrol & Company, Limited, is worthy of attention. The book under review deals with reinforced concrete construction, and is a companion volume to the Bridge and Structural Engineer's Handbook, now in its second edition, embodying the same firm's practice in steel construction and issued by the same publishers. These books, of course, deal particularly with British methods and are intended to assist designers and constructors in carrying out their work; incidentally, they illustrate the firm's methods and achievements.

Section I of the Reinforced Concrete Reference Book consists of a series of photographs of typical reinforced concrete structures; Section II gives the formulae to be used for members subject to flexure; Section III deals with standard specifications and regulations; and Section IV contains a series of Tables for use in detail designing.

It is interesting to note that in Britain, with the exception of the British Standard Specifications and certain reports of the Institution of Structural Engineers, there are at present few authoritative publications regulating the use of reinforced concrete. In drawing up the volume now published the author has, therefore, consulted the most recent regulations elsewhere, covering both European and American practice, and including the building codes of New York, Chicago, and Sydney, N.S.W. Documents such as the United States Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, 1924, and the Canadian Engineering Standards Association's Standard Specification for Concrete and Reinforced Concrete have also been drawn upon and those provisions selected which appear best suited to British requirements.

The volume thus contains in accessible form and reasonable compass a body of information required in reinforced concrete design. If due allowance is made for the differences in local conditions, it will be found of considerable utility as an office reference book.

Electric Light and Power*

The electric light and power industry grows faster than the population of the country. It is inevitable that the size of the industry should attract attention. Indeed, for many years, close observers have predicted that, notwithstanding great economies and public benefits, the danger which confronts the industry is that its phenomenal growth will outgrow public understanding. Yet all the canons of economics indicate that in the public utility business, consolidations and mass production are prerequisites to sound growth and low cost of service.

The policy of effecting physical interconnection of electric systems to embrace widespread geographic areas has been continuously advocated. It is basically sound and economically unassailable. The lower costs and better service which have accompanied interconnection amply justify the continuance of the policy. Without interconnection and co-ordination of the facilities by merger or through the common control by the holding company, high-grade electric service would not have been available to the small towns and villages or to the farms of the country. Reliable, abundant, and low cost power is vital to the nation's industries, communities, homes and farms. This quality of service is in turn dependent on large-scale production and on the managerial, financial and technical ability which large companies alone can command.

Large productivity, higher wages, shorter hours, better working conditions, position in world's markets and maintenance of general prosperity depend in a great measure on the application of electricity. It is doubtful if any economic or social force has exerted a more positive influence on the daily lives of so many people and certainly none has contributed more to comfort, convenience and to the fullness of life.

In the last five years:

1. The use of electricity in American homes has increased 70 per cent including that used in homes added to the systems in the period.
2. The unit price of household electricity has decreased 15 per cent, effecting an aggregate estimated saving of 230 million dollars.
3. Although the average home has increased its consumption of electricity by 27 per cent, the monthly bill has gone up but 7 per cent. Of the total expenditures made to meet living costs, those for electricity take less than 2 per cent.

Public regulation, by commissions devoting their time exclusively to this work and staffed with competent technical and legal advisers, has brought benefits to the public, and economic values to the nation. Regulation should be established on such a sound and equitable basis as to commend itself to the public served and not deny to the public utility the opportunity to earn that reasonable rate of return on the value of the facilities devoted to the service necessary to enable it to secure the additional capital needed to make the improvements and extensions requisite to provide increasingly efficient and economical service to ever-expanding territories.

The best judgment is that during the next ten years, to adequately meet the requirements of the nation, the output of electricity will have to be doubled. The benefits accruing to the whole national life—economic, industrial and social—attainable from this larger use of electricity, are beyond visualization.

It is clear that to raise the large sums of money required now and year by year, the utility companies must merit and receive the high degree of confidence which has enabled them to finance these large programmes of expansion. Investors in the business, now numbering more than three millions, have shown this confidence.

Obviously, if by unduly restrictive legislation, political abuse, or unjustifiable attacks on the utilities, public confidence is disturbed, electrical development will, as a consequence, be rendered more difficult, less economical, and wider extension will be restricted. In such a situation, the utilities will be injured beyond question, but the injury and the deprivation to the public will be infinitely greater.

**Abridged from the report of the Public Policy Committee of the National Electric Light Association. Presented at the fifty-third convention of the N.E.L.A. at San Francisco, 1930.*

Dodge Manufacturing Company, Toronto, are issuing a new publication entitled "Material Handling News," the first issue of which appeared in July of the current year. Although this is primarily an advertising medium, it is being edited and published by the company's engineering department, with the idea of putting into the hands of those interested a monthly paper on materials handling. In each issue the first two or three pages will be devoted to an article on materials handling copied from one of the leading technical or trade journals setting forth the latest developments in this field, and the remainder of the paper will contain items relating to the company's own product and its own advertising. Copies of the Material Handling News may be obtained by addressing the Dodge Manufacturing Company, Ltd., Toronto, Ont.

Graphs for Design of Reinforced Concrete Beams

(Blue Prints Available)

The graphs for the design of reinforced concrete beams, by C. G. Moon, A.M.E.I.C., published on pages 559 and 560 of The Engineering Journal for September 1930, were necessarily reproduced to a somewhat small scale. Through the kindness of the author a limited number of large scale blue prints of these, taken from the original tracings, have been placed at the disposal of members who desire them, and copies can be obtained on application to the General Secretary.

The full-size blue prints, of course, permit of much more accurate readings than is possible with the small scale reproductions.

A New Method of Gathering Peat

Peat is a valuable fuel when properly dried and handled. Methods of treating it hitherto devised have been found so expensive, however, that in many localities which contain peat deposits these are not utilized at all. Many efforts have been made to develop cheaper and more efficient methods of preparing peat for the market, but these usually require expensive machinery, or large amounts of space, or have other drawbacks which have prevented their general adoption. A method which has been recently devised and applied successfully in some large peat bogs in Russia includes features not previously used and may prove of interest in Canada. It is based on sun-drying, the only economical means of separating moisture from peat. Methods hitherto employed require the excavation of the entire depth of the bog. The wet peat is brought to the surface and spread out to dry, and after about a month, when dried to 30 or 45 per cent moisture content, is cut up and stored in piles. This treatment requires a good deal of power and labour for excavating the peat and transporting it with its high percentage of moisture; the peat prepared by these methods has so far been unable to compete effectively with other forms of fuel.

The essential feature of the Russian method consists in gathering the peat as a fine powder, which is dried out from the surface of the bog in thin layers. This drying of the peat in the open air is accelerated by its pulverization. In working a bog by this method the peat is prepared for working by draining by means of open ditches. The top layer of moss and turf is first removed, and as a rule the portion of land to be dealt with is surrounded by a deep trench, into which the water is led from a system of drains covering the area to be worked. The prepared bed of peat is cut up on the surface by a suitable tractor-driven cutter to a depth of about four inches, and this milling is done on alternate strips about seven feet in width. Care must be taken to avoid the danger of breaking the cutter on stumps. After cutting the milled peat is piled on the strips left unmilled for that purpose, forming pointed rows in the centre of the strip. Under the action of the sun and wind, the peat is quickly dried on the surface of the rows. The dried part is raked off to the depth to which it has dried and piled in two new rows on the sides of the original row. The uncovered wet peat in the original hill then continues drying, and during the working day the removal of layers is repeated many times. When completed the dried peat is piled in cone-shaped heaps. If necessary the peat in these heaps can be subjected to further drying by means of repeated removing of dried peat layers. This process takes about four days in favourable weather, and ten days in bad weather, and the finished peat has a moisture content of from 25 to 50 per cent.

This process, known as the Korelin method from the name of its patentee, has been employed in the United Soviet States of Russia on a large scale and the cost is stated to have been only about half that of peat prepared by the older processes.

The milled peat is not briquetted or compacted, but is burned in special furnaces like those for pulverized coal. Briquettes can, however, be prepared from it at a very low cost.

Additional information regarding this development may be obtained from the Amtorg Trading Corporation, New York City, the American representatives of the new Russian industrial developments.

The North York Hydro-Electric Commission have recently completed a test panel for the accurate and convenient testing of all types of watthour meters.

Variations of current on ¼ ampere steps to 10 amperes may be obtained either direct through the meter under test or through the primary of the step-up loading transformer.

For testing 3-wire meters, a three-pole double-throw switch transfers the load from one series coil to the other and at the same time retains line-side connection for the potential coil.

A 0-110/220/550 volt auto-transformer furnishes voltage for meters of various ratings. Convenient terminals for connecting a rotating standard are provided. Two hanger straps support a small front panel upon which the meter under test is placed. These can be seen in the photograph and serve to keep the meter away from stray fields and within convenient distance of the operator. Leads to the meter are flexible and weighted below like those on a telephone switchboard, keeping them out of the way when not in use.

A separate test rack provides for ten meters under dial test.

An adjunct to the panel is a small air compressor and trigger nozzle which facilitates removal of dust from working parts of the meter.

BRANCH NEWS

Cape Breton Branch

S. C. Mifflen, M.E.I.C., Secretary-Treasurer.
Louis Frost, Branch Affiliate, Branch News Editor.

The Cape Breton Branch of The Institute staged a very successful picnic on September 9th. The arrangements for the outing, the first of its kind attempted in Cape Breton and somewhat in the nature of an experiment, were under the capable direction of the past-president of the Branch, Mayor Michael Dwyer, of Sydney Mines.

The largely attended party of members and their ladies congregated in Sydney, whence they proceeded to Mira Ferry, where a delightful afternoon was spent in games. Toward evening the company gathered around an old fashioned campfire where all joined in a happy singsong and in story telling, the ladies enhancing the happy occasion by serving a delicious luncheon.

The outing concluded with a dance at the Mira Ferry pavilion, which continued until a late hour, those present having a very enjoyable time.

Hamilton Branch

John R. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. A. M. Galilee, Affiliate E.I.C., Branch News Editor.

EXECUTIVE MEETING, AUGUST 27TH.

A luncheon executive meeting was held on Wednesday, August 27th, at the Wentworth Arms hotel, to arrange for the opening meeting of the Branch in September. A. J. Grant, M.E.I.C., having promised to address the Branch on Institute affairs for the first meeting, it was decided to hold it in the Royal Connaught hotel on September 11th.

It was further decided to instruct the Secretary to get in touch with the A.S.M.E., Ontario Section, to see if a joint meeting of that body and The Institute Branch might be arranged.

Including the chairman, there were six present.

OPENING MEETING, SEPTEMBER 11TH

The first meeting of the 1930-31 season of the Hamilton Branch was held in the grill room of the Royal Connaught hotel. It was a happy thought that the President of The Institute, A. J. Grant, M.E.I.C., should be the speaker for this opening meeting and that there should be such a good turn out of members from the Niagara Peninsula Branch. During the evening Mr. Anderson sang. Those seated at the head table were Messrs. W. F. McLaren, M.E.I.C., A. J. Grant, M.E.I.C., E. G. Cameron, A.M.E.I.C., R. K. Palmer, M.E.I.C., E. H. Darling, M.E.I.C., F. L. Haviland, M.E.I.C., C. G. Moon, A.M.E.I.C., H. A. Lumsden, M.E.I.C., J. K. Davidson, Jr.E.I.C., and W. L. McFaul, M.E.I.C.

Mr. Palmer, who had to leave early, spoke in favour of the Hamilton resolution.

"That section 5 of the By-laws be deleted:

Section 32 delete "Affiliates $10.00" and add "Affiliates" to last sentence.

That section 34 read as follows:—

The annual fees shall be as follows:—

		If paid on or before Mar. 31st.
Members	$13.00	$12.00
Associate Members		
First 10 years	11.00	10.00
After 10 years	13.00	12.00
Juniors	7.00	6.00
Students	2.00	1.00
Affiliates	9.C0	8.00

That the first paragraph of section 56 be deleted and the following substituted:—

The secretary of The Institute shall each year remit to each branch an allowance of $150.00 and in addition a rebate of 10% of the annual fees, current or arrears, received from the members of that branch during the year, payments being made quarterly.

That copies of this resolution be forwarded to headquarters and to each Branch."

THE FUTURE OF THE INSTITUTE AND HOW TO IMPROVE FINANCES AND INCREASE MEMBERSHIP

Mr. McLaren, in introducing the speaker, thanked the members for honouring him by electing him chairman of the Hamilton Branch.

Mr. Grant, whose subject was "The Future of The Institute and How to Improve Finances and Increase Membership," expressed himself as being not only pleased to be present at Hamilton, but that he was fulfilling a duty by being present. The more exchanges that take place among the branches, as exemplified by the presence of the Niagara Peninsula Branch, the better it would be for The Institute at large.

He then proceeded to outline some of the points that are to be discussed at the forthcoming Plenary Meeting of Council. The primary question is—Increased membership is necessary or else the subscriptions will have to be increased. The source of revenue is from the members alone. The fees, in comparison with those of other societies, are extremely small. The council, however, is on the horns of a dilemma because the members have been canvassed twice, and on the last occasion only 946 members voted out of about 3,300 who were eligible, the ayes getting 627 votes, the nays 319. The motion was therefore lost by 4 votes which were necessary to obtain a two-thirds majority. This small interest was disappointing to the council. However, Mr. Grant was emphatic in his statement that by some means or other, revenues must be increased.

One solution of the problem of increased revenues is by increasing the membership. There are eight separate professional associations with standings varying in quality; their members should be members also of The Engineering Institute of Canada.

One of the points to be brought up at the Plenary Meeting of Council is the question of the formation of professional sections. The two sections proposed are, Aeronautical and Radio. In Ottawa alone there are 10 aeronautical and 25 radio men eligible for membership. These men at the present time are members of foreign societies. They would obtain the same facilities that they now enjoy if these sections were incorporated. It is estimated that there is a strong potential membership available in the personnel of aeronautical and radio companies throughout the Dominion.

Mr. Grant then went on to discuss some of the proposed financial changes, that the grade of Branch Non-Resident be abolished and that the Associate Members should pay the same as the Members. He urged that very serious consideration be given to this point, as, in his opinion, a decrease in membership would inevitably follow. His own opinion was that there should be no category of Members.

The question of size of the Journal was touched on as well as the advisability of publishing Transactions.

The chairman in thanking the President for his analysis of the situation concurred that increased membership is a necessity. He stated that the Hamilton Branch were of the opinion that the Journal should be kept the same size.

The meeting was then thrown open for discussion, a synopsis of which follows:—

Mr. McFaul. The confederation of the professional societies and The Engineering Institute of Canada is absolutely essential. Data should be completed showing how many members of the one are members of the other. The Institute members should use their influence to push forward this confederation.

Mr. Grant. The basis of confederation is to arrive at a uniformity of qualification of members.

Mr. McGill. We should pay someone to go after new members. Many did not realize the benefits of membership.

Mr. Lumsden. Something must be wrong when a man who is an engineer is not interested in The Institute. The whole question of grade is complicated, and often a man would prefer to drop out when a question of transfer was brought up.

Mr. Moon (St. Catharines). In the old days of the Canadian Society of Civil Engineers, the idea of the society was to select the membership and when the public engaged any civil engineer, the work was guaranteed. Mr. Busfield's classification of the function of the professional societies as protectors of the public and The Engineering Institute of Canada as being interested in the education of the engineer, is a good one. No examinations should be held for entrance of middle aged men. If a man can earn his living by his professional work, he should be eligible for membership.

Chairman. If we are to increase membership we should widen the scope and take more of this class.

Mr. Cameron. Thanked the Hamilton Branch for their hospitality and hoped that more inter-Branch meetings would be held. The individual members should be the logical men to impress membership on others. The confederation of The Institute and the professional societies is desirable. Mr. Adams' committee was going to recommend that no action be taken re change in size of the Journal, that the Transactions be issued in the 9 inch by 12 inch size. He presented a very strong argument for the 6 inch by 9 inch size showing exhibits carefully prepared that had been submitted to Mr. Adams' committee.

Mr. Darling. There are other points not touched on by Mr. Cameron which should receive consideration.

Chairman. Recommended that a straw vote be taken, and out of a show of nine hands, eight expressed an opinion that the size should be 6 inch by 9 inch, and one 9 inch by 12 inch. Forty members were present.

The discussion then became very general, the opinion of the meeting fairly generally came to the following conclusion:

That, waiving all financial questions, the size of the publication should be 6 inch by 9 inch, provided that the papers were so arranged that they could be taken out by the members and either filed or bound separately. The Transactions then would be unnecessary.

Mr. Lumsden. Paid a tribute to Mr. Cameron and complimented him on the splendid work he had done in studying the question of Journal size. He stated that the Hamilton Branch was honoured by the presence of so great an engineer as Mr. A. J. Grant.

Mr. Darling then proceeded to enumerate what he considered to be the feelings of the Hamilton Branch, to be presented at the Plenary Meeting of Council, under the following headings:

Transfer Fee
Provincial Professional Societies
Rebate System
Publications.

It was decided to get the requisite number of signatures of corporate members on the Hamilton resolution in time for submission to council before October 1st.

The meeting then adjourned with the singing of "Auld Lang Syne."

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

By kind permission of the Minister of National Defence, members of The Engineering Institute were given an opportunity of visiting the British dirigible R 100 at the St. Hubert Airport on August 7th.

A special train was run by the Canadian National Railways from their Guy street station and approximately 250 members took advantage of this opportunity of seeing the great airship at close range.

Every courtesy was extended by the officials in charge at the mooring mast and as a result of this it was possible for practically all of the party to inspect the interior of the ship. An electric elevator carried the passengers to the top of the mast and access to the gangway was had by means of an ingenious revolving platform carrying flights of steps. From the opening in the nose a long suspended gangway led to the living accommodation amidships. This consisted of a combined dining room and lounge surrounded by a gallery. Opening off this were the cabins for passengers and officers and on the outside of the cabins were observation verandas and sun-rooms commanding a view of the country beneath, through large windows in the outside fabric of the ship. The crew's quarters were directly forward of the general accommodation and a second gangway led to the stern of the ship and the three engine room gondolas. The control cabin was directly below the living quarters but as members of the crew were on duty there at all times, it was not possible for any of the visitors to enter and inspect it.

Taken all round, the trip was an extremely interesting one and it was very gratifying that so many members were able to avail themselves of their opportunity.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

A joint meeting with the Hamilton Branch was held on September 11th to discuss certain business matters connected with The Institute.

About twelve members of the Niagara Branch motored to Hamilton and enjoyed dinner at the Connaught hotel after which the discussion blazed into full force.

The principal subjects to be dealt with were three, namely, a proposed amendment to the By-laws revising fees, another proposed amendment dealing with rebates to Branches, and a proposal by the Niagara Branch to reduce the size of the Journal and make it available for loose leaf binding, or the issuance of transactions.

President A. J. Grant, M.E.I.C., opened the meeting with a review of some of the activities during the past year. He deplored the fact that the increase in fees had been lost by such a narrow margin but stated that The Institute would carry on and retrieve the financial condition by certain retrenchments combined with a determined drive to interest and obtain new members. Regarding the Hamilton proposed amendments he thought the Branches to be the greatest contributing factor to the present success of The Institute and a revision of the rebate system might very well be given serious consideration. The other proposal to alter the scale of fees for different grades however was complicated by the fact that the present grading was not acceptable to many members. The proposal to charge heavier fees to Associate Members of more than ten years standing might result in numerous resignations unless they were given the grade of Member. It is a question as to whether or not The Engineering Institute should have only one grade of membership in a manner similar to that of the medical or legal professions.

There followed a lively discussion participated in by Messrs. W. F. McLaren, M.E.I.C., chairman, L. W. Gill, M.E.I.C., H. A. Lumsden, M.E.I.C., W. L. McFaul, M.E.I.C., H. B. Stuart, A.M.E.I.C., and others. Many phases of Institute affairs were covered and many good suggestions were advanced for improvement. It appeared to be the general impression that energetic, perhaps even radical, measures were desirable in order to arouse the seeming lethargy of the membership. One note stood out rather prominently in some of the speeches indicating that Hamilton Branch opinion was strongly against any change in the size of the Journal as it would surely jeopardize the financial status of that publication.

E. G. Cameron, A.M.E.I.C., felt that this opinion should not go unchallenged and asked for the protection of the chair while he endeavoured to illustrate some of the high lights on the other side of the picture. In a very able manner he pointed out that the publications of an Institute were more important than any other single activity. They were the tangible evidence that The Institute was giving something in return for the yearly fee and upon their popularity or utility depended much of the good will of the membership. The monthly Journal is a very valuable publication and a great step ahead of the older system of advance pamphlets and transactions. If however it could be improved in such a manner as to simplify the filing of individual papers and at the same time enable Transactions to be printed for permanent record, or for sale, then why hesitate? The question of cost was important but not so important as utility. Too much stress had been laid upon giving service to the advertisers rather than upon giving service to the membership. As a matter of fact the latest advice from Mr. Adams' committee was to the effect that it would cost no more to print the Journal in the small size than in the large size and no concrete evidence had so far been presented that the revenue from advertising, after the initial adjustment, would be any less than it is at present.

At the conclusion of Mr. Cameron's speech the chairman remarked that the Hamilton Branch had voted upon this question last spring but they were then distinctly under the impression that such a change would dislocate the finances of The Institute. The question was to come up at the nearby Plenary Meeting and he was sure that Councillor Darling would like to be instructed as to the feeling of the members present. A show of hands was then asked for and the majority shown were in favour of the Niagara proposals—one vote alone was cast in favour of keeping to the present size of the Journal. E. H. Darling, M.E.I.C., Councillor for the Hamilton Branch, thanked the members for this expression of their opinion and stated that he had no pessimism as to the future of The Institute when he noted the remarkable interest which was indicated by the discussion during the evening. In connection with the proposals to confederate or affiliate with the provincial organizations, which had been mentioned by Mr. McFaul and other speakers, he wished to point out this difference: the Provincial Associations had no power to debar any man if he could pass the qualifying tests whereas The Institute still retained that power when an applicant was deemed undesirable for any reason. This is a very valuable safeguard in preserving the integrity and high standing of its membership.

A total of forty were present.

EMPLOYMENT SERVICE BUREAU

This Service is operated for the benefit of members of the Engineering Profession and Industrial and other organizations employing technically trained men—without charge to either party.

All correspondence should be addressed to

The Employment Service Bureau, The Engineering Institute of Canada

2050 Mansfield Street, Montreal

All notices intended for publication must be received not later than the Tuesday of the week preceding the date of the issue in which they are to be inserted.

Situations Vacant

ELECTRICAL ENGINEER, with experience in sales, manufacturing and advertising, with company selling to railways and general industrials. Apply giving full experience to Box No. 613-V.

INDUSTRIAL ENGINEER, qualified to reorganize a factory employing 500 to 1,000 operators, manufacturing electrical and radio apparatus in a modern, efficient manner and to direct its activities for most economical results; who possesses initiative and the ability to direct employees. Application must state complete qualifications, including history, education, and salary expected. Apply to Box No. 620-V.

ARCHITECTURAL DRAUGHTSMAN, capable of getting out details and experienced in the design of fireproof buildings. Must be thoroughly experienced and able to take charge of a small drawing office. Apply to Box No. 621-V.

CHEMICAL ENGINEER. A pulp and paper mill in the province of Quebec has an opening for an assistant chemical engineer. Must be a graduate and have some experience in pulp and paper mill work. Good opening for right party. Apply to Box No. 623-V.

PLANT ENGINEER, experience in plant maintenance and construction, not over 35 years, for an industrial company in Montreal. Apply to Box No. 624-V.

MECHANICAL ENGINEER, recent graduate, for large pulp and paper mill in the province of Quebec. Will be required to do draughting and design in connection with the maintenance of mill equipment and alterations. Experience in pulp and paper mills not essential. Apply to Box No. 627-V.

Situations Wanted

CIVIL ENGINEER, A.M.E.I.C., married, desires employment with manufacturer of industrial products, selling to industrial and other markets. His experience includes engineering and building construction, administration and operation of utilities, municipal works, etc. Record of integrity; moderate salary; location immaterial. Apply to Box No. 14-W.

CIVIL ENGINEER, A.M.E.I.C., experience: highways, railways, drainage projects, stream diversion, earth, timber and concrete dams, laying large and small pipe, timber structures, concrete walls and pavements. Location, construction or maintenance. Desires position as engineer or superintendent. Location immaterial. Apply to Box No. 34-W.

ELECTRICAL ENGINEER, B.Sc. (McGill '26), Can. Gen. Elec. Co. test course, with experience in testing and maintenance. Apply to Box No. 39-W.

ELECTRICAL ENGINEER seeks connection with Montreal engineer or architect for part time work involving the design and specification for industrial and public buildings. Experienced and capable of complete responsibility. Apply to Box No. 40-W.

CIVIL AND MECHANICAL ENGINEER; aggressive, practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mills. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), 15 years experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal engineering, construction work, inspection, estimating. Apply to Box No. 107-W.

COLLEGE GRADUATE, age 34, with over ten years experience in power developments and pulp and paper mill construction and maintenance, largely in direct charge of design or construction; desires new connection as chief or assistant engineer or construction superintendent. Apply to Box No. 167-W.

CIVIL ENGINEER, B.Sc. (McGill), M.E.I.C., P.E.Q. and B.C., with broad experience in hydro-electric power investigations, studies and exploration of forest lands, including design and construction driving and storage dams, wharves, flumes, piers and booms and loading plants, as well as general engineering and contracting, is open for engagement. Location immaterial. Now engaged but available on short notice as projects are nearing completion. Speak French fluently, physically fit, active and energetic, and can get results. References can be furnished if required. Apply to Box No. 177-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Ont., with twenty-four years experience embracing dams, wharves, grain elevators, foundations, pile driving, highways, municipal engineering, water power surveys, road locations, inspections and estimating is open for engagement as engineer or superintendent in construction, operation or maintenance. Location immaterial. Apply to Box No. 358-W.

CIVIL ENGINEER, A.M.E.I.C., university graduate, O.L.S., married, twenty years experience city surveys, calculations for curved surveys, design, layout and supervision, sidewalks, pavements, sewers and water systems. Acted in capacity of chief engineer for large engineering and surveying firm for five years. Best of references. Available on short notice. Apply to Box No. 413-W.

CIVIL ENGINEER, S.E.I.C., 1930 graduate of Nova Scotia Tech. with experience as plane table topographer, instrumentman and draughtsman and particularly interested in hydro-electric power development and reinforced concrete design, desires position. Willing to go to foreign fields. Available at a few weeks notice. Apply to Box No. 431-W.

SALES ENGINEER, B.Sc. (McGill, 1914), A.M.E.I.C., 37, married, presently employed in position of responsibility, desires to communicate with a prominent railway equipment supply house, with a view to becoming its Pacific Coast representative. Has a complete knowledge of railway locomotive equipment particularly. Excellent references can be furnished. Apply to Box No. 444-W.

ELECTRICAL ENGINEER, McGill graduate. Thoroughly experienced in the sale of mechanical and electrical industrial equipment. Has carried responsibility and prepared publicity campaigns and technical studies. Commands both French and English and can handle French-Canadian clientele. Available at short notice. Go anywhere. Single. Apply to Box No. 457-W.

ELECTRICAL ENGINEER, graduate '26, University of Manitoba, Canadian General Electric test course; also three years as assistant to industrial control engineer. Available for a position at once. Apply to Box No. 462-W.

ELECTRICAL ENGINEER, S.E.I.C., B.Sc., (McGill Univ. '27), age 26. Fifteen months outside plant engineering with large public utility. Twenty months sales engineering experience with electrical manufacturing company. Available on reasonable notice. Apply to Box No. 463-W.

ELECTRICAL ENGINEER, B.Sc. (McGill), Jr.E.I.C., age 28, graduate Canadian General Electric Company, test course, with two years experience in the design of induction motors and direct current machines. Previous experience includes electrical installation in large paper mill, and assistant to engineer in charge of small utilities company. Married. Location immaterial. Apply to Box No. 466-W.

CIVIL ENGINEER, experienced in road construction, mine surveying, transmission line survey and construction; paper mill construction; age 27. Available on short notice. Apply to Box No. 468-W.

Preliminary Notice

of Applications for Admission and for Transfer

September 19th, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in November 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

DENMARK—DONALD ERNEST, of 983 Jessie Ave., Winnipeg, Man., Born at Montreal, Aug. 29th, 1897; Educ., Matric. in Arts, Univ. of Man., 1914; D.L.S., 1926; Man. L.S., 1927; 1920-22, chainman and instr'man. on subdivision and baseline surveys; 1923-26, control traverse surveys as articled pupil, Topog'l. Surveys Branch, Dept. of the Interior, Ottawa; 1926 to date, with McColl Bros., Surveyors and Engineers, Winnipeg, as follows: 1926-27, location and survey of Great Falls-Central Manitoba Mines, transmission line; 1927-28, reconnaissance work and prelim. surveys in connection with Seven Sisters power development; 1928, location and survey of Manitoba Eastern Railway; (1929, location and survey of Seven Falls-Winnipeg transmission line, City of Winnipeg Hydro); 1929-30, location and survey of Seven Sisters-Winnipeg transmission line; also various land, road and drainage surveys in connection with municipal work.

References: G. B. McColl, S. E. McColl, J. W. Sanger, E. V. Caton, F. H. Martin.

FILION—LOUIS GERARD, of 4288 Delorimier Ave., Montreal, Que., Born at Montreal, Aug. 30th, 1905; Educ., Civil Engineer, B.Sc., Ecole Polytech., Montreal, 1930; Summers—1927, surveying, road location, Port Alfred Pulp Co.; 1928, geol. survey., Laurentian Mountains, for Prov. of Quebec; 1929, geol. survey, at Abitibi, for Prov. of Quebec; at present, asst. engr., City of Lachine, Que.

References: A. Frigon, R. E. Joron, R. Dorion, A. Cousineau, W. H. Abbott, H. G. Hunter, J. A. Lalonde, T. J. Lafreniere.

HUMBLE—ARCHIBALD MARSHALL, of 25 Bingham Ave., Toronto, Ont., Born at Dumbarton, Scotland, Oct. 10th, 1892; Educ., 1909-13, Royal Technical College, Glasgow; 1907-11, Dumbartonshire County Surveyor's Office; 1911-13, Inland Revenue, valuation dept., Glasgow; 1924-25, res. engr. on trunk sewers, Scarboro Twp.; Designing dftsman. with Kerry & Chace Ltd., Toronto, as follows: 1923-24, Hollinger power plant; 1925-26, Canada Cement power plant, Lakefield, Ont.; 1927-28, Canadian Paperboard plant, Toronto; 1928, res. engr. on trunk sewers, North Toronto Sewer Scheme; 1928 to date, asst. designing engr., Toronto Harbour Commrs., Toronto, Ont. (1914-19, overseas, B.E.F., Capt. 3½ years in France.)

References: J. G. R. Wainwright, F. J. Blair, G. Phelps, H. R. McClymont, A. T. C. McMaster, W. E. Bonn, F. L. Macpherson.

LARRIVEE—J. ALBERT EDOUARD, of 4101 St. Lawrence St., Montreal, Born at Mont Joli, Que., Aug. 7th, 1902; Educ., B.Sc., Univ. of N.B., 1926; Summers: 1919-20, rodman, 1920-21, levelman, 1921-25, transitman, Quebec Streams Commission; 1927-28, asst. divn. engr. on rly. constrn., C.N.R., at Shawinigan Falls; 1928 to date, mtce. of way dept., also as asst. divn. engr. or instr'man., C.N.R., reporting to J. J. Richardson, A.M.E.I.C., Montreal.

References: O. O. Lefebvre, H. Massue, A. Duperron, J. J. Richardson, F. Bossu.

MILLER—HARRY, of Montreal, Que., Born at Warrington, England, Nov. 18th, 1902; Educ., B.A.Sc., Univ. of Toronto, 1925; 1923, Sask. Dept. Public Works; 1925, asst. operator, H.E.P.C. of Ont.; 1925-26, plant engr., i/c design and constrn. of motor fire apparatus, Bickle Fire Engine Co., Woodstock, Ont.; 1926-27, demonstrator in engrg. drawing, Univ. of Toronto; 1927-date, with Northern Electric Co. Ltd., Montreal, as follows: 1927-28, designer, master mechanics dept.; 1928-29, asst. to technical engr., and at present, engr. in charge of factory planning dept. Work covers active charge of design and install'n. of mfg. equipment in factory.

References: J. S. Cameron, W. H. Eastlake, H. G. Thompson, C. A. Norris, E. A. Allcut.

RICHARDSON—WILLIAM GORDON, of Montreal, Que., Born at Watford, Ont., Dec. 5th, 1903; Educ., B.Sc.(E.E.), Queen's Univ., 1926; 1926-27, elect'l. and mech'l. test of transformers, relays, A.C. and D.C. motors, amplifiers, etc., General Railway Signal Co., Rochester, N.Y.; 1927-28, research work on machinery for manufacture of abrasives, grinding wheels, etc., Carborundum Company, Niagara Falls, N.Y.; 1928-29, demonstrator in elect'l. lab., Queen's University, Kingston, and operator of radio stn., CFRC, and responsible for all lab. tests, reports, problems, mtce., etc., of this stn.; at present in development branch, Northern Electric Co. Ltd., Montreal,—(elect'l. and mech'l. methods used in manufacture of relay coils, repeating coils, transformers, retardation coils, carrier telephone and telegraph equipment).

References: D. M. Jemmett, W. H. Eastlake, S. R. McDougall, L. M. Arkley, A. Jackson.

THOMPSON—VINCENT SWIRE, of 40 Bold Street, Hamilton, Ont., Born at London, England, Feb. 5th, 1901; Educ., Assoc. City and Guilds of London Institute, 1921. Grad. 1920, Assoc. Member, 1929, Inst.M.E.; 1924-25, dftsman., Dominion Bridge Co., Lachine; 1925-26, dftsman., Canadian Bridge Co., Walkerville, Ont.; 1926-28, checker and dftsman., Apr. 1928 to date, designer, Hamilton Bridge Co. Ltd., Hamilton, Ont. (1928-29, lecturer in struct'l. design, evening classes, Hamilton Technical Institute).

References: R. K. Palmer, H. B. Stuart, G. A. Colhoun, A. LeP. T. Clifford, N. Wagner, J. A. McFarlane, C. Anderson.

FOR TRANSFER FROM THE CLASS OF JUNIOR

DYER—JOSEPH WILSON, of Toronto, Ont., Born at Brampton, Ont., Oct. 12th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1923; 1923 to date, with the Bell Telephone Company of Canada as follows: Nov. 1923 to Apr. 1925, asst. to divn. employment supervisor, Toronto Divn., i/c technical corres. course for employees, etc.; May 1925 to Mar. 1928, supervisor of results, bldgs., vehicles and supplies dept., Toronto Divn.; Apr. 1928 to Dec. 1929, bldgs. methods and results supervisor, gen. plant dept., Montreal; Jan. 1930 to date, bldgs. supervisor, gen. plant dept., western area, Toronto, Ont.

References: H. G. Thompson, A. M. Reid, P. M. Knowles, T. R. Loudon, R. E. Smythe, C. H. Mitchell.

ELLIOT—GERALD B., of Cleveland, Ohio, Born at Westmount, Que., Nov. 24th, 1895; Educ., B.Sc. (Mech.), McGill Univ. 1923; 1922, dftsman., Dominion Engrg. Co.; 1922-23, Laurentide Co., Grand Mere, Que.; 1923-24, constrn. work, Shawinigan Engrg. Co.; 1925-27, sales engr., Refrigerating Engineers Ltd., Montreal, including supt'g. install'n. on smaller types of ammonia refrigeration machines; 1927 to date, district sales engr., for Canadian territory with the Carrier Engineering Corporation, Cleveland, Ohio, in charge of sales and install'ns. of air conditioning apparatus and equipment in Canada, including the following plants: Rotogravure Dept., Toronto Star; entire press room, MacLean Publishing Co., Toronto; film processing and drying depts., Can. Govt. Motion Picture Bureau, Ottawa; part of transformer dept., Northern Elec. Co. Ltd., Montreal.

References: C. M. McKergow, A. R. Roberts, R. DeL. French, E. Brown, J. A. Coote, W. H. Eastlake.

FOR TRANSFER FROM THE CLASS OF STUDENT

BRACKEN—WILLIAM DONALD, of 1975 Drummond Road, Niagara Falls, Ont., Born at Seeley's Bay, Ont., July 10th, 1900; Educ., B.Sc., Queen's Univ., 1923; 1920 (summer), inspr. on overhead distribution, Toronto Hydro-Electric System; 1921-22 (summers), constrn. work, Hollinger Cons. Gold Mines, Timmins, Ont.; 1923-24, engr. on test work, Canadian Westinghouse Co., Hamilton, Ont.; Aug. 1924 to date, with Canadian Niagara Power Co., Niagara Falls, Ont., in various capacities, such as plant inspr.; estimator on constrn. work and gen. repair work; engr. i/c transmission line constrn.; engr. i/c substation constrn.; supt. of Fort Erie Distribution System during 1927, and at the present time, asst. supt.

References: H. L. Bucke, H. M. King, M. F. Ker, N. R. Gibson, W. Jackson, W. S. Orr.

GRANT—WILFRID JOHN, of 245 Howland Avenue, Toronto, Ont., Born at Toronto, Aug. 8th, 1899; Educ., B.A.Sc., Univ. of Toronto, 1922; 1918 (4 mos.), testing dept., Canadian Aeroplanes Ltd., Toronto; 1919, 2 mos., mixing dept., Goodyear Tire Co. Ltd., 3½ mos., correspondent, Can. Gen. Elec. Co., Toronto; 1920 (2 mos.); sub-foreman, Canadian Electro Products Co. Ltd., Shawinigan Falls, Que.; 1921 (5½ mos.), British American Oil Co. Ltd., Toronto; 1923 (7½ mos.), technician, Connaught Laboratories, Toronto; 1924 (5½ mos.), jr. asst. lab. engr., H.E.P.C. of Ontario; 1923-25, demonstrator, dept. of chem. engrg., Univ. of Toronto; 1926 to date, teacher of physics, Central Technical School, Toronto, Ont.

References: J. Gillespie, C. R. Young, E. A. Allcut, C. H. Mitchell, R. B. Young.

LAWRENCE—FREDERICK S., of 2149 Tupper Street, Montreal, Que., Born at Montreal, Nov. 11th, 1899; Educ., B.Sc. (Civil), McGill Univ., 1923; 1925-29, instr'man., C.N.R. dist. engr's. office, Montreal; 1929 (Apr.-Nov.), res. engr., 30" H.P. gas main, Montreal Light Heat & Power Cons.; Feb. 1930 to date, engr. of constrn., gas. dist. dept., with same company.

References: J. J. Humphreys, D. O. Wing, F. L. C. Bond, W. Walker, R. O. Stewart, J. A. Ellis, H. Kay.

MacPHAIL—GORDON MILLER, of Woodstock, N.B., Born at Woodstock, Feb. 15th, 1902; Educ., B.Sc., Univ. of N.B., 1926. M.Sc., Rothesay Collegiate School, 1927; 1927-28, contracting under New Brunswick Govt. and State of Maine Highway Commission—constrn. of international highway bridge at Forest City, Maine, and bridge at Grand Falls, N.B.; March 1929 to date, town manager, Woodstock, N.B.

References: E. O. Turner, E. B. Allen, M. J. Rutledge, J. Stephens, A. F. Baird.

SWIFT—EARLE RAYMOND, of 109 Wilton Ave., Welland, Ont., Born at Chihuahua, Mexico, Jan. 5th, 1898; Educ., B.Sc., Queen's Univ., 1923; 1919, rodman, mtce., C.N.R.; 1923, inspr., municipal work, Scarboro Twp.; 1924-25, inventory work, Bell Telephone Company of Canada; 1922, road paving, Stratford, Ont.; 1923, asst. field engr., mill constrn.; 1925-26, field engrg.,mill constrn.; 1926 to date, junior engr., Welland Ship Canal, Welland, Ont.

References: E. P. Johnson, D. E. O'Brien, E. S. Turner, J. C. Street, J. E. Sears.

The Tanna Tunnel in Japan

The long-expected completion of the Tanna tunnel of the Japanese Government Railways has been further delayed by an accident that happened towards the end of June, when there was a cave-in and a great inburst of water. The engineers estimate that the accident will cause a delay of nine months, which means that it will be three years—the official estimate—before this difficult piece of engineering work is completed.

Work on the tunnel was commenced in April 1918. Difficulties were anticipated, owing to the geological conditions known and suspected, but it is doubtful if the great enterprise would have been started had the true characteristics of the area been fully known. However, it would not be fair to say that the Tanna tunnel, as was said of the Simplon, is the grave of the geologist's reputation, for opposition was heard from more than one source before the work was begun, but the obvious economic advantage of the new route was probably a greater incentive to action than the assurances of men learned in the nature of this volcanic land. In the years intervening since 1918 several serious accidents entailing heavy loss of life have occurred, but in the most recent mishap, owing to the experience gained, there were no casualties of any sort.

The object of this cut-off, which is known as the Atami line, after the famous hot spring at the eastern portal of the tunnel, is to avoid the tortuous 37 miles in the many-tunnelled section between Kozu and Numazu, which was completed in 1889. It is worthy of note that the highest point on this section, at Gotemba station, is 1,240 feet above sea level, while the highest point on the cut-off, near Atami, is only 259 feet. In other words, the train rises 1,200 feet in the short run of 18 miles from Kozu at the seaside to Gotemba, and descends 19 miles to Namadzu, also a seaside town. Therefore, there is every inducement from an economic point of view for abandoning the old route, which is, moreover, 7 miles longer than the new one.

The traffic capacity of the Kozu-Numazu section will be increased threefold by th new cut-off, the limited express will save 30 minutes, and the railways in the course of a year will save many thousands of yen, represented by coal bills and wear and tear. This is held to justify the expenditure of over seven million sterling on 30 miles of double track, with several stations and one great tunnel. The cost of the atter is estimated at £2,600,000.

A general description of the terrain through which the tunnel is bored has been published by the director of the Bureau of Construction, Railway Department, Japan, who points out that the difficulties encountered are due to a combination of three bad conditions, "many faults, great inflow of water and soltafaric clay of bad composition."

The accident in June was due to the tapping of a huge interior reservoir. The cave-in occurred at a point 11,980 feet from the western portal, and water and mud rushed out at a rate estimated at 45 cubic feet per second, the mass of detritus blocking the tunnel being estimated at 4,000 cubic yards. The torrent was brought under control and many tons of cement injected into the area to solidify it, after which the work of excavation proceeded. The existence of this reservoir was ascertained in 1926, when a boring was made, and at a depth of 80 feet water was encountered which spurted 40 feet into the air. At this point the tunnel was to run 600 feet below the surface, and the drillers striking a great transverse fault crossing the main island of Japan at this point, running south-north coming from the bay of Sagami and entering the sea of Japan, tapped the subterranean lake. Between four and five thousand feet now separate the heads of the excavations from the eastern and western portals, but the engineers in charge are confident that the worst obstacles have been encountered and overcome.

—*The Engineer.*

The Horton Steel Works, Limited of Bridgeburg, Ontario, has acquired from the Canadian Barking Drum Company, Limited the rights to sell and serve, as well as to manufacture, U-BAR barking drums and accessory equipment. Formerly, the Horton Steel Works, Limited handled only the fabrication of the equipment.

The Sao Paulo-Parana Railway Company

In April 1930 the section of the Sao Paulo-Parana Railway from Cambara to Inga was opened to traffic by the representative of the president of Parana. Much progress has been made by the railway company since 1928, at which time the railhead was at Cambara Km. 29, and one could only travel west of that point by road, ferrying across the Cinzas and Laranginha rivers. This year there is a solid railway bridge over the Cinzas river and the railhead has reached Bandeirantes, Km. 82.

The contractors on the work are Messrs. Macdonald, Gibbs and Company (Engineers) Ltd. of which Lieut. Colonel A. C. Macdonald, M.E.I.C., is managing director. Captain C. B. R. Macdonald, M.E.I.C., is in charge of the survey and construction of the project in question.

The railway is well sited and solidly built. Construction of the 96 kilometres to Km. 125 is due for completion by the end of this year, and it seems clear that it will be completed about three months ahead of time, and for a figure which will show some saving on the estimates. Km. 125 is on the top of the ridge between the Laranginha and the Congonhas rivers, which is the highest ridge the railway has to cross. In the next section of 61 kilometres from this point to Jatahy, and particularly on the descent to the Congonhas river, the work will inevitably be heavier and the cost of construction per kilometre will be higher than in the sections so far constructed. No pains have been spared by Macdonald, Gibbs and Company in the study of alternative routes for this section, and some modifications have resulted from recent surveys which will effect some slight reduction of cost.

Frost Heaving

A recent paper on the "Freezing and Thawing of Soils as Factors in the Destruction of Road Pavements,"* by Stephen Taber, Professor of Geology, University of South Carolina, draws attention to the information now available on this subject as a result of considerable experimentation by the author and others.

Soils, when frozen under natural conditions, generally behave as open systems with respect to water. The extent of heaving may be either greater or less than that encountered when freezing occurs in a closed system. Some soils, under certain conditions, freeze with no appreciable uplift of the surface, while others give uplifts as great as 60 per cent of the depth of freezing. Soils that are very impermeable because of high colloid content behave in laboratory tests essentially as closed systems. These include certain muck and gumbo soils, and soils containing bentonite.

Laboratory experiments show that excessive heaving is always accompanied by the segregation of ice in layers or lenses. Similar segregations have been observed when excavations were made in badly heaved ground. The factors which chiefly affect ice segregation are texture of soil, composition of soil, supply of water, rate of removal of heat, and surface load.

Various measures are suggested for the elimination or reduction of damage due to ground freezing, thawing, and alternate freezing and thawing. Proper drainage is always essential. Placing a thick layer of coarse material under the pavement, extending to the extreme depth of ground freezing, is an effective but expensive method. Addition of sand to the subgrade will prevent ice segregation. Uniformity of texture in subgrade soils is essential to the avoidance of differential heaving.

Extensive research in the problems of ground freezing is recommended.

*Published in "Public Roads," Vol. II, No. 6.

Gypsum, Lime and Alabastine, Canada, Ltd., announces the appointment of Robert S. Wright as European representative of the company with headquarters in London, England, where he will be particularly concerned with acoustical and insulation engineering in connection with the uses of the Canadian building materials on British and European construction projects.

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Increase of Steam Power Facilities of The New Brunswick Power Company

John D. Garey, A.M.E.I.C.,

Chief Engineer, New Brunswick Power Company, Saint John, N.B.

Paper read before the Saint John Branch of The Engineering Institute of Canada, December 12th, 1929.

In 1928 the old steam power plant of the New Brunswick Power Company at Saint John, New Brunswick, had become inadequate for its increasing load, and inefficient according to modern standards. It had grown in size to fill entirely a long narrow block between city streets, (figure No. 1), so that the usual procedure of adding a new turbine and boiler could not be followed. The equivalent of a new plant with greater capacity, reduced operating labour and costs, and freedom for expansion was needed.

The above were the principal elements in the situation. In addition, it was desired that plans for securing more power should make use of the old building but keep the new equipment entirely free of dependence on the old, should avoid any possible interference with continuous reliable operation of the full capacity of the old station during the construction period, and should permit future reconstruction under the same conditions.

The engine room of the old station was situated between two boiler rooms, one containing old hand-fired boilers and the other somewhat newer stoker-fired boilers. This required a considerable operating force and restricted the purchase of coals to those which could be burned on the stokers with reasonable efficiency at the rating required by the station load. The old engine room contained engines and turbines of a total capacity of 3,700 kw. alternating current and 650 kw. direct current, 600 volts, and about 1,200 kw. in motor generator sets for railway and elevator service. It was desired that the new equipment should be suitable for operation by a minimum number of men and with any coal which might be economically available, and that the operating force should be able to ascertain readily that the high efficiency of the new equipment is continually maintained.

A considerable reduction in first cost and operating costs could be obtained by the installation of a relatively large new turbine and boiler unit. Since the old plant would be kept in reserve, dependence on a single unit would not unduly jeopardize continuous power supply until considerable increase in load had taken place. The new unit must not be much larger than needed for the near future, partly to avoid idle investment, but principally because it would unduly postpone the installation of a second unit, which should preferably be a duplicate, until the load had grown so large that failure of the first unit would overload the reserve equipment in the original engine room. It was also desirable that the second installation should not encroach too much on the space devoted to the railway equipment, which would involve a material expenditure for its relocation.

Studies indicated that a turbine with maximum rating of 7,500 kw. and a boiler of equal capacity would meet these conditions. The length required would be just about equal to that of the older (hand-fired) boiler room. By omitting the usual division wall between the boiler and turbine and placing the firing side of the boiler toward the turbine, the entire equipment, including the necessary auxiliaries to give high efficiency and convenient operation, could be placed within the limits of the narrow building. This compact arrangement also furthered the plan to reduce operating labour to a minimum by making all apparatus accessible, visible, and largely controllable from a central point. Figure No. 2 shows the relative locations of the equipment and figure No. 3 shows a cross-sectional elevation. The new layout forms the beginning of a single row of turbines and a single row of boilers, which may be extended into the old section as the load grows.

The day-by-day performance of the completed new equipment is shown in figure No. 4. The solid straight line is the "Parsons line." To obtain this the weights of coal burned for each of 121 consecutive 24-hour days, including Sundays, between December 10, 1929, and April 9, 1930, were plotted against the kilowatt-hours generated each day. During this time the daily average circulating water inlet temperature was 40 degrees F. or below. Above this temperature the effect of reduced vacuum in increasing the coal consumption is noticeable. Each point shows the operation for one day. The outputs were divided into groups of 40,000-50,000 kw.hrs., 50,000-60,000 kw.hrs., etc., and the straight line was drawn through the circles representing the averages of these groups. Since the daily generated output did not fall below about 40,000 kw. hrs., a point at about 27,000 was obtained by the summation of a number of low-load night periods, to assist in fixing the position of the lower part of the line. The curve of b.t.u. per kilowatt-hour was calculated from the Parsons line. Both are plotted against generated, rather than distributed kilowatt-hours, because it has been impossible so far to separate the auxiliary power for the new plant

Figure No. 1.—Steam Power Plant of the New Brunswick Power Company at Saint John, N.B.

from that for the old. Indications are that the energy used for auxiliaries in the new plant ranges from about 9 per cent at monthly capacity factor of 50 per cent, to 7 per cent at 80 per cent capacity factor.

As most of the old hand-fired boilers were in use, it was necessary to start the new work by the installation of the boiler and put it into operation before the remaining old boilers could be removed from the place where the turbine would stand. The only changes in the building consisted of deepening the basement. The stack for the old hand-fired boilers is outside the limits of the new work and is used for the new boiler until a second new boiler is put in.

The old circulating water pump-pit, because of the tide range of about 28 feet, was situated outside the building line under the street toward the harbour, its floor being below low tide level. It remains unchanged except for the replacement of the old pumps with units of larger capacity.

Circulating water for both the new and old parts of the plant is obtained through a concrete intake tower standing in the harbour about 450 feet from the power plant. The large and rapid change in tide level necessitated special methods of construction for this intake. After driving and cutting off piles for a foundation at the tower site, a timber mat was suspended from two derrick boats until sufficient concrete was added so that when landed on these piles, the concrete was above low tide level. Divers were used in subsequent form work and in placing the 42-inch intake pipes.

Trash racks are used at present, but provision is made for the later installation of revolving screens, should future harbour water conditions cause rapid plugging of the condenser tubes. The two 42-inch pipes from the new intake to the old intake, and the concrete tunnels from the old intake to the pump-pit are entirely submerged at extreme low tide level and there is no lift on the pumps.

On the discharge side of the condenser the circulating water passes through a 30-inch cast iron line, running through a concrete tunnel from the turbine basement to the dock, a distance of about 275 feet. At this point it drops vertically into the harbour and ends in a bend with the outlet facing up at an elevation 11 feet above extreme low water. This provides a seal and maintains a siphon on the outlet line, reducing the head on the circulating pumps. The circulating pumps are driven by variable speed motors, maximum speed being used to develop a total head of 58 feet for the condensers in the old plant and to lift the water to the highest point of the circulating water system. After the discharge pipe is filled, the siphon is, of course, established, decreasing the head and permitting the pumps to run at a lower speed.

In fixing the elevation of the basement floor it was desired to reduce as much as possible the amount of excavation, all of which was in rock, because of difficulty with seepage into it, the necessity for waterproofing, and uplift forces at high tide. The deepest excavation was therefore confined to the small area beneath the boiler ash-pit required for feeding the ash into the steam jet vacuum conveyor. This method of ash removal was very well adapted to the conditions because of the small space required. The ash passes directly into the conveyor through gates in the bottom of the ash-pit, preventing the escape of any dust.

The old building was reconditioned and concrete basement walls were carried up to the street level, with pilasters for the crane columns. A large door at the end of the building opens onto a platform within reach of the crane. The space between the turbine platform and the boiler firing floor gives the crane access to equipment in the basement. The compactness of the new layout is indicated by the building volume required for the complete new equipment, 34 cubic feet per kilowatt of capacity.

The Nova Scotia coals usually ignite easily and give an ash containing considerable iron. These characteristics pointed to the desirability of a furnace largely water-cooled. Fin tubes were therefore provided on rear and side walls and arch, and two rows of plain tubes on 12-inch centres in each row, across the ash-pit. At an output of 90,000 pounds of steam per hour the rate of heat release is 18,500 b.t.u. per cubic foot. During a year's use of the boiler this furnace, with only one brick wall exposed to the flame, has required no attention.

The boiler is designed for operation at 448 pounds drum pressure and 250 degrees superheat. It is fired by two horizontal, turbulent short-flame burners using primary air at a maximum pressure of 4 inches, and secondary air at 480 degrees F. and 7 inches maximum, the latter supplied through a duct passing around the side and across the front of the boiler. Because of the very rapid ignition of the coal used, it was found necessary to make several minor burner changes and adjustments with the result that the flame from the two burners now fills the furnace very well at maximum load, without impinging sharply on the furnace walls. Figure No. 5 shows the modified burner. A small accumulation of friable ash on the ash-pit screen-tubes against the rear wall occurs under sustained heavy load, but otherwise the furnace remains quite clean

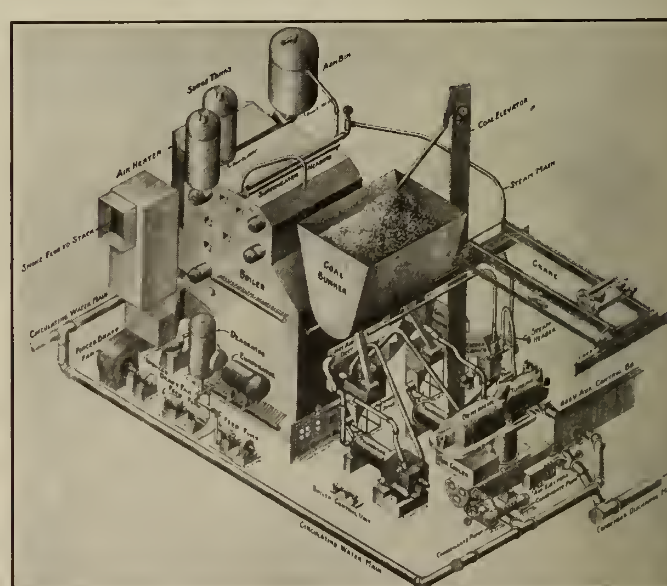

Figure No. 2.—General arrangement of plant.

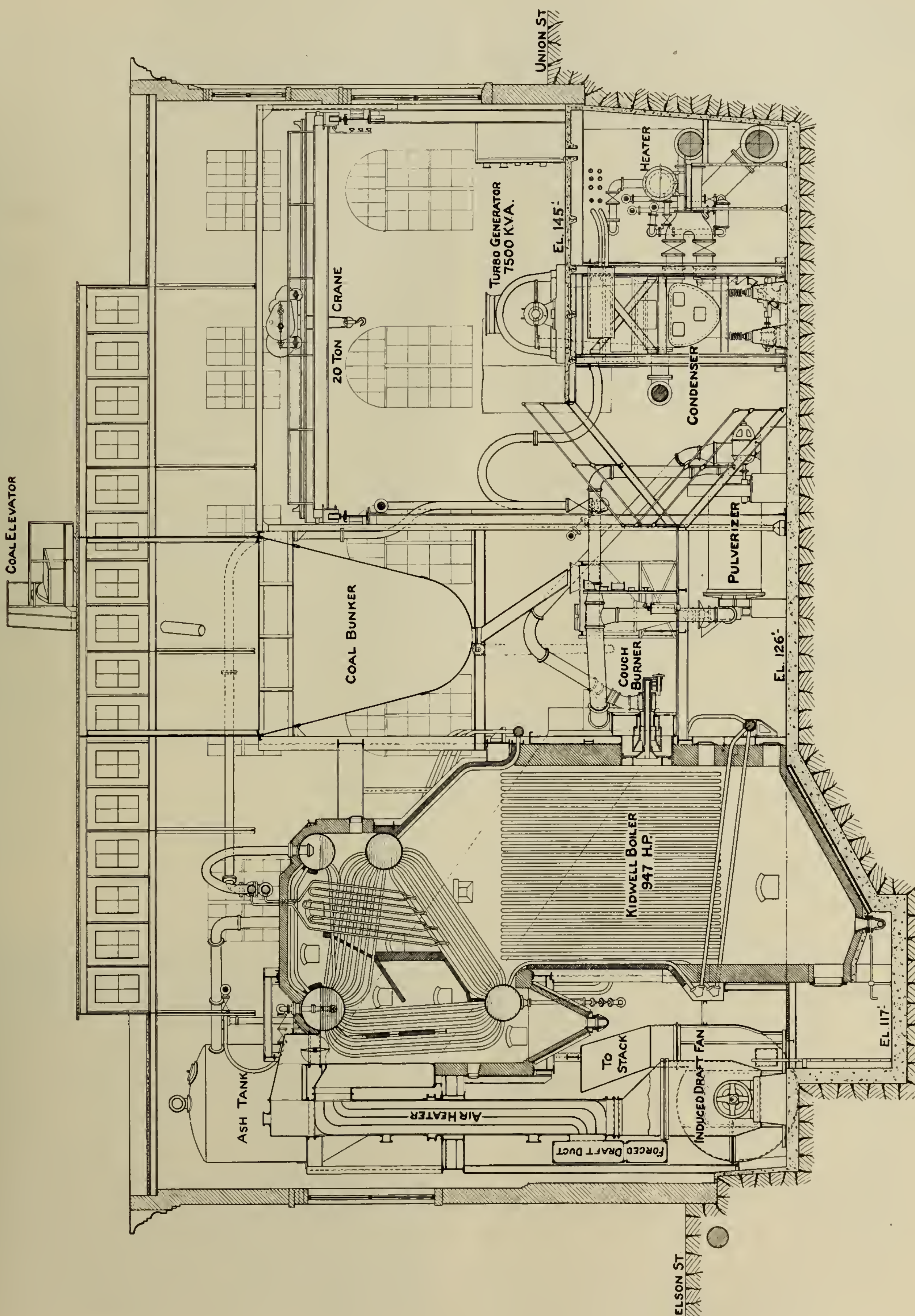

Figure No. 3.—Sectional elevation of plant.

except for the usual very thin film of ash on all metal surfaces. There is a notable absence of "sparklers." The boiler is equipped with soot blowers. No difficulty has been experienced with slag accumulations between the tubes since making the burner alteràtions. It was found necessary to cut sections from the soot blower cams to shut off the steam while they pointed directly at the burners during rotation, to prevent disturbance of the flame.

The gases pass from the top of the boiler down through the plate-type air heater back of the boiler to the induced draft fan placed on the basement floor level. This fan is driven by a variable speed motor and discharges into a flue leading to the brick stack in the old engine room.

The forced draft fan, also driven by a slip ring motor, stands on the basement floor level near the induced draft fan. It takes air from near the boiler and forces it through the air heater in a direction counter to that of the boiler gases. The following table shows the expected performance of the boiler:—

Evaporation, lb. per hr.	15,000	25,000	50,000	70,000	90,000
CO_2 entering air heater, per cent	14.0	15.0	14.8	14.5	14.0
Temperatures, deg. F.:					
Gas leaving boiler	445	470	545	625	710
Gas leaving heater	323	319	338	374	414
Air entering heater	70	70	70	70	70
Air leaving heater	413	407	404	431	479
Draft losses, in water:					
Boiler (incl. superheater)	0.05	0.07	0.37	0.67	1.03
Heater, gas side	0.07	0.17	0.61	1.26	2.21
Heater, air side	0.03	0.12	0.49	1.07	2.07
Superheater:					
Pressure drop, lbs.	....	2	5.5	10	16
Superheat, deg. F.	....	180	212	235	250
Efficiency boiler, superheater and air heater, per cent	....	....	83.1	82.1	80.4

Tests indicate that the boiler, as well as the other equipment, has met expectations.

Coal is received by truck or wagon and dumped into a hopper at street level. From this an apron feeder takes it up a slight incline to a high speed swing-hammer crusher from which a vertical bucket elevator takes it through the roof to a sufficient elevation to spout it into the suspended steel bunker running across the front of the boiler. The low grade coal now burned contains such a large proportion of fines that removal of some and shortening of the other crusher-hammers was necessary to avoid coal so fine that it would pack in the bunker when wet. This change was readily made and has the advantage of increasing the capacity and reducing the crusher power required.

When future boilers are installed, a horizontal conveyor will be placed across the top of the bunker, receiving coal from the bucket elevator.

From the bunker the coal passes through spouts to two automatic scales placed accessibly on the firing floor. Openings are provided so that any stoppage of coal can be immediately seen and corrected. Directly below the scales, and at about the floor level, are the two disc feeders for the mills. In this position they can be seen by the operator either in front of the control board or near the burners, and the manual adjusting mechanisms can be reached from the firing floor.

The two pulverizing mills, with their primary air fans, are placed on the basement floor in front of the boiler. The ball mills used, giving a uniform fineness of grind with little attention required for adjustments or repairs, contribute materially to the ease of operation of the station. The energy required for the ball mills per ton pulverized becomes quite high at low outputs, and to care for possible low night loads the installation of a third small capacity mill and burner was kept in mind and provision was made so that it could be added without great difficulty.

A steel ash tank of 33 cubic yards capacity is installed about 30 feet above the street level near the boiler. A high

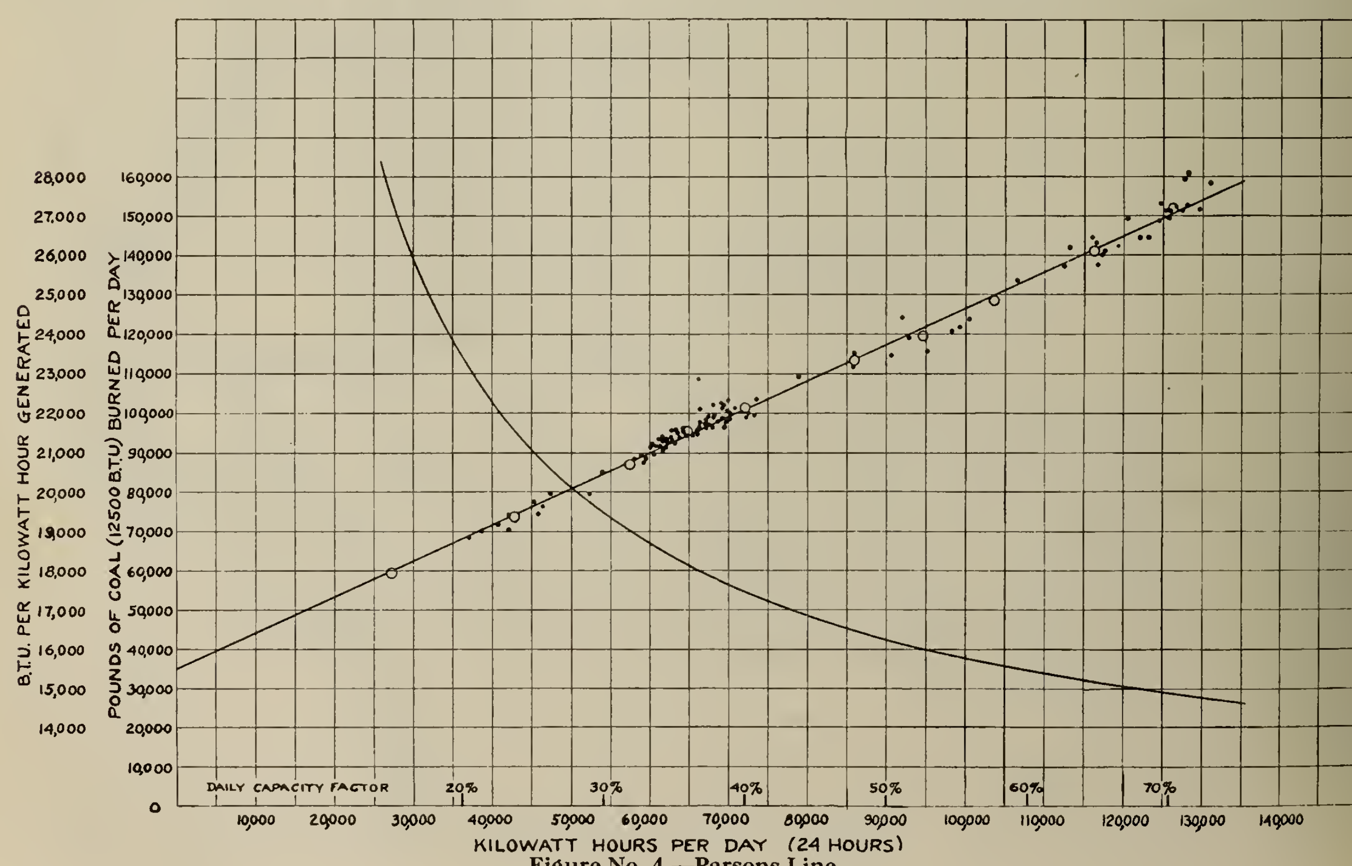

Figure No. 4.—Parsons Line.

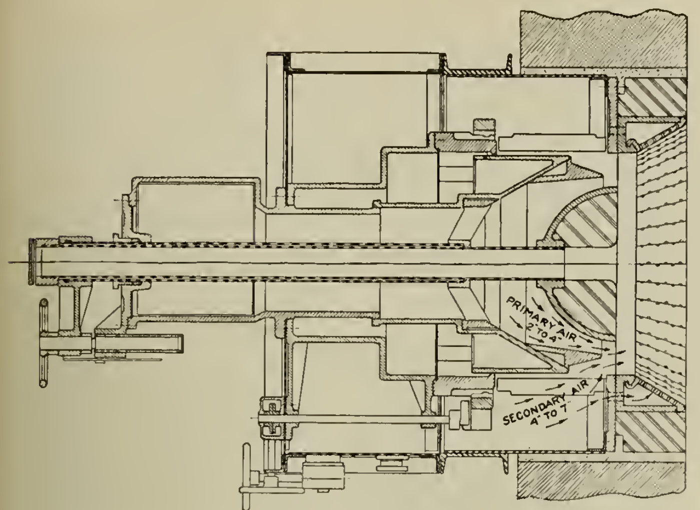

Figure No. 5.—Modified Pulverized Coal Burner.

pressure steam jet produces a partial vacuum in the tank, lifting the ash and cinders from the ash-pit and hoppers under the last passes of the boiler. From the tank the ash is delivered through a chute to trucks in the street.

By facing the boiler toward the turbine, the pulverizer mills are within reach of the turbine crane and the scales, feeders and burners are visible and accessible from a central operating position between the boiler and turbine. There is, of course, some noise from the mills, although the lagging around them deadens that from any parts but the gears. To offset this, the forced and induced draft fans are placed at the rear of the boiler where their noise is not objectionable. No more dust is found in the turbine section than in plants having the usual division wall between the boiler and turbine. The enclosure between the top of the bunker and the roof is dust tight. Pressure above atmospheric does not exist in any of the powdered coal equipment except the two primary air pipes to the burners.

A rather complete system of automatic control of the pulverized coal and fan equipment has been provided to maintain proper efficiency and output under the rapidly fluctuating demands caused by the railway load, and also to free the operator for other work. The master controller is placed on a board with practically all boiler instruments and controls, and also sufficient turbine and condenser instruments to allow the operator at that point to supervise the operation of all equipment and control most of it (figure No. 6). There is, of course, a main electrical

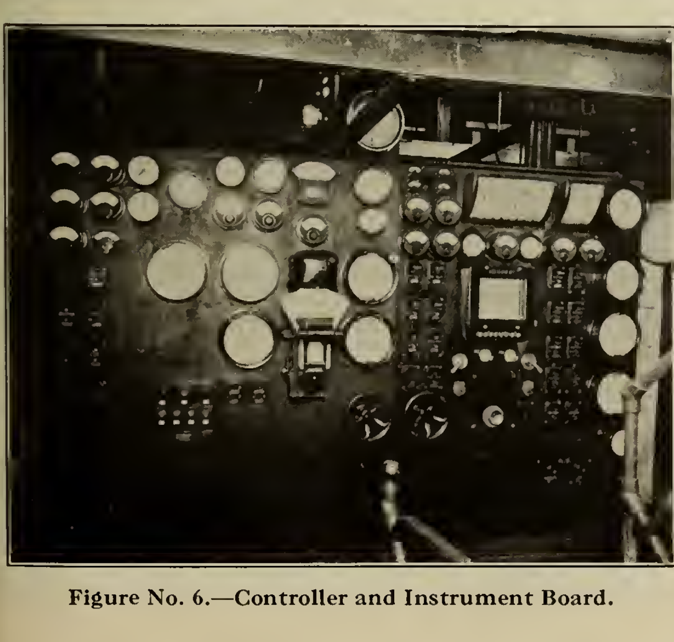

Figure No. 6.—Controller and Instrument Board.

switchboard placed along the wall nearest the turbine, where panels can be added as the number of feeders or generators increases, but it is necessary for the operator to go to this only occasionally for switching. The central control board is near the stairway from the basement to the turbine floor, on the firing floor level, and midway between the boiler and turbine, and hence is quickly reached from any part of the room. Its position parallel to the boiler front will line up with future similar boards when the station is further enlarged. All the important auxiliary motors are provided with ammeters mounted on this board, and most of them can be started and stopped from it.

The scheme of combustion control is shown diagrammatically in figure No. 7. The control equipment automatically adjusts the speed of the mill feeder, primary air fans, and induced draft fan to maintain the proper steam pressure in the main header at all loads. The forced draft fan speed is then automatically adjusted so that a slight suction is maintained in the furnace, and a damper in the suction line to each of the mills prevents positive pressures inside the mills. Fan motor speeds are controlled through adjustment of secondary resistance by motor driven controllers. The boiler uptake damper and the forced draft fan discharge damper are so interconnected with the automatic control as to cause them to move just sufficiently to smooth out the fluctuations in the flow between the steps of the induced and forced draft fan motor speeds.

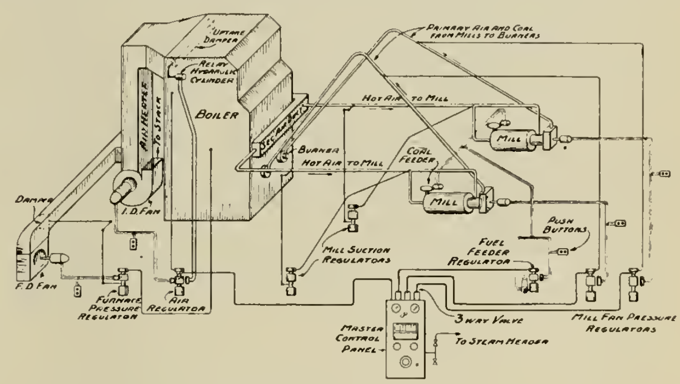

Figure No. 7.—Combustion Control System.

This automatic equipment can be quickly rendered inoperative and the individual motors controlled manually by push buttons on the central board. The equipment is found to give good control over a range from 18,000 to 90,000 pounds evaporation per hour.

As it is obviously undesirable to permit the building up of air pressure in the furnace with the induced draft fan shut down, electrical interlocks are provided so that the induced draft fan, forced draft fan and the two pulverizer fans must be started in the order named. These interlocks also function on failure of any fan motor.

The turbine is a combined impulse-reaction unit, operating at 3,600 r.p.m. and rated at 7,500 kv.-a., with 0.8 power factor. It was made in Baden, Switzerland. Sufficient spare parts are carried either at Saint John or in the manufacturer's American factory to insure against long outage. The following table shows the expected steam rates of the turbine at 375 pounds gauge pressure, 700 degrees F. steam temperature and 29-inch vacuum, with direct excitation:—

Load, kilowatts at terminals	3,000	4,500	6,000	7,500
Power factor, per cent	80	80	80	100
Steam rates, lb. per kw.hr.:				
Without steam extraction	10.45	10.07	10.0	10.45
With extraction at two points, to heat condensate to approximately 212 degrees F., and make-up	11.2	10.8	10.6	11.2

Figure No. 8 shows both turbine and generator.

The generator is star connected, 2,300 and 4,000 volts, and supplies a three-phase, four-wire system with a grounded, interconnected neutral. It is equipped with differential protection relays of the modern percentage type and with thermo-couple type temperature detectors. The generator ventilating air circulates in a closed system in which is installed a tubular air cooler connected to the circulating water system in parallel with the condenser.

No main generator field rheostat is provided, since the direct connected exciter is designed to be stable at all required excitation voltages, which permits manual adjustment of the generator voltage by means of the exciter rheostat. Normally the excitation voltage is automatically adjusted to maintain the required generator voltage, by a Brown Boveri rheostatic regulator connected in the shunt field of the exciter. The main field circuit of the turbine generator can be transferred to a spare exciter in the old power plant. Since this emergency exciter might not be stable at the lower voltages required, provision has been made for transferring its field to the control battery. Under this condition the spare exciter operates as a separately excited machine and is, of course, stable at any output voltage.

A very compact single pass condenser with 4,600 square feet of surface is installed inside the steel turbine foundation. The low temperature of the harbour water allows high vacuum to be obtained with very little surface. The normal summer maximum is 56 degrees F. with an extreme of 62 degrees F. on low tide. The condenser has the usual equipment of steam jet air ejectors, and two motor driven condensate pumps. The latter are so designed as to maintain positive water pressure on both stuffing boxes to prevent in-leakage of air. The condenser has horizontally divided water boxes to permit cleaning one-half with the other in use. The table following indicates the expected performance:—

Steam condensed per hr., lb	67,000	67,000	33,000	33,000	35,000
Temperature circulating water, deg. F	55	40	55	55	40
Quantity circulating water, imp. g.p.m	10,000	8,330	8,330	4,110	4,170
Condenser friction, ft. of water	11.5	8.5	8.5	3.5	3.9
Vacuum, referred to 30 in. barometer	29.0	29.25	29.22	29.6	29.25

To keep the turbine lubricating oil in condition, two 420-gallon tanks are provided, into one of which a used charge of oil may be drawn for settling. The other contains a new charge ready for use.

The system for heating the condensate or feed water was designed to give fairly high efficiency without introducing complications unwarranted in a relatively small plant. Figure No. 9 shows the principal piping. Steam is extracted from the turbine at two points; the lower one at a maximum pressure of about 9 pounds absolute, to heat the condensate passing through an extraction heater, and the upper one at about 70 pounds gauge pressure to furnish pure make-up by the evaporation of city water in the evaporator. The vapour from this latter process also enters the de-aerating heater and provides the second stage of heating to give a water temperature of about 212 degrees F. entering the boiler. Sufficient excess steam is withdrawn from the de-aerator to the vent condenser to de-aerate the condensate. Since an economizer is not used with the new boiler, this provision is not strictly necessary at present. The de-aerator, however, is designed to handle both the present and an additional future unit, and the possibility of the future use of an economizer makes the slight additional expense and complication of the de-aerating features seem warranted.

The water leaving the condensate pumps passes successively through the air ejector condensers, the de-aerator vent condenser, the extraction heater and into the de-aerating heater through a float valve which allows any excess or deficiency to be cared for by the surge tanks. Here it meets the evaporator vapour and steam line and other drips and passes to the boiler feed pump suction header below. A second float valve on the de-aerator will admit city water if the level goes unduly low.

This arrangement of the condensate piping permits the new de-aerating heater and the old open heater to be cross connected and provides insurance against low water in the boilers in the form of a 4,200 gallon reserve of condensate in the roof surge tanks. It also is well adapted, without special preparations, to the making of turbine and boiler tests by the operating force, to ascertain that the original efficiencies of the main equipment are maintained. This is accomplished by providing two roof surge tanks instead of one, piped so that for a turbine test the condensate may be discharged alternately into the two, for volumetric measuring—one filling while the other is emptying into the de-aerator. The method of accomplishing this can be seen from figure No. 9. Feed water is measured for a boiler test in the same manner. This allows accurate determination of either turbine steam consumption or boiler evaporation to be made without interrupting the continuous flow of water to the feed pumps, and with very few changes from normal operating conditions. The surge tanks are provided with bottle shaped tops to reduce the test error from a wrong determination of water level. The other data required during such tests are provided for by coal sampling taps, test thermometers wells, and connections for test gauges, and by a small plant laboratory.

There are two boiler feed pumps, each with more than sufficient capacity to supply the new boiler. Both operate at 3,550 r.p.m. This high speed reduces the size and cost of the units and makes them well adapted to direct drive by either motor or turbine. The pump ordinarily used is driven by a squirrel cage motor, and the reserve pump by a turbine which exhausts either to the atmosphere, or into the de-aerator if the evaporator should be out of service. For a 250 imp. g.p.m. pump the constant speed drive was found to be more economical in total cost than variable speed. The reserve pump is controlled by a governor maintaining a fixed difference between the pressures at the pump and in the main steam header.

The feed and steam piping is fabricated in accordance with the American engineering standard for 400 pounds working steam pressure, and presents no special features other than arrangements for connection to future new installations. The piping allows the boiler to be fed at one side through an automatic regulator preceded by a valve whose function is to limit the differential pressure across the regulator. The boiler may be fed at the other side through an entirely independent manually operated valve.

An 8-inch tie line from the new steam header passes into the old engine room where there is installed an equipment for reducing the pressure and temperature of the steam to about 160 pounds and 500 degrees, for the old units. Sufficient safety valves are provided on the outlet side of the reducing valve to prevent dangerous rise in pressure due to any improper functioning of the equipment. Under the very rapidly fluctuating loads the pressure is maintained within a range of 4 pounds or less.

With reference to the electrical connections, the main 4,000-volt generator-leads go directly to circuit breakers in an outdoor substation, situated on a wharf about 175

Figure No. 8.—Turbine and Generator.

feet from the power house. From a station service bank of transformers in this substation, leads return to a 3-phase bus at the rear of a 440-volt steel auxiliary panel board in the turbine room. The main switchboard, of the standard vertical type, adjoins the auxiliary board. It is fitted with the usual switches, instruments, and relays for controlling all the generator and feeder circuits connected to the bus in the outdoor substation. The 1,000 kv.-a. station service transformer bank has sufficient capacity to carry the present load when operating in open delta when any one of the transformers is out of service. This bank probably will be duplicated when additional generators are installed, but for the present it is considered that sufficient provision for the continuity of the auxiliary supply has been made by providing for open delta operation.

The station service board carries safety type knife switches and primary contactors for the individual auxiliary motor circuits. This arrangement of the auxiliary motor equipment conforms to the present tendency to group similar apparatus wherever practicable. It was particularly desirable at Saint John by reason of the limited available space adjacent to most of the motors.

Each of the primary motor contactor circuits is provided with two interconnected push buttons for starting and stopping the motors, one button of each pair being located adjacent to the motor and the other button mounted on the boiler control panel. This panel also mounts other buttons for speed control of certain motors, speed indicators, etc., as well as the boiler instruments previously described. By this grouping it is possible for one man at the boiler control board to control and supervise all the principal motors during normal operation, while the push button adjacent to each motor makes emergency control possible without going to the boiler control panel.

Wherever frequent speed adjustment is required, the motors are of the slip ring type and are fitted with motor driven secondary drum controllers. In all cases these controllers and the accompanying secondary resistors are mounted adjacent to the motor, which minimizes the length of interconnecting leads. For each of these motors a pair of "fast-slow" push buttons is also provided, one button being placed adjacent to the motor and the other on the boiler control board. Contrary to common practice, the motors for driving the secondary drum controllers are all supplied from a 110-volt, 3-phase source rather than at 440 volts, since this lower voltage permits this equipment to be maintained with less hazard. The 110-volt supply is secured through two small transformers fed from the 440-volt bus.

Wherever speed control is not required and where the starting duty will permit, squirrel cage motors of the full voltage starting type are used. The coal handling motors, which are of this type, are interlocked electrically through extra contacts on the primary contactors so that the coal elevator, coal crusher, and apron feeder motors must be

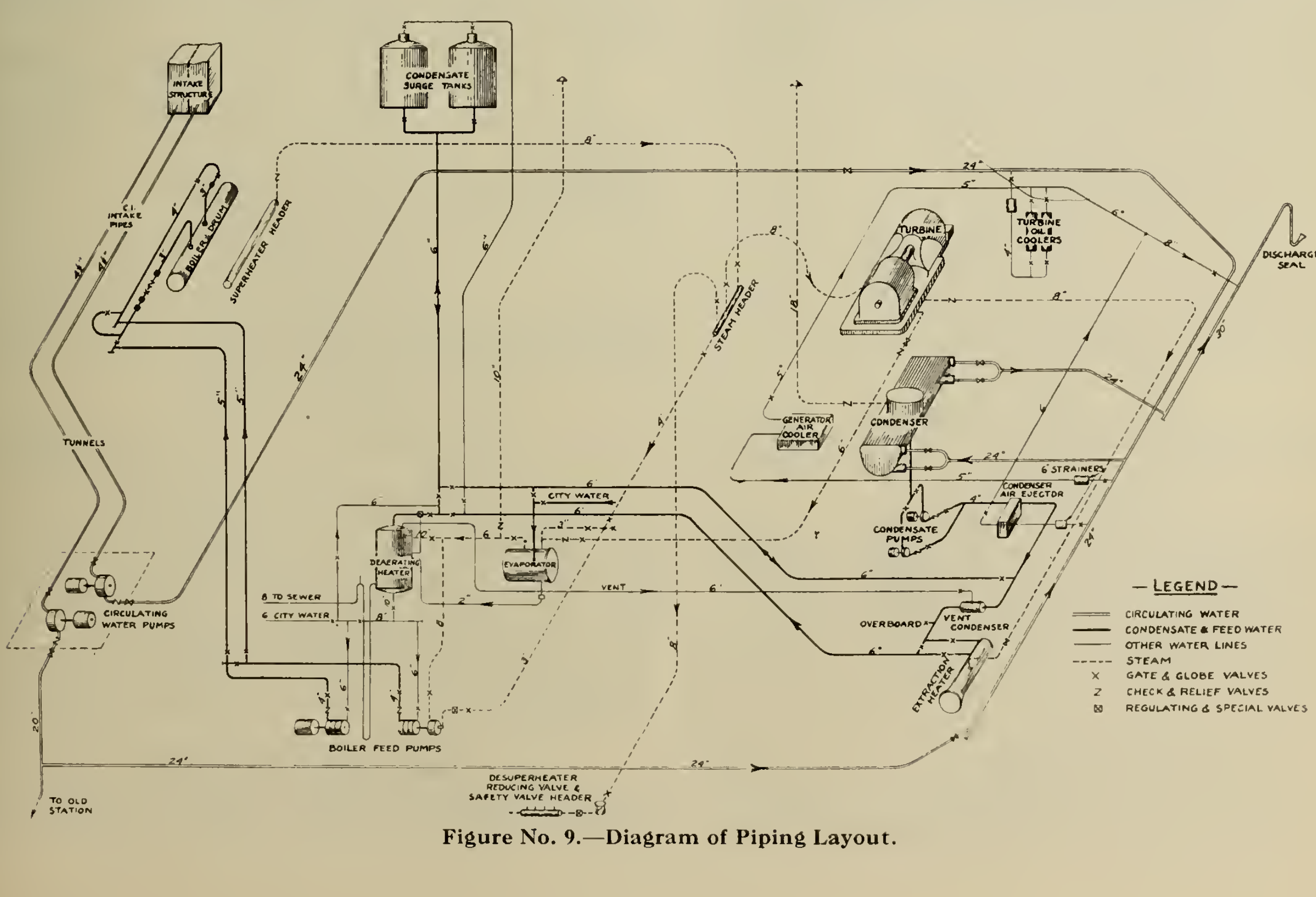

Figure No. 9.—Diagram of Piping Layout.

started in the order named, or shut down automatically in case of any motor failure in such sequence as will prevent delivery of coal to equipment not running. For supervision of operation from the control board, it was deemed desirable to install an ammeter for each important motor to give a positive indication when the circuit is closed. As the slip ring circulating pump motors are located in a pit at a remote corner of the station, a Selsyn transmitter has been provided on each of the two secondary drums with indicators on the boiler control board which show the position of these drums at any time.

Coal is fed to each pulverizer by a one-quarter horse power, 125-volt, direct-current motor supplied from the station control bus. The speed of these motors is controlled simultaneously by a motor-operated rheostat controlled by manually operated push buttons near the motor, on the control board, or through contacts on a Smoot regulator. Preliminary operating experience showed the desirability of an indication of speed on the coal feeder motors and on the pulverizer fan motors; therefore, speed indicating magnetos were added to these motors with electrical indicators on the control board.

The outdoor 4-kv. substation controls the new generator, 6 regulated outgoing feeders, station service bank, and one tie feeder to the system of the New Brunswick Electric Power Commission. This last feeder also is tied to the 2,300-volt bus in the old substation through two transformer banks having a total capacity of 3,000 kv.-a.

The steel structure for the substation is of the conventional type, except that a roof has been installed. The structure mounts the main and transfer bus, together with the necessary disconnecting switches. The electrically operated circuit breakers and instrument transformers are mounted in individual sheet metal houses with the leads carried through roof bushings. This arrangement permitted the utilization of a number of indoor oil breakers which were available at Saint John. Three single-phase outdoor type induction regulators are installed on each of the outgoing feeders. The current and potential transformers for the regulator control have been mounted inside the regulator top housing, which has greatly simplified the installation.

A roof was incorporated in the substation design because the unloading plant of a large coal company is situated adjacent to the substation site, which makes this location subject to a great deal of coal dust under certain wind conditions. For this reason it was considered advisable to cover the substation structure to minimize the necessity for cleaning insulators, bushings, etc., and to insure increased reliability.

The main 4,000-volt generator leads are carried in fibre conduit, encased in concrete, through a tunnel under the street adjacent to the power house. This tunnel was cut through rock. The leads then continue through a concrete enclosed passageway built through the warehouse situated on the wharf, where they terminate in a concrete manhole. From this point the conduits run to the generator switch in the outdoor 4,000-volt substation.

All control cables are carried from the switchboard in iron conduit through the tunnel and passageway above. They terminate in a separate concrete manhole from which the conduits lead to the various breakers, etc. The 4,000-volt feeder cables are carried in iron conduit through the tunnel and terminate at poles in the street for connection to the overhead distribution system, which was changed from the 2,300-volt three-wire arrangement, to 4,000-volt four-wire. All iron conduits in the yard are encased in concrete for protection against corrosion occasioned by the ash fill.

This station of the New Brunswick Power Company at Saint John, N.B., was designed and constructed by Sanderson and Porter, in cooperation with J. D. Bowles, chief engineer of the Federal Light and Traction Company.

Data on Plant and Equipment

Building (Section Containing the New Equipment)

Width inside of building—48 ft. 6 in.
Length inside of building—93 ft. 0 in.
Area per kw. capacity based on 7,500 kw.—0.6 sq. ft.
Volume per kw. capacity based on 7,500 kw.—34.0 cu. ft.
Elevation of extreme low water—100 ft.
Elevation of high water—128 ft.
Elevation of pump room floor—97 ft.
Elevation of condenser floor—126 ft.
Elevation of turbine floor—145 ft.

Circulating Water Intake and Discharge

Gross area screen chamber extreme low water—140 sq. ft.
Intake lines—Two, each consisting of 112 ft. of 42 in. c.i. pipe and 290 ft. of 3 ft. 10 in. by 4 ft. concrete tunnel.
Discharge line—One 30 in. c.i. pipe 280 ft. long.
Elevation of seal on discharge line—111 ft.

Fuel

Kind and source—Dominion—Sydney, Nova Scotia.
Proximate analysis, as fired—volatile matter 28.8%, fixed carbon 54.8%, ash 13.1%, moisture 3.3%. b.t.u. per lb. 12,610.

Boiler and Furnace

Type of boiler—Class 22-36 D, Kidwell, steel cased.
Steam pressure—448 lb. gauge maximum drum working pressure.
Steam drums—36 and 42 in. diameter, approximately 25 ft. long.
Other drums—Two 36 in. diameter, approximately 25 ft. long.
Boiler tubes—3¼ in. diameter, No. 8 b.w.g., 36 tubes wide.
Fin wall tubes—Sides 4 in., arch and rear 3 in., all No. 6 b.w.g.
Ash-pit screen tubes—4 in., No. 6 b.w.g., two rows, 12 in. centres each.
Boiler heating surface—9,472 sq. ft.
Projected area water cooled surface in walls, arch and screen—1,400 sq. ft.
Furnace volume above screen tubes—7,050 cu. ft.
Manufacturer—Canadian Vickers Limited.

Superheater

Tubes—1⅝ in., No. 9 b.w.g., 4 loop, 1,650 sq. ft. total surface.
Type and manufacturer—Elesco—Superheater Company.

Air Heater

Elements—3 ft. by 25 ft., 10,260 sq. ft. heating surface.
Spacings—Air side ¾ in., gas side 1 in.
Type and manufacturer—Vertical plate—Combustion Engineering Corporation, Ltd.

Forced Draft Fan

Capacity at 8.75 in. static pressure—31,800 cu. ft. per minute at 100 deg. F.
Type and size—Double inlet, 48 in. RB design C2.
Manufacturer—Green Fuel Economizer Company.
Drive—75 h.p. slip ring motor, 580-1,160 r.p.m.
Speed control—Secondary resistance, 13 points.

Induced Draft Fan

Capacity at 6 in. static pressure—68,500 cu. ft. per minute at 414 deg. F.
Type and size—Double inlet, type SA, No. 8.
Manufacturer—Green Fuel Economizer Company.
Drive—125 h.p. slip ring motor, 248-495 r.p.m.
Speed control—Secondary resistance, 13 points.

Stack (Built for Old Boilers)

Dimensions—175 ft. above burner floor, 7 ft. 6 in. inside top, brick.

Raw Coal Handling Equipment

Receiving hopper with grating—8 ft. by 8 ft., opening 6 in. by 6 in.
Apron conveyor—18 in. wide, 15 ft. centres, 25 tons per hour.
Apron conveyor drive—3 h.p. squirrel cage motor, 870 r.p.m.
Crusher—30 in. by 24 in., type A, 1,160 r.p.m., 25 tons per hour.
Crusher drive—40 h.p. squirrel cage motor, 1,160 r.p.m.
Elevator—Single strand bucket chain, 64 ft. centres, 25 tons per hour.
Elevator drive—5 h.p. squirrel cage motor, 1,160 r.p.m.
Manufacturer—Jeffrey Manufacturing Company.
Coal bunker—⅜ in. unlined copper steel, capacity 135 short tons.
Automatic coal scales—Two, 200 lb. scale, capacity 12,000 lb. per hour, Richardson.

Pulverized Coal Equipment

Mills—Two 6,000 lb. per hour ball mills, 4 ft. 6 in. by 9 ft., herringbone gear drive.
Mill drives—Two 50 h.p. slip ring (starting duty) motors, 575 r.p.m.

Feeders—Two 30 in. diameter, disc type.
Feeder drives—Two ¼ h.p. direct current motors, 300-1,200 r.p.m., 120 points.
Primary air dans—Two 30 in., plate type.
Primary air fan drives—Two 15 h.p. slip ring motors, 580-1,160 r.p.m., 13 points.
Manufacturer—Canadian Kennedy Manufacturing and Engineering Company, Ltd.
Burners—Two 30 in. Couch type D—Combustion Engineering Corporation, Ltd.

Combustion Control Equipment

Equipment—One 8 element master controller, power unit, and 7 regulators—Smoot Engineering Corporation.

Ash Handling Equipment

Type and capacity—Steam vacuum, 5 tons per hour.
Sizes—8 in. ash-pit line, 6 in. soot hopper line.
Manufacturer—George J. Hagan Company.

Main Generating Unit

Turbine—2 impulse stages, 23 reaction stages, 3,600 r.p.m.
Generator—3-phase, 60 cycles, 4,150 volts, star connected.
Capacity—7,500 kv.-a., 0.8 power factor,—7,500 kw., 1.0 power factor maximum.
Steam conditions—375 lb. gauge, 700 deg. F. (450 lb. 750 deg. maximum).
Direct connected exciter—37 kw., 125 volts, shunt wound.
Manufacturer—American Brown Boveri Electric Corporation.

Generator Air Cooler

Tubes—⅝ in. Admiralty metal, 1,100 sq. ft. total.
Ventilating air—24,000 cu. ft. per minute at 104 deg. F.
Cooling water—56,700 lb. per hour at 77 deg. F.
Manufacturer—American Brown Boveri Electric Corporation.

Turbine Lubricating Oil System

Oil coolers—Two, 130 sq. ft. each, American Brown Boveri.
Settling tanks—Two, 420 imperial gallons each.

Main Condenser

Type and size—Surface, single pass, horizontally divided, 4,600 sq. ft.
Tubes—¾ in. No. 18 b.w.g., 17 ft. 6 in., rolled one end, admiralty.
Packing—1 fibre ring, corset lace, and 1 lead ring.
Circulating water—Salt harbour water, 8,330 imp. g.p.m. (10,000 maximum).
Manufacturer of condensing equipment—Canadian Ingersoll-Rand Company, Ltd.

Circulating Water Pumps

Number and type—Two, single-stage, 16 in. discharge.
Capacity each—8,330 imp. g.p.m. at 25 ft. head, 3,000 imp. g.p.m. at 58 ft. head.
Drive—125 h.p. slip ring motor, 435-870 r.p.m.
Speed control—Secondary resistance, 13 points.

Condensate Pumps

Number and type—Two, two-stage, 2½ in. discharge.
Capacity each—133 imp. g.p.m., 80 ft. discharge head.
Drive—10 h.p. slip ring motor, 875-1,750 r.p.m.
Speed control—Secondary resistance, 11 points.

Condenser Air Ejectors

Number and type—3 primary and 2 secondary steam jets.
Capacity—5 cu. ft. per minute with 2 primary and 1 secondary jet.

Extraction Heater

Type and size—Horizontal, 6 pass, floating head, 410 sq. ft.
Tubes—¾ in., No. 18 b.w.g., Admiralty metal.

Evaporator

Type and size—Horizontal shell, submerged admiralty coils, 126 sq. ft.
Steam pressures—53 lb. gauge (400 lb. maximum)—vapour 2 lb. gauge.
Capacity—3,000 lb. make-up per hour.
Manufacturer—Riley Engineering and Supply Co., Ltd.

De-Aerating Heater

Type and size—Vertical, 5 ft. 3 in. diameter by 8 ft. 6 in.
Operating pressure and capacity—1 lb. gauge, 170,000 lb. water per hour maximum.
Vent condenser—25 sq. ft., 82,000 lb. condensate per hour.

Condensate Surge and Measuring Tanks

Number and size—Two, 7 ft. diameter by 10 ft., 2,100 imperial gallons each.

Boiler Feed Pumps

Number and type—Two 3-stage Cameron; one motor, one turbine driven.
Capacity and head—250 imp. g.p.m. each, 1,200 ft. total head.
Drive—200 h.p. squirrel cage motor, type FT, 3,550 r.p.m.
Drive—190 h.p. non-condensing turbine, type 2-MD, 3,550 r.p.m.
Speed controls—Motors; constant speed. Turbine; Fisher excess governor.
Manufacturer—Canadian Ingersoll-Rand Co., Ltd.

High Pressure Steam and Feed Water Piping

Flanged joints—400 lb. American Engineering Standard, Van Stone.
Valves—400 lb. American Engineering Standard cast steel, Reading.
Piping fabricator—Walworth Manufacturing Company.

Low Pressure Piping

Flanged joints—125 lb. American Engineering Standard, Durabla gaskets.
Valves—Jenkins Bros., Ltd.

Miscellaneous Valves

Boiler safety valves—Three 4½ in. Crosby.
Superheater safety valve—One 4 in. Consolidated.
Boiler non-return valve—One 8 in. Edward.
Drum stop-check valves—Two 3 in. Edward.
Blow-off valves—Six 2½ in. Edward, two in tandem.
Turbine atmospheric relief valve—18 in. Atwood-Morrill.
De-aerator back pressure valve—10 in. Cochrane multi-port.
Circulating water valves—16 in.-24 in. Jenkins Bros., Ltd.

Heat Insulation

High pressure steam lines—3 in. thick except small sizes.
High pressure feed lines—Double standard magnesia except small sizes.
Manufacturer—Johns-Manville Corporation.
Hot air duct covering—1½ in. Rockwool blankets and hard finish.

Steam Pressure Reducing Equipment

Type—Master controlled 8 in. reducing valve, 400-160 lb.
Manufacturer—Swartwout Company.

De-Superheater

Type—Copper cartridge.
Manufacturer—Elliott Company.

Crane

Type and capacity—3 motor, 20 tons, type NE, pendant operated.
Motors—Hoist 30 h.p., bridge 7½ h.p., trolley 10. h.p.
Manufacturer—Northern Crane Works, Ltd.

Mechanical Instruments

Steam flow meters—Indicating recording totalizing—Republic.
Feed water flow meter—Indicating recording totalizing—Republic.
Boiler water level recorder—Differential pressure type—Foxboro.
CO_2 recorder—Ranarex—Permutit Company.
Draft gauges—P9F and P4F—Bailey.
Surge tank level indicator—Industrial Jr.—Liquidometer.
Pressure and temperature recorders—12 in. Class III—Foxboro.
Indicating pressure-vacuum gauges—Form IR-SP—Ashcroft.
Indicating thermometers—12 in. Tag-Hespe—Tagliabue.
Feeder and fan tachometers—Electric—Weston.

Laboratory Equipment

Chemical testing set—Lab-Rette—Babcock and Wilcox.
Sieve shaker and sieves—Ro-Tap—Tyler.
Dead weight gauge tester—Type 1300—American.

Miscellaneous Mechanical Equipment

Air compressor—12 by 10 in., 368 c.f.m., 100 lb., Ingersoll-Rand.
Sump pump—210 imp. g.p.m., 20 ft., vertical, 1,150 r.p.m., Rumsey.
High pressure steam traps—Inverted submerged bucket, Armstrong.
Boiler soot blowers—14 half-width elements—Diamond.
Boiler feed water regulator—Type SM and type S—Swartwout.
Boiler water column—Reliance.

Main Switchboard

Type—7 panel 90 in. vertical remote control, ebony asbestos.
Manufacturer—Canadian General Electric Company.

Station Service Switchboard

Type—10 panel 90 in. vertical safety board, steel.
Manufacturer—Empire Switchboard Company.

Generator Voltage Regulator

Type—Quick acting, controlling exciter field, Brown Boveri.

Control Storage Battery

Type—60 cell, Exide KXF-13, sealed in glass jars.
Capacity—13 amperes for 8 hours, 150 amperes for 1 minute.
Manufacturer—Electric Storage Battery Company.

Battery Charging Equipment

Type and capacity—Induction motor-generator, 1½ kw., 140 volts, shunt.
Manufacturer—Canadian General Electric Company.

Station Service Transformers

Rating—Three 333 kv.-a., single phase O.I.S.C., 4,150/460-230 volts.
Manufacturer—Canadian General Electric Company.

Feeder Induction Regulators

Rating—48 kv.-a, single phase self-cooled automatic outdoor.
Voltage—2,400 volts primary, 10/5 per cent buck or boost.
Manufacturer—Canadian General Electric Company.

Outdoor Substation

Type—Galvanized steel structure, asbestos protected metal roof.
Manufacturer—Canadian General Electric Company.

Oil Circuit Breakers

Generator and tie breakers—Type FK-55, solenoid operated.
Feeder breakers—Type FK-12, solenoid operated.
Mounting—Individual weatherproof houses, with instrument transformers.
Manufacturer—Canadian General Electric Company.

The Electric Trolley Omnibus

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The last few years have seen an unprecedented increase in motor traffic in the United Kingdom. The automobile has ceased to be a rich man's luxury, with the result that roads which were comparatively unfrequented before the war have become more and more congested. Side by side with the increase in private motoring has been a similar growth of heavy vehicular traffic on the roads, consisting of both freight movements and the development of the large passenger coach. The congestion of the roads has naturally concentrated in the towns, in many of which the narrow streets have proved totally inadequate to deal with the increasing volume of traffic, with the result that costly reconstruction has become necessary.

This increased congestion of traffic, coupled with severe competition from motor buses, has made it more and more difficult in the smaller towns to operate tramways satisfactorily. The difficulty has been accentuated by the decrease in money values since the war, so that many tramway undertakings have not only found their passenger returns decreasing, but have also found their renewals funds insufficient to keep the systems in good repair. Consequently the last few years have seen the complete removal of many tramway systems, and their replacement by motor buses or by trolley buses.

The latter vehicle has proved so successful and popular with the public, being less expensive to operate than the motor bus, and much more comfortable due to its smooth and high acceleration and absence of noise and smell, that its status has changed from that of a cheap substitute for the tramcar to that of an extremely important and popular means of transportation.

It is the purpose of this paper to give some account of the development and use of the trolley bus, both in Europe and on this continent, together with its more important technical features.

Early Development in Europe

By the end of the nineteenth century considerable progress had been made in electric street railways on the continent of Europe, especially in Germany. The more important technical features, such as current collection from overhead wires and track, and the series-parallel control of two series motors, had become fairly standardized and many systems were in operation in cities and towns.

The new system having proved successful in areas of fairly dense population, it was natural that electric traction should be looked upon as the possible solution of transportation problems in less thickly populated districts such as the outskirts of cities and rural areas, but here the street railway was found to be unprofitable due to the cost of constructing and maintaining the steel track.

It was in order to eliminate this latter expense that the idea was conceived of constructing a road vehicle driven by electric motors and supplied with power from two overhead wires, the collecting device being such as to allow considerable lateral freedom of movement of the vehicle. It is this type of vehicle that has come to be known as the "trolley bus" or "trackless trolley."

The first working example of a trolley bus seems to have been the vehicle which was shown at the international exhibition of Paris in 1900, which was fitted with steering gear and driven by electric motors (*Note 1*). Power was supplied by means of two overhead wires, connection being made to the bus by the use of an electrically driven "contact carriage" which ran on the overhead wires, from which carriage a flexible cable conveyed current to the motors. The system attracted considerable attention, but only two or three further installations were made, one being at Eberswalde near Berlin and one near Monte Carlo, and none of them were in operation for any length of time.

Meanwhile a German engineer, Max Schiemann, had been developing a trolley bus in which the current was collected from the overhead wires by means of two trolley poles, with under-running sliding contacts. His first installation was in the Biela valley and provided both a passenger and goods service. The line was opened in July, 1901, and was in use for several years (*Note 2*).

Figure No. 1 shows one of the passenger buses. These vehicles had seating space for eighteen passengers, while there was standing room for six more on the rear platform. The average running speed was 12 kilometres per hour. Motive power was provided by two series motors arranged for series-parallel control, with short-circuit braking. A tramcar controller, with vertical drum and operated by hand, was used.

The new system was only advocated for use where conditions did not warrant the expense of a track; there was no suggestion that it might supersede the tramway, but in rural districts where traffic was comparatively light or where it was desired to develop a traffic route to be served ultimately by street cars it had the great advantage of low capital cost (Schiemann gives the initial cost as about one-quarter of that of a track system).

Another use to which the new trackless system was put was that of connecting factories and warehouses with railway stations, such an "industrial line" being shown in figure No. 2 which shows a passenger bus passing a train of goods wagons near Monheim-on-Rhine (*Note 3*).

Schiemann's system with trolley poles had better success than the cable-collection method, and during the following years many installations were put into operation. Figure No. 3 shows a bus at Mülhausen, where it is seen that the two poles have been replaced by a single one, with a double-pole sliding contact. Many of these early buses had front-wheel drive.

An example of a trolley bus using alternating current was shown at the electrical exhibition at Leipzig in 1912; built by Schiemann, it was driven by a brush-shifting repulsion motor at 1,000 volts and 50 cycles, and had a free-running speed of 20 kilometres per hour (*Note 4*).

Schiemann's buses had a lateral freedom of movement of about three metres on either side of the centre line of the wires, and it was to obtain greater mobility that other engineers used the more complicated cable collector. After an experimental stage this idea was successfully developed, and an important example was the system used in Italy, where by 1909 there were about 60 miles of route in operation in the neighbourhood of Lake Como. The Italian buses were built with a short wheelbase of 8.5 feet so that they could negotiate the sharp bends which were so prevalent in the roads. On the two overhead wires ran a four-wheeled contact truck, which was connected to a trolley pole on the bus by a flexible cable, so arranged that the vehicle could turn round without any manipulation of the collecting gear, which advantage was common to all cable

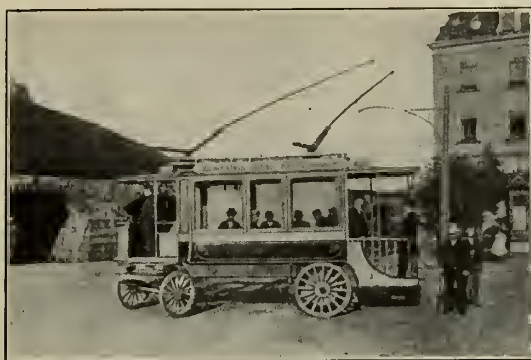

Figure No. 1.—Trolley Bus in Biela Valley, Germany, 1901.

systems. The passing of two buses using the same pair of overhead wires was, however, more difficult when a cable was used; with trolley poles, those on one of the buses could easily be pulled down from the wires while the other bus passed by, but with the over-running contact trucks of the cable systems it was necessary to arrange some method of disconnecting the cable from the truck and then exchanging trucks. On the early systems, with comparatively infrequent service, the economy of using but one pair of wires for two-way traffic justified the slight delay which took place when two buses met. With the heavy services in use at the present time two pairs of wires are always used.

In Germany the cable system was developed principally by the engineer Stoll, whose installations, at Dresden in 1903 (*Note 5*), and in a few other places, were not so successful at first as those of Schiemann. However, the largest use of Stoll's system was in Austria, where the Austrian Daimler Company built buses which were installed quite widely in that country (*Note 6*).

Figure No. 4 shows a type of bus in use near Vienna about the year 1908 which has several interesting features including a back-wheel drive, the motors being incorporated in the wheels themselves, thus eliminating all transmission problems and, it was claimed, prolonging the life of the motors. The cable was attached to the bus on a spring drum, which automatically wound up any superfluous length, while its other end was attached to the four-wheeled contact truck, which had a hanging arm with a heavy weight on the end whose purpose was to prevent the carriage being pulled off one of the wires by the lateral pull of the cable. The total length of the cable was about ten metres, so that the bus had a large freedom of movement.

A similar type to this was also used, except that the motors were built into the front wheels. These buses, seating twenty-four passengers, were operated at a cost of

Figure No. 2.—Passenger Bus passing Goods Train at Monheim-on-Rhine.

from 7 to 9.5 cents per mile, while their energy consumption was about 80 watt-hours per ton-mile in fine weather.

Another example of cable collection was that installed in Bremen in 1911, where the two overhead wires were placed in the same vertical plane, 30 centimetres apart. A contact carriage with two contact wheels ran on the upper wire, while connection was made with the lower wire by means of sliding contacts; the carriage was connected to the bus by a flexible cable. The system, which consisted of two lines each two kilometres long, was constructed by Köhlers of Berlin and Bremen. The buses seated twenty, weighed 3.2 tons empty, and took about 0.4 kw.hr. per bus-mile.

Progress in the development of the trolley bus was naturally cut short by the war, though many miles of temporary route were used by the military in Italy during the conflict. During the post-war years of reconstruction, it was Great Britain that first took full advantage of the economies of the system, so it is to that country we must now look for its further development. During the last few years, however, several deputations of continental engineers and municipal men have visited the systems in England,

Figure No. 3.—Trolley Bus with Single Trolley Pole at Mülhausen.

and the trolley bus would seem to be starting on a new lease of life on the continent.

Development in England

In the first decade of this century the use of the tramcar had been steadily growing in Great Britain, and so long as the area served was one of fairly dense population the undertakings proved successful. It was soon found, however, in the smaller towns and outlying districts of the larger ones that it was much more difficult to operate at a profit. The high cost of operation was due, firstly, to the high cost of the track and its maintenance; secondly to the high rates paid on the track; and lastly, to the fact that the tramway companies had to maintain a disproportionately large area of paving, this being an unwelcome legacy from the old horse trams.

Naturally in these circumstances any system which could dispense with the track was bound, sooner or later, to find favour, and in 1910 we find a delegation sent by the city of Bradford to the continent for the purpose of inspecting the existing trolley bus systems there and reporting on their suitability for use in England. Their report was favourable, and in 1911 the first trolley bus line in the United Kingdom was opened at Bradford. Figure No. 5 shows one of the two buses which were put into service. They had seating capacity for twenty-eight, and required two men, a driver and a conductor, to operate them. Two 20 h.p. series motors, with shunted field control, supplied the motive power, and it will be noticed that current was

Figure No. 4.—Trolley Buses near Vienna, 1908.

collected by means of two trolley poles with under-running contact wheels, a method which had been used for tramcars in Great Britain and which now has become standardized in trolley bus practice (*Note 7*).

There were also four buses put into service about this time at Leeds, but these differed from the Bradford vehicles in having a front entrance and requiring only one man to operate them.

Other corporations now followed the lead of Bradford and Leeds; during the year 1912 the Rotherham corporation opened a route from Rotherham to the village of Maltby, and Dundee also commenced a trolley bus service. Considerable interest was aroused in tramway circles and not a little opposition from the rapidly growing motor omnibus companies. Altogether at the outbreak of hostilities in 1914 there were seven installations of trolley buses in operation in Great Britain, and though the vehicles were somewhat primitive in mechanical and electrical equipment the experiment seemed to be successful. The technical press of that time bears witness to the keen discussions which took place as to the possibilities of the new system. The trolley bus had to defend itself against both the motor bus interests and the firmly established tramcar, but the newcomer proved its worth at least from an economic standpoint on light traffic routes where the tram was definitely unsuccessful: the day had not yet come when road vehicles could surpass the tramcars in riding comfort.

The war put an end, for the time being, to any further development, but the growth of the use of the trolley bus in the years of reconstruction which followed can be traced to some very definite effects which the war produced. The smaller towns had let their track systems get out of good repair and now found that their renewals funds, due to the change in money values, were insufficient for the purpose. Road vehicles had been developed enormously and consequently the roads and especially the narrow streets in towns began to suffer from congestion, and finally the improvement in the construction of road vehicles enabled a trolley bus to be developed which completely surpassed the pre-war examples in comfort, speed, economy and reliability.

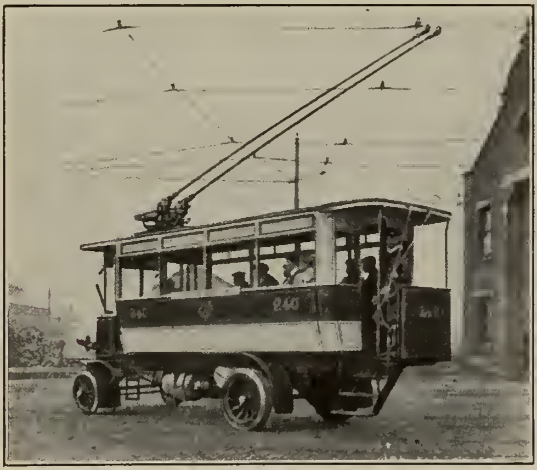

Figure No. 5.—Trolley Bus at Bradford, England, 1911.

Many of the smaller towns have now entirely removed their old track systems, and the movement would seem to be spreading to the larger cities. The latter naturally have a much greater amount of capital sunk in their tramway undertakings, and were better able to keep their systems in good repair during the war; having much heavier traffic to deal with, the tramcar, in these cases, has been quite successful financially. The congestion of traffic and the intense competition of motor bus companies, with the increased use of the private motor car, have, however, helped to decrease the popularity of the trams even in the large cities. It should not be forgotten, however, that great efforts are being made at the present time by the manufacturers to improve the riding comfort and to increase the speed of tramcars so that, with their superior carrying capacity, it would be unwise to say that they have not a very definite and important place in city transportation.

Figure No. 6.—Six-wheeled Double-deck Trolley Bus at Wolverhampton, England, 1926.

Some of the towns have replaced their trams by trolley buses, others by motor buses, while still more have adopted both types of vehicle. The advantages of the motor bus lie solely in its independence of route and overhead fixtures. On the other hand the trolley bus is very much quieter and smoother in motion, due to the absence of reciprocating parts, clutch, and gear box; its acceleration is high and smooth, due to the characteristics of the series motor and its control, while there is entire absence of smell. Use can be made of existing overhead material and of the old tramway power supply and distribution system. Provided that the route is permanent, as are most routes in towns and cities, it is just as flexible in traffic as the motor bus. Unless the service is so infrequent as to require a headway of twenty minutes or more (the exact limiting headway is a matter of local circumstances and cannot be taken as any definite figure to suit all cases), the trolley bus is considerably more economical to operate than the motor bus.

Although the two types of vehicle are often rivals when the removal of trams is considered, it is the enterprise of the motor car industry which has produced a trolley bus seating as many as sixty-five and capable of serving large towns and cities. In figure No. 6 is seen the modern type of

Figure No. 7.—Open Top Double-deck Trolley Bus at Hastings, England.

double-deck, six-wheeled pneumatic-tired vehicle which was first put into use at Wolverhampton in December, 1926.

This bus seats sixty-one and weighs approximately fourteen thousand pounds. It was built by Guy Motors, Ltd., of Wolverhampton. The adoption of the six-wheeled principle, with four driving wheels, has enabled a large capacity bus to be constructed without excessive axle weight. Since the pair of driving wheels on either side are locked together by the transmission gearing, wheelspin is almost impossible since both wheels on one side are very unlikely to leave the road surface at the same instant; thus one of the chief causes of skidding is removed. The two driving axles are situated at the ends of double springs which are slung from the frame at their centre, so that any vertical movement of a wheel only causes half that movement in the frame. Actually, the springs absorb a considerable amount of any such movement, so that the bus is delightfully smooth in motion.

Wolverhampton, with a population of about 134,000, is now served entirely by trolley buses, while motor buses, both single- and double-decked, run to the surrounding rural districts. Trolley buses also connect Wolverhampton with neighbouring Black Country towns, the population of the total area served being about 360,000. During the year ended March 31st, 1930, 23,176,000 passengers were carried by trolley buses alone, which ran a total of 2,419,762 miles. The gross profit of the trolley buses was £75,271 with an average fare per mile of 1.171d. The motor buses ran 2,251,607 miles, carried 16,522,400 passengers, and earned a gross profit of £26,236 with an average fare per mile of 1.196d. There are nearly 30 miles of trolley bus route, and plans are under way for the construction of an additional 13 miles; the system is one of the best examples of the success of these vehicles in a large industrial centre. The schedule speed of the service has increased by over twenty per cent, and the removal of the tracks has been a great boon to motorists. One of the greatest advantages to residents near a route has been the elimination of the often distressing noises of the tramcars.

At the present time, trolley buses are in operation in the following places in England:

Ashton-under-Lyne	Leeds
Birmingham	Maidstone
Bradford	Mexborough and Swinton
Chesterfield	Nottingham
Darlington	Oldham
Grimsby	Ramsbottom
Hastings	Rotherham
Ipswich	St. Helens
Keighley	Southend-on-Sea
Tees-side Railless Traction	Wolverhampton
West Hartlepool	York.
Wigan	

During the present year a great many additional installations will be started, one of the most important being the scheme of the London United Tramways Company who are abandoning some forty-six miles of tramways to the west and south-west of London and are substituting trolley bus routes covering at first about twenty miles in Twickenham, Teddington, Hampton, Kingston, Surbiton, Malden, and Wimbledon. This company has not paid any dividend on its ordinary shares since 1907 or on its preference shares since 1914, and since the war has had to spend £878,000 on track and road maintenance.

Among other places where trolley buses will be installed include Birkenhead, Cheltenham, a route from Atherton to Haydock in South Lancashire, Bournemouth, Newport, Leicester, Liverpool, Derby, and Pontypridd, the latter being the first example of trolley buses replacing street-cars in Wales. Aberdeen, Southport, Preston, and Manchester are also considering the adoption of these vehicles. Altogether twenty-three applications for trolley bus powers were before Parliament this year.

British firms have supplied trolley omnibuses to Christchurch, New Zealand, Bloemfontein, Orange Free State, and also to Italy and Belgium. It is interesting to note that continental opinion is now leaning more to the use of double-deck buses instead of single deckers with trailers, such as were supplied by a British firm to Copenhagen.

As a result of the visit of a delegation of German engineers to England a trial service of trolley buses has been put in operation between Mettmann and Gruiten, near Dusseldorf, this year.

Mechanical Features of the Trolley Bus

Figure No. 9 shows a typical example of a six-wheeled trolley bus chassis (*Note 8*); its outstanding feature is the "dropped" frame, which enables the floor of the bus to be within about twenty-four inches of the ground. The two rear axles are slung at the ends of double cantilever springs and are each fitted with a differential gear. The transmission is through propellor shafting through universal joints. All six wheels are fitted with brake drums, a foot-operated Westinghouse air brake acting on front and rear wheels and on two brake shoes on each of the middle wheels, these being fitted with duplex brakes with four shoes each, the

Figure No. 8.—Four-wheeled Single-decked Trolley Bus at Chesterfield, England.

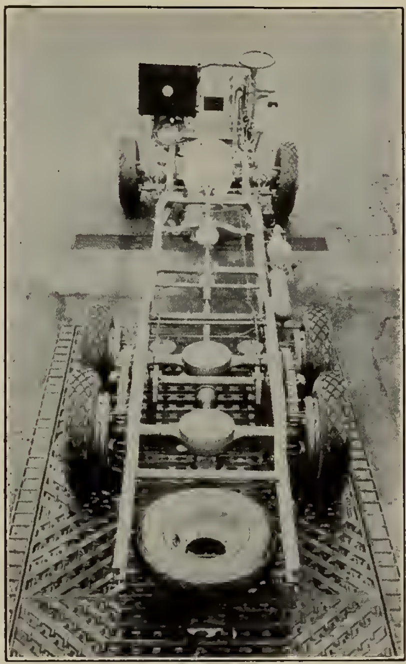

Figure No. 9.—Six-wheeled Trolley Bus Chassis.

other pair in each drum being operated by the hand-brake. In an emergency braking test at Hastings in 1929 on a bus with this chassis, at which the writer was present, retardations of over eleven feet per second per second were obtained by the simultaneous use of all the mechanical brakes. The road surface was dry, and of good macadam, and it was found that with a retardation of twelve feet per second per second the wheels just commenced to slip, thus giving a co-efficient of adhesion under these conditions of 0.40.

The following are representative figures for the type of six-wheeled bus in use at the present time, with covered upper deck:

Weight, complete............from 13,000 to 17,000 lbs.
Mean wheel-base............16 ft
Overall length...............26.5 ft
Height to top of roof........14.5 ft
Overall width...............7 ft 2 in.
Length of trolley poles......18 ft
Tires, pneumatic............36 ins. to 40 ins. by 8 ins.
Seating capacity............54 to 65
Maximum capacity.........85 approximately.

The seats in the latest buses are all of the bucket type and upholstered. Except for two side seats which cover the driving wheels on the lower deck all seats face forward. Unfortunately, it is not possible to use bodies wider than about seven feet, on account of the limited width of the roads; an extra foot in width, which would bring the buses up to the usual dimension on this continent, would entirely overcome the slight lateral overcrowding which takes place.

Single-deck buses, which are used on routes where the traffic is not so heavy, usually have only four wheels, a typical example being shown in figure No. 8. This bus is one of the Chesterfield fleet, and was constructed by Clough, Smith and Company, London. It seats thirty-two passengers, and weighs 12,700 pounds. It is 26 feet long and 7 feet 4.5 inches wide. Nearly all single-deck buses have a centre entrance. The trolley poles are somewhat longer than those on double-deckers, usually being about twenty-one feet.

With an 18-foot pole a trolley bus has an extreme lateral movement of about fifteen feet from the centre line, or about thirty feet in all; for ordinary running a deviation of about ten feet to either side is quite usual. Thus the electric bus is just as flexible in traffic as the motor bus, and is indeed superior in this respect on account of its high acceleration.

Electrical Equipment and Control

In the early days of the trolley bus, as the number of vehicles in operation was comparatively few and as the future of the new method of transportation was uncertain, it was not considered necessary to design equipment *de novo* when existing street-car apparatus could be employed. Consequently in the first buses we find vertical tramway controllers and heavy tramcar motors. As the trolley bus developed, it was realized more and more that in order to obtain the best possible results it would be necessary to build equipment specially designed for the purpose.

Both single-motor and double-motor equipments are used in the latest buses, the usual one-hour ratings being, for a six-wheeled double-decker, either 60 to 80 h.p. if a single motor is used or two 35 to 40 h.p. motors if the older method of series-parallel control is adopted; for a single-decker the ratings are in some cases the same, but a single 50 h.p. motor is also used.

The majority of buses are fitted with series motors, series-parallel control being used with double motor equipment, and shunted or tapped field control for the higher speeds if only one motor is fitted. A popular arrangement for series-parallel control is the "twin" motor, both armatures being mounted on the same shaft.

An interesting application of the compound-wound motor is found on the buses manufactured by Guy Motors, Ltd. The electrical equipment on these vehicles is manufactured by the Rees Roturbo Company, of Wolverhampton. A single 60 h.p. compound motor is adopted with a strong series field which supports the shunt field when taking power from the line. The bus is started on full shunt field with resistance in the armature circuit; when this is cut out in steps by contactor control the bus runs at about 11 miles per hour when taking full-load current of 85 amperes, whereupon further movement of the controller puts resistance into the shunt field circuit, finally bringing the vehicle up to full speed of about 25 miles per hour.

This system is also interesting in being the only example of regenerative braking in use on trolley buses. When the power pedal, which operates the master controller, is allowed to return from its lowest (full speed) position shunt field resistance is cut out and the back e.m.f.

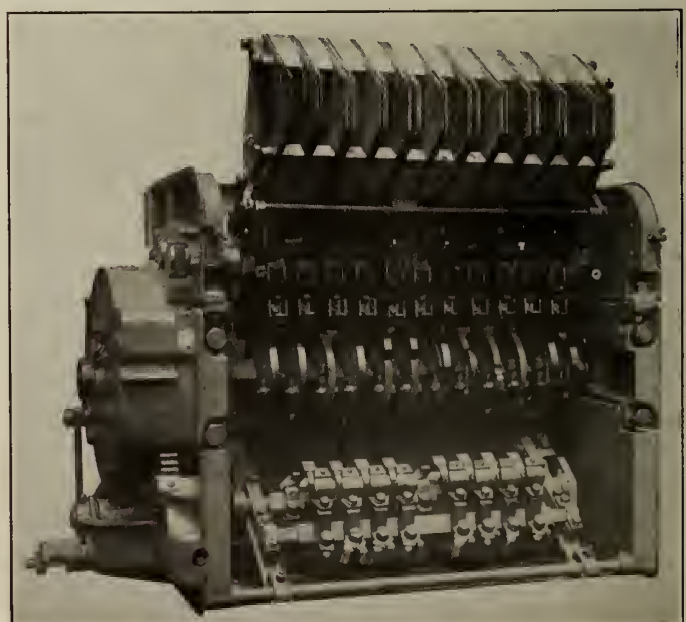

Figure No. 10.—Foot-operated Main Controller for Trolley Bus with series-parallel Control.

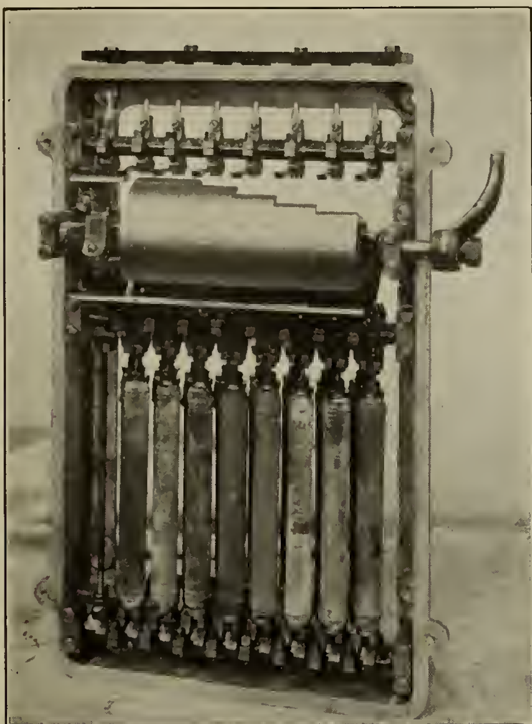

Figure No. 11.—Master Controller for Compound Motor with regenerative Braking.

of the motor rises to a value higher than the voltage of the supply. Under these conditions the machine generates power which is returned to the line, and the bus is braked due to the transformation of its kinetic energy into electrical energy. When regenerating, the series field opposes the shunt field, which prevents any violent or excessive braking effects due to variation of line voltage or careless operation.

The operation of this equipment has been found to be entirely satisfactory, and has proved by experience to effect a saving in current consumption and brake wear. In Hastings, where the routes are hilly, it is said to reduce the energy consumption by about 0.3 kw.hrs. per bus mile. It is only effective above a speed slightly in excess of that corresponding to full shunt field, or about 12 miles per hour. As the energy destroyed while braking varies as the square of the speed, if a bus is brought to rest from 24 miles per hour by regenerative braking down to 12 miles per hour, and by the mechanical brakes below that speed, three-quarters of the energy of motion will have been absorbed during regeneration and only one-quarter remains to be dissipated in the brake drums.

Another type of equipment, constructed by Messrs. Bull Motors, of Ipswich, makes use of an "eddy current" brake, which is operable down to very low speeds. It consists of a short-circuited rotor on the armature shaft which revolves in a field system which is energized by the application of the brake pedal. Its operation is smooth and satisfactory, but all energy is dissipated as heat in the rotor, while the additional weight is quite considerable.

In all cases a foot-operated controller is used. Figure No. 10 shows a foot-operated main controller for series-parallel control of two motors, in which the main motor currents are directly controlled. This is the product of the English Electric Company (*Note 16*).

Figure No. 11 shows the master controller on the Wolverhampton buses. It is operated from the "power pedal" through cranks and rods, and a complete movement from "off" to "full speed" operates consecutively the contactors which cut out the series resistance and then cuts in steps of resistance in the shunt field circuit. The shunt field resistance is seen beneath the controller drum.

All control pedals push downwards to operate, being analogous to the accelerator of a motor bus. A spring returns the controller to the "off" position when the driver's foot is removed.

A reversing controller or switch is always provided which reverses the direction of motion by reversing the connections of the armature alone. This switch is interlocked with the power pedal so that it can only be operated when the main control is in the "off" position.

In order that the whole of the electrical equipment may be isolated from the line, and to protect against overloads, two circuit breakers, one in each lead, are usually situated in the driver's cab. A signal lamp in the cab goes out if the poles come off the wires, while in some cases a system of small lamps informs the driver how far the bus is from the centre of the overhead conductors, this being of great use in foggy weather.

Energy Consumption

At first sight it might seem that the energy consumption of a trolley bus must of necessity be much higher than that of a street-car of similar capacity, due to the greater resistances to motion experienced with a rubber tire on a road surface compared with a steel wheel on a steel track.

The specific energy consumption (i.e., watt-hours per ton-mile) must always be higher in the case of a trolley bus, but the discrepancy decreases as the frequency of stops on a route increases. This is due to the fact that with more stops to the mile a greater proportion of the total energy required is taken up in accelerating the bus, and less in overcoming the resistances to motion.

By keeping the weight of the trolley bus as low as possible the energy consumption per bus-mile can be brought to a very economical figure. For the year 1927-1928 the average consumption for all the trolley buses operating in Great Britain was 1.48 kw.hrs. per bus-mile, with an average seating capacity of 40.4. This figure includes many old buses whose consumption is relatively high; taking particular cases of modern six-wheel double-deck buses, two examples are:

Doncaster — Six-wheel, double-deck, with double motor equipment and series-parallel control: 1.47 kw.hrs.

Wolverhampton — Six-wheel, double-deck, with single compound motor, regenerative control: 1.38 kw.hrs.

Comparing the two cases, the seating capacity is practically the same in each (sixty and sixty-one respectively). There is a slight difference in weight in favour of the Wolverhampton bus, but the difference in energy con-

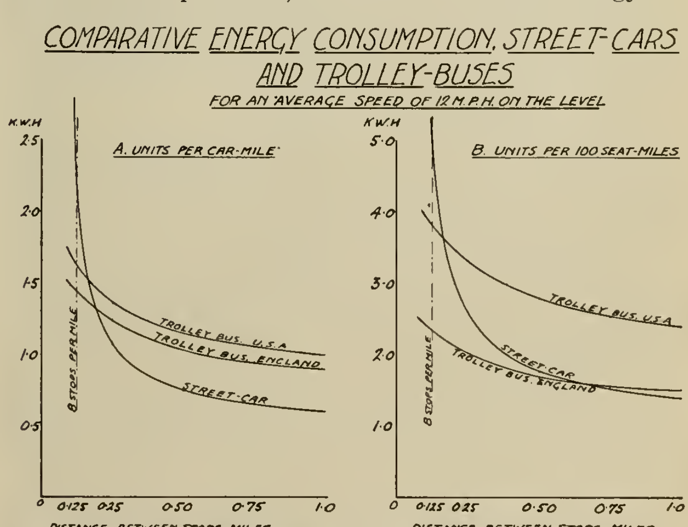

Figure No. 12.

sumption would seem to be due mainly to the electrical systems used. In addition to the saving produced by regenerative braking, there is less loss in the series rheostats in the case of the compound motor, since the greater part of the speed variation is obtained by control of the shunt field, with the series resistance all out. With series-parallel control approximately one-third of the energy supplied during uniform acceleration is wasted in the rheostats, but this is reduced somewhat by shunting the field in the full parallel position to obtain the maximum speed. With shunt field control of the compound motor only about one-quarter is dissipated in resistance.

In order to illustrate the influence of the frequency of stops on the relative energy consumption of trolley buses and street-cars, the curves in figure No. 12 have been calculated from the following assumptions:

American street-car. Light-weight double-truck car.

Seats	42
Weight unloaded	30,000 lbs.
*Weight loaded	32,240 lbs.
Average resistance to motion	12 lbs. per ton (2,000 lbs.)
Average resistance to motion while coasting	15 lbs. per ton
Acceleration	1.5 m.p.h.p.s.
Braking retardation	2.0 m.p.h.p.s.

English trolley bus. Six-wheel, double-deck.

Seats	61
**Weight unloaded	13,000 lbs.
Weight loaded	16,080 lbs.
Average resistance to motion	44 lbs. per ton (2,000 lbs.)
Average coasting resistance	46 lbs. per ton
***Acceleration	2.0 m.p.h.p.s.
Braking retardation	2.0 m.p.h.p.s.

American trolley bus. Four-wheel, single-deck.

Seats	42
Weight unloaded	16,000 lbs.
Weight loaded	18,100 lbs.

Other figures the same as for the English trolley bus.

Note *: The weight loaded has been taken to be the weight when one-third of the seats are filled at an average weight of 140 pounds per passenger. Statistics show that the average load is roughly one-third of the seating capacity. The American street-car and the English trolley bus are assumed to have a staff of two men while the American trolley bus is taken to be a one-man vehicle.

Note **: This represents the lightest weight of a six-wheeled double-deck trolley bus under present conditions.

Note ***: This is a very conservative estimate. The acceleration of modern trolley buses is usually as great as three miles per hour per second or more, while the braking retardation is often greater.

The energy for the short runs is calculated on the assumption of a period of constant acceleration, one of constant coasting retardation, and one of constant braking retardation. The long runs have a period of free-running (constant speed) instead of coasting.

Series-parallel control is assumed in each case, and the loss in the rheostats is taken as 50 per cent of the energy required for acceleration only. An overall efficiency of 80 per cent is assumed to cover all other losses, electrical and mechanical.

The effective weight of the street-car is taken as 5 per cent greater than the dead weight, and the effective weight of the trolley bus 3 per cent above the dead weight, due to the absence of heavy gears, heavy steel wheels, and fewer motors.

The curves give the energy consumption for a run on the level at an average speed (excluding stops) of 12 miles per hour in kilowatt-hours per vehicle-mile and also per 100 seat-miles, the latter figure taking into account the seating capacity and being a fairer method of comparison than the former.

The following general conclusions may be drawn:

(1) For stops as frequent as every 220 yards (an average figure for city service), the street-car cannot compete with the trolley bus if such a high average speed as 12 miles per hour is required. Of the two trolley buses considered, the English one has the advantage due to its slightly lower weight and larger seating capacity.

(2) When a basis of 100 seat-miles is used the advantage of the English bus with stops every 220 yards is greatly increased, and this vehicle keeps the advantage until the distance between stops is over half a mile.

(3) For long periods of running without a stop the street-car is superior to the trolley bus in energy consumption.

In hilly districts the advantage of the trolley bus is increased, due to the lighter weight of this vehicle.

Thus it is seen that for city transportation with fairly frequent stops and a high schedule speed the trolley bus is more economical in energy consumption than the present street-car, due to the practicability of building a bus very much lighter than the modern "light-weight" double-truck street-car.

Actually, with modern traffic control and the rapid acceleration of city traffic, the trolley bus is the only passenger vehicle which can conform economically with conditions of high acceleration.

The figures for double-truck street-cars as used on this continent are often extremely high, due to the use of out-of-date equipment. For instance, the average consumption per car-mile in a certain large Canadian city for the year 1929 was 5.4 kw.hrs. with an average seating capacity of 42.5.

The Overhead Equipment (*Note 9*)

Trolley buses require two overhead conductors for the supply of power to the motors. The usual practice in Great Britain is to space them 18 inches apart and 21 feet above the ground, and the most common size of wire is No. 4/0 s.w.g., which has a cross-sectional area of 0.1257 square inches and a resistance per mile of 0.347 ohm. The weight of such a pair of wires, 40 yards long, with their hangers and insulators, is about 130 pounds. The distance between the wires and the curb is usually about ten feet, which enables the buses to pull into the curb when stopping.

The negative wire is placed next to the side of the road, and triple insulation is placed between it and the positive wire: the insulators on the hangers and a strain insulator in between. A strain insulator should also be used between the negative wire and the pole, so that double insulation exists between the negative wire and ground. This protects the steel pole from electrolytic effects should one of the insulators become faulty. Also, though the present practice

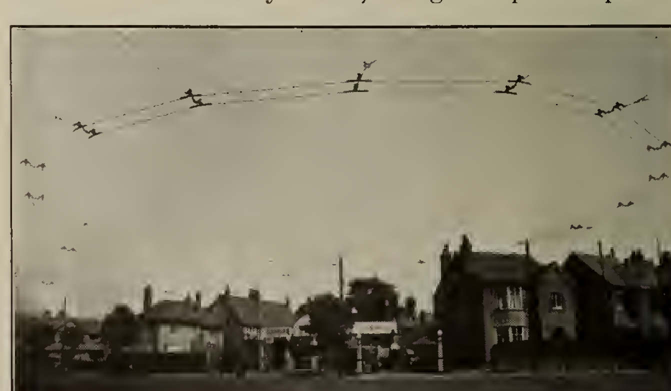

Figure No. 13.—Turning Circle for Trolley Buses.

is to ground the negative side of the line at the power station, there is no reason why the mid-point of the system should not be earthed, giving a maximum voltage to ground of 250 on a 500-volt system.

The positive wire is split into half-mile insulated sections, supplied from feeders as in standard tramway practice. The question of providing negative feeders has to be decided when converting from a track system, and this naturally depends on the circumstances of each case. In Hastings the feeder problem has been solved by the unusual method of using No. 6/0 s.w.g. wire for the overhead conductors (*Note 17*).

Where the two lines cross, it is necessary to insert an insulated crossing wherever a positive wire crosses a negative one. Where a branch line joins a main route, the wires of the latter should be unbroken, and it should be arranged that the wires on an uphill route should be as continuous as possible.

A six-wheeled bus requires a turning space of from sixty to seventy feet in diameter, and the overhead conductors are constructed in a corresponding loop, as illustrated in figure No. 13. Where space is not available triangle turning may be used or the line taken round a block.

Operating Expenses

The advantage of the trolley bus from an economic standpoint was shown long before the new type of vehicle captured the approval of the riding public. Mr. T. G. Gribble, in a paper read before the Institution of Civil Engineers in London in March, 1914, showed that even with a two and a half minute service, representing heavy traffic conditions, the operating costs should be less than those of a track system by about 7 per cent, while the construction costs should be less by about 44 per cent. With a light service of thirty minutes headway these figures would be increased to 36 per cent and 70 per cent respectively.

The economy of the trolley bus may best be verified from the published accounts of the Wolverhampton municipal transport undertaking, and reliable comparisons can be made between all three methods of transportation. For the years 1925-1926, which were the last years of service of the main portion of the tram system, the operating costs averaged 29.58 pence per 100 seat-miles, with an average number of seats per vehicle of 46. For the years 1928-1929, during which trolley and motor buses have been in full operation, the operating costs per 100 seat-miles were:

Trolley buses (average seats 46)	23.76 pence
Motor buses (average seats 38.5)	31.43 pence

Taking the trolley bus figure as 100 per cent, we have:

Trolley buses	100 per cent
Tramways	124 per cent
Motor buses	132 per cent

A more detailed comparison of trolley and motor buses yields the following relative figures:

	Trolley buses	Motor buses
*Maintenance and repairs	1.0	1.53
Traffic expenses	1.0	1.35
Power or fuel	1.0	1.69
General expenses	1.0	0.61

*Includes overhead equipment.

The rates payable on the overhead equipment make the "general expenses" higher in the case of the trolley bus.

The total number of passengers carried by each type of vehicle for the two years in question were:

Trolley buses	32,562,672
Motor buses	25,069,624

Mr. C. O. Silvers, manager of the undertaking, has published the following figures for the period from April 1st, 1929, to January 5th, 1930:

Trolley buses:	operating expenses per bus-mile	10.48 pence
	operating expenses per 100 seat-miles	21.4 pence
Motor buses:	per bus-mile	12.148 pence
	per 100 seat-miles	29.63 pence

The above figures are operating costs only, and do not include any contribution to the renewals fund, which in the case of tramways would require about $15,000 per mile per annum for the track alone.

General Remarks

Wherever the modern trolley bus has been substituted for street-cars a quicker and more popular service has been the result. The overall schedule speed (including all stops and shedding) of the trolley buses in Wolverhampton for the year 1929 was 9.274 miles per hour against about 7.5 miles per hour for the trams. Motor buses had an average schedule speed of 8.53 miles per hour.

The six-wheeled buses, with their balloon tires, are distinctly more comfortable to ride in than the average street-car with its noisy vibration of unsprung weight and often nauseating oscillation of the body. One important factor of the popularity of the trolley bus is its almost complete absence of noise. This is a great boon to the passengers and to the residents along the route, while the nerve-racking medley of city noises is greatly reduced.

In every case of the installation of trolley buses, traffic has been speeded up and congestion relieved. The buses load and unload at the curb and leave the crown of the road to fast moving traffic. The appearance of the road is greatly improved by the removal of the tracks, while the extra overhead wire is hardly noticeable.

Those transportation undertakings which were unable to operate tramways at a profit and which have adopted the trolley bus have found their passenger receipts go up and are now on an economically sound footing.

The ultimate status of the trolley bus is difficult to foresee; at the present time it would seem to be superior to the street-car on all but the heavy traffic routes. Many transport undertakings which serve densely populated areas are renewing their track and replacing their rolling stock by the most up-to-date tramcars, in which great efforts have been made to reduce noise and vibration and to increase speed.

At the same time it should be noticed that in areas of exceptionally heavy traffic, such as in the hearts of London and Paris, the track systems have naturally given way to more flexible road vehicles while the great bulk of the city transportation is carried on underground, where the electric railway can have its own right-of-way and can develop to the full the advantages of steel track. The question naturally arises as to how far it is advisable to attempt to carry the population of a large city on the streets alone. So long as no other method of public transportation is available in such a city then the tramcar, provided that it is an up-to-date vehicle and has a double track in wide and well designed streets, would seem to be the best solution of the problem; but as soon as the density of traffic necessitates the construction of a high-speed electric railway with its own right-of-way, whether underground or not, then the operation of tramways is only duplicating an expensive service, and the local traffic of the streets can be carried much more effectively by the trolley bus. In a rapidly growing city which is destined to have a population of several million it would seem advisable to consider the use of trolley buses before the track system has grown to such an extent that it would be a costly matter to replace it.

Figure No. 14.—Four-wheeled Trolley Bus, Chicago Surface Lines.

It is assumed in the above that street-cars, if used, would have a capacity considerably greater than that of a double-deck trolley bus. The usual single-deck street-car of this continent, seating between forty and fifty, has no advantage whatever over the sixty to sixty-five seater trolley bus.

So far as the smaller towns and cities are concerned, the trolley bus has proved itself to be definitely superior to both the tramcar and the motor bus, and it now seems certain that in such cases the track system is obsolete. It has already been seen that the trolley bus has the advantage over the gasoline vehicle in operating costs, efficiency of operation, and comfort. It is only in rural districts where the service is infrequent, or in developing a new traffic route, that the motor bus is of real advantage in transportation.

The Trolley Bus in North America

The history of the trolley bus on this side of the Atlantic dates from the year 1903, when an experimental line was successfully operated at Scranton, Pa. Other lines were planned following the same system, but it would seem that none of them were actually put into service. In 1910, however, we find a route in operation in Los Angeles, one and a half miles long, which was the only trolley bus system in use in the United States at that time.

Little progress was made in the development of the new vehicle until after the war. Mention should be made however, of a trolley bus which was operated at Merrill, Wis., in 1913 and abandoned the same year. This same vehicle was sold to the West End Street Railway, Boston, where it was in operation for a short time in 1916.

After the war it was found that the cost of installing and operating street railways had increased considerably, so that during the years 1920 to 1924 great interest was shown in the possibilities of the trolley bus (*Note 10*), and a number of systems were put into service in Canada and the United States. This was the first concerted effort on the part of the manufacturers to develop the new type of vehicle, but as the venture was largely experimental, no very serious attempt was made to design equipment specially for the purpose. In consequence, these early post-war buses, with their truck frames, solid tires, and heavy street-car motors, were found in general to be expensive to operate and uncomfortable to ride in. In four cases only have these early buses survived to the present day—in Baltimore, Md., Philadelphia, Pa., Rochester and Cohoes, N.Y. Those systems installed in Staten Island, N.Y., Toronto and Windsor, Ont., Minneapolis, Minn. and Petersburg, Va., have all been abandoned (*Note 11*).

The failure of these systems brought the principle of trackless trolley operation, quite illogically, into disfavour: the failure was due to the fact that the principle had not been developed along sound engineering lines. A committee of the American Electric Railway Association visited Europe in 1924 and inspected trolley bus systems there. At this time the vehicles in use in England were of the old type with solid tires and heavy equipment; apart from their advantage of low capital cost, they were looked upon as having a certain sphere of use where the service was too heavy for the motor bus, but lighter than that necessary to make a track system successful. It is therefore not surprising that the Committee reported that they considered the trolley bus to have too narrow a field to justify its further development. An editorial in the Electric Railway Journal in 1927 summed up the situation with the words: "Whatever the ultimate fate of the trackless trolley may be abroad, it certainly appears to have passed the crest of its popularity in this country" (*Note 12*).

We have seen how improvements in large passenger motor buses enabled the trolley bus to increase in popularity in England; exactly the same thing now happened in the United States, and a new interest was aroused when on September 9th, 1928, a service of trolley buses commenced operation in Salt Lake City (*Note 13*).

For some time previously it had been found that the cost of maintaining track and paving was preventing the successful operation of the street-car system, and during the three years 1925, 1926 and 1927 the company had to abandon over twenty-seven miles of track. One stretch of single line, over four miles in length, was in need of reconstruction and as the route was a profitable one there was no question of abandoning it, but the cost of renewing the track was prohibitive. It was therefore decided to operate trolley buses, and the success of the venture has started a new era in trolley bus operation in the United States.

The new vehicles, 10 in number, are six-wheeled, pneumatic-tired, single-deck buses seating 43. Manufactured by the Versare Coach Corporation, they are a very great improvement on any hitherto used in that country. Weighing about 16,000 pounds, they have a length of 31 feet 7 inches and a mean wheel-base of 18 feet 9 inches. With cushion seats upholstered in leather they bear no resemblance whatever to the uncomfortable vehicles which have previously called forth so much adverse criticism.

The electrical equipment is of Westinghouse construction, and consists of two 50 h.p. series motors, weighing approximately 800 pounds each, arranged for series-parallel control, with rheostatic braking. A pedal operates a master controller, which actuates contactor gear under the rear seat. There are six notches in the series connection, and five in parallel.

Figure No. 15.—Latest type Double-deck Trolley Bus supplied to Birmingham by Guy Motors, Ltd.

Trolley poles 19 feet long connect the buses to the overhead wires, which are 18 feet 6 inches above the ground. The positive is placed 24 inches from the negative wire, while the centre line of the two is 13 feet from the curb.

The operating experience of the line has shown very clearly that the trolley bus in its more perfected state is a most important contribution to transportation problems. The traffic on the route increased by about 30 per cent after the conversion, which increase has been maintained. At rush hours the buses carry from seventy to eighty passengers.

The comparative operating costs of the new buses, motor buses, and street-cars have been given as:

Trolley buses	100 per cent
Street-cars	125 per cent
Motor buses	159 per cent

(compare with figures for English buses)

The energy consumption for the winter months is given as a little over 2.2 kw.hrs. per bus-mile, compared with 4.3 kw.hrs. for street cars.

It is interesting to note that the six-wheel principle is considerably hampered in the United States, due to the more important details being protected by British patents (*Note 8*). Consequently the trend of development seems to be towards a four-wheeled vehicle with dual tires on the rear wheels, as is shown in figure No. 14.

Two such vehicles were put into service in New Orleans on December 2nd, 1929 (*Note 14*). One, built by the American Car and Foundry Motors Company, and fitted with General Electric electrical equipment, weighs 19,000 pounds and has a nominal seating capacity of 40. The other, built by the Twin Coach Company and fitted with Westinghouse equipment, weighs 16,500 pounds and seats 42. Both are fitted with two 50 h.p. series motors, each driving a rear wheel through a separate propellor shaft with a gear reduction of eleven to one. A foot-operated master controller and contactor gear under the rear seat give series-parallel control and automatic acceleration by means of an accelerating relay, which allows a step of resistance to be cut out only when the motor current has dropped to a definite value. In the General Electric equipment the resistance contactors are closed by cams on a shaft driven by an air engine.

A perfectly smooth acceleration of over 3 miles per hour per second can be obtained, while retardations of about 6 miles per hour per second are common. The manufacturers give 1.7 kw.hrs. per mile as the average energy consumption.

In the course of a few months Chicago will have the largest trolley bus installation in the United States (*Note 15*). A total of 41 buses will serve five routes with an aggregate mileage of seventeen. The first route, 3.75 miles in length, was opened on April 17th, 1930, and 13 buses maintain a three-minute service in rush hours and a seven-minute service at other times. The buses are four-wheeled forty-seaters; see figure No. 14.

Among places where the most recent type of trolley bus has been installed are Manila, P.I., Knoxville, Tenn., and Detroit. Other cities are now taking an interest in the system.

It would therefore seem that the trolley bus is finding a definite place in American city transportation. As the forty-seater single-decker has a smaller carrying capacity than large up-to-date street-cars, its sphere of use is naturally not on the heaviest traffic routes, but rather in residential districts where traffic is not so heavy and its comfort and absence of noise are particularly appreciated, or in any situation where it is found that the density of service is insufficient to warrant satisfactory maintenance of track.

Though this would seem to be the situation at the moment, the trolley bus has proved so popular and successful in the few years that have elapsed since it was first made a comfortable vehicle, and since any change in street-car practice must necessarily be gradual on account of the large amounts of capital invested in track and cars, it is not improbable that the trolley bus will come to be used much more widely and in situations where the street-car is considered to be supreme. In all but the large cities the profitable operation of street-cars is often very doubtful, while the trolley bus has great advantages over the motor bus except where it is quite impossible to erect overhead wires or where the service is temporary or very infrequent.

In a large city it is an advantage to the riding public to have a homogeneous service; that is, a service that only uses one type of vehicle. If the major part of the system is served by the street-car, as happens in the typical Canadian city, the density of traffic is really only great enough to justify street-cars in the concentrated business areas, and this is the point where track vehicles contribute most to traffic troubles and congestion. On the extensive routes which serve the residential portions of the city the traffic must in many cases fall below the economical limit for track maintenance. At the same time, in a growing city the existing track system is always lagging well behind the real traffic requirements of the population, whereas a trolley bus system, on account of its low capital cost, could easily keep pace with the growth of a city and at the same time would alleviate troubles of traffic congestion in the business areas.

With the ever-increasing number of private automobiles, it becomes more and more important to provide an efficient and comfortable method of mass transportation, in order to stem the inevitable congestion of the streets produced by vehicles which take up an extremely large road-area per passenger carried. It is obviously extremely difficult, if not impossible, to limit the use of private cars by law, so that it is necessary to provide a public service which will be attractive enough to compete with the automobile.

The increased comfort, speed and economy of the modern trolley bus have shown that it is no longer necessary to have a steel-tired car running on expensive track in order to provide comfortable city transportation. The street railways are already in existence and have an enormous amount of capital invested in them, so that no sudden change is possible or desirable except when companies are faced with necessary track reconstruction; it is then that a bold policy of scrapping the old and adopting the new may make all the difference between financial success and failure.

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Abbreviations: E.T.Z. Die Elektrotechnische Zeitschrift.
E.R.J. The Electric Railway Journal.
E.R. The Electrical Review.

Note

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6. E.T.Z. 1909, p. 231, "Gleislose Elektrische Automobilbahnen," E. Honigmann.
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Note

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Note

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Acknowledgments

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A Method of Equalizing Stresses in Masonry Arches with Particular Reference to Arched Dams

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Paper read before the Vancouver Branch of The Engineering Institute of Canada, March 27th, 1930.

General

In the normal course of things, a masonry arch is built on centring and, after being keyed up, is swung by gradually lowering the falsework until the arch is self-sustaining. When the centres are struck, the arch is at once put under stress due to its own weight and during its ordinary service is subjected to further and varying stresses by whatever live load may come upon it. If the material in the arch were perfectly rigid, that is, not subject to strain as a result of stress, it would be possible, at least in theory, to design the curve of the neutral axis and the profile of the ring so that the dead load stress would be of uniform intensity over every radial section. The unit stress at any point would be the same as at any other point and there would be neither moment nor shear anywhere in the ring.

Since, however, every material of which we have knowledge is subject to strain as a result of stress, it follows that the size, or the shape, or both, of the arch ring under its own weight must differ from that of the unloaded arch. If the arch is built without hinges, as most masonry arches are, the ring must change its shape under load. The tangent to the neutral axis is fixed at the abutment, or practically so, and hence the change in shape must involve a shortening of the radius of curvature there and a lengthening of the radius at the crown. At two intermediate points there will, of course, be no change. These changes in curvature must involve bending moments in one direction or the other with the consequent result that the stresses over any cross section, except at the two points mentioned, are no longer uniform. In other words, the line of thrust no longer coincides with the neutral axis, and, since the maximum fibre stress is limited to a definite figure, it follows that the material is not being used to the maximum advantage.

In addition to the change of shape due to dead load, there is a further change due to the shrinkage of the concrete in setting. Most of this is really a thermal effect caused by the dissipation of the chemical heat developed in the hydration of the cement, but a small part is due to the evaporation of the surplus water not needed for hydration. If the arch were free in space, this shrinkage would merely result in a change in dimensions, but as it is not free, shrinkage must result in a change of shape as well. This deformation is in the same direction as the deformation due to dead load and the two must, therefore, be considered together.

It is impossible to prevent these deformations, but if it were possible to neutralize them in some way, we could effect a material saving in the masonry of the ring which would be reflected in a further saving in the abutments and piers. Obviously, too, the saving in weight of the ring would extend the field of the masonry arch to spans otherwise considered impracticable. This compensation cannot be effected by any jockeying with the curve of the neutral axis, in fact, any such attempts usually result in making a bad matter worse. The necessary compensation can only be accomplished mechanically, by introducing stresses of opposite sign to those set up by the deformations caused by dead load and shrinkage. One method of doing this forms the subject of this paper. The method will be described as it would be applied to arch dams, but it will be realized that it is perfectly general in its application and can be applied to masonry arches of any kind. Indeed, it also has application to structural elements other than arches should the need be apparent.

Mechanics of the Arch Dam

In figure No. 1, the solid lines are a cross-section of a hollow cylinder exposed to uniform radial inward pressure all round the circumference. If the thickness of the cylinder wall be small in proportion to the outside diameter, we may assume that it would be subjected to uniform circumferential compression; the circumference would be shortened and every point would move inward on radial lines so that A would move to A' and B to B'. There would be a change in size but no change in shape.

In figure No. 2 we have a segment of a cylinder, fixed at the abutments A, B, and G, H, and subjected to radial pressure. Since the segment is fixed at the abutments, no movement can occur at those points, but elsewhere it is free to move radially, and D will move to D' and E to E'. The tangent at the abutment being fixed, the radius of curvature there must be shortened which will involve a compensating increase in the radius of curvature at the

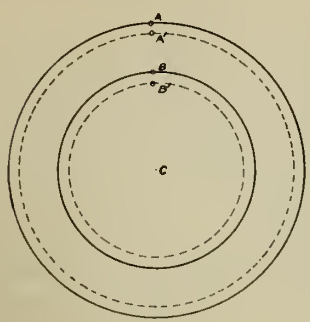

Figure No. 1.

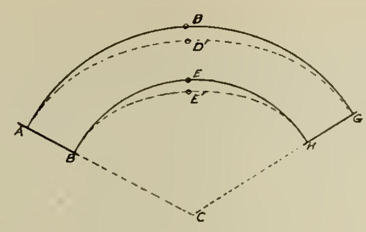

Figure No. 2.

crown, and the segment will be deformed to some such curves as *GD'A* and *BE'H*. This change involves bending moments which will be of one sign at the springing line and of the contrary sign at the crown. When these moments are combined with the tangential thrust, the resulting condition of stress will be as shown in figure No. 3. At the abutments, the stress varies from a maximum at the intrados to a minimum at the extrados; at the crown, from a maximum at the extrados to a minimum at the intrados. At or near the quarter points, the stress is uniform over the section, but the masonry is nowhere used to its maximum advantage. The condition shown in figure No. 3 is more favourable than is usual in an arched dam. As a general rule, tension will be found on the minimum side for some distance either way from the crown and almost always for some distance inwards from the abutments. If the stresses are to be made uniform throughout the arch, it is necessary to introduce by mechanical means stresses of opposite sign to those set up by the deformation under the water load.

Consider for the moment that the arch is constrained only at the abutments and free at all other points. Assume that a very thin radial slice, perpendicular to the plane of the paper, were cut out of the arch at the crown, *DE*, and that an infinite number of very small jacks were inserted in the cut, so arranged that they would either force the sides apart or pull them together. Let each jack exert the same force as existed previously in the uncut arch, the stresses in the masonry adjoining the cut would be the same as before the cut was made and we would have the condition shown in figure No. 4, where each jack is represented by an arrow, and the force which it exerts is measured by the length of the arrow, positive or compression when drawn to the right, and negative or tension when drawn to the left. Now assume that to the force exerted by each jack there be added an equal positive increment, we should have the condition represented in figure No. 5, where U represents the amount of the increment. The effect is to change previously existing tension to compression, but it also results in increasing the compression at the opposite edge where, by hypothesis, it was already at the allowed maximum. Clearly, nothing much has been gained by this operation.

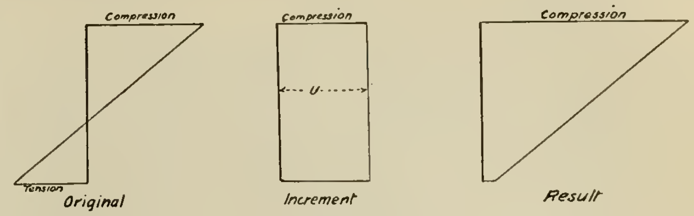

Figure No. 5.

Instead of applying an equal increment to all the jacks, assume that the increment is graduated so that it is negative where the initial stress is positive and positive where the initial stress is negative. In this way we could get the result shown in figure No. 6, with the stress uniform across the section. For mechanical reasons, it probably would not be possible to introduce negative increments in this way, the best we could do would be to graduate the increment from zero at the positive edge to a maximum at the negative edge with the result shown in figure No. 7, where the stress is still uniform but higher than in figure No. 6. We have assumed an infinite number of very small jacks. In practice we should have to use some finite number and, for many reasons, we should limit this to two or, at most, three, and we should have the condition shown in figure No. 8, where G_1, G_2, G_3 are the increments of the forces which each jack must exert. Actually, of course, the line of the resulting stress would not be stepped as shown but would be smoothed off as indicated by the dotted line.

Hitherto, it has been assumed that the compensating forces were applied after the dam was deformed by the water load. Obviously, it will make small difference in the ultimate result if we apply them first and the load afterwards. In that case we should deform the dam in the opposite direction and in opposite amounts to the deformation which will afterward occur under the water load. In the case of a bridge arch, the live load (and, possibly, part of the dead load) is still to come on, and it makes no difference which we do first, though, for practical reasons, the compensating forces are more easily applied while the bridge is on its centres. In the case of a dam, we must apply the compensating forces before the water load comes on, otherwise the dam would be subject to the very conditions which we wish to avoid.

The method of using jacks to compensate for the deformation stresses due to dead load and shrinkage has been used, principally in Europe, with success in the case of long span bridges. The operation is carried out while the arch is on its centres and, after jacking is completed, the wedge-shaped cuts are filled with concrete. The operation is a delicate one and the apparatus expensive. Consequently, the method has been confined to long spans where the possible saving in concrete can pay for the labour and plant involved. Even in a small bridge, the total forces required are very great, but not out of reach of hydraulic jacks. In even a very small dam, the forces are enormous and quite beyond the possibilities of any system of hydraulic jacking. Something cheaper is needed.

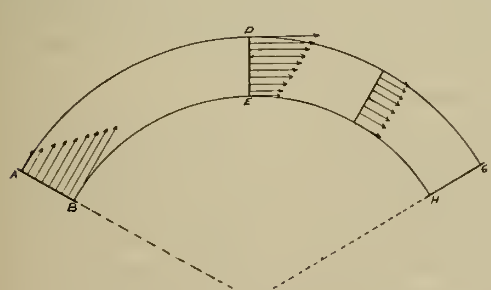

Figure No. 3.

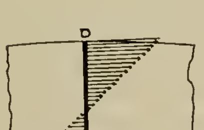

Figure No. 4.

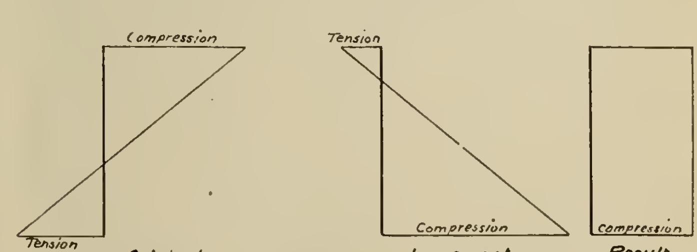

Figure No. 6.

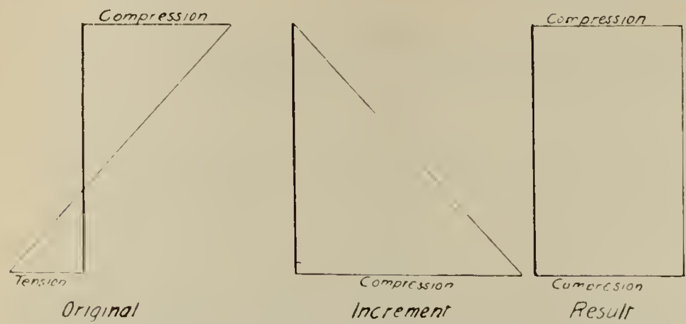

Figure No. 7.

cannot begin until either the joints or cracks are closed, or all the tension has been changed to compression. In other words, the dam must first deflect enough to compensate for all the shortening due to shrinkage, and during this primary deflection the dam is not an arch at all but a system of cantilevers. This effect can be avoided if construction joints are provided and filled up solid, *but only if this is done after all the shrinkage has taken place.* In a thick dam, this may not occur till after the lapse of months, or, even years. It is one of the advantages of Dr. Vogt's method that the shrinking process can be very much accelerated and the time materially reduced.

Method of Differential Pressure Grouting

The method now to be described was developed primarily for use with arch dams, but it is perfectly general and can be used even with quite small bridges and shows a saving where the use of mechanical jacking would be quite out of the question by reason of cost. The method requires no expensive apparatus unusual on small jobs, a small pump and a grout mixer being all that is needed. The process is the invention of Dr. Fredrik Vogt, a noted Norwegian engineer, formerly retained by the United States Bureau of Reclamation as consultant in the design of the proposed Boulder canyon dam on the Colorado river.

Shrinkage and Arch Dams

Any dam is bound to be subjected to stress arising from the shrinkage of the concrete in setting. If it were free in space, this shrinkage would amount to something in the neighbourhood of three-quarters of an inch in 100 feet; but, since it is not free, the shrinkage must result in setting up stress in the concrete and the dam will probably crack across at intervals. If it were a straight dam, these cracks would come at intervals between 30 feet and 60 feet apart. In a curved dam, some of the stress can show up by shortening the versed sine of the arc, that is, by pulling the arch downstream, and the cracks may be much further apart. The consequence is that ugly stresses of very uncertain magnitude may be set up. In order to avoid these, it is now common practice to divide the arch into sections or voussoirs by construction joints from 30 feet to 60 feet apart along the arc. These joints are generally formed with steps or off-sets so that half the area is available to take any shear which may develop and also to prevent leakage.

It must be noted that these joints do not prevent the shrinkage; shrinkage takes place, joints or no joints. Their function is to prevent the concrete from cracking across at undesirable, unexpected and unpredictable places and to ensure that the structure will be, at least, relatively free from utterly incalculable stresses. If joints are provided in an arch dam, shrinkage opens them up; if no joints are provided, the dam either cracks across or the concrete is subject to very high tension. In any event, arch action

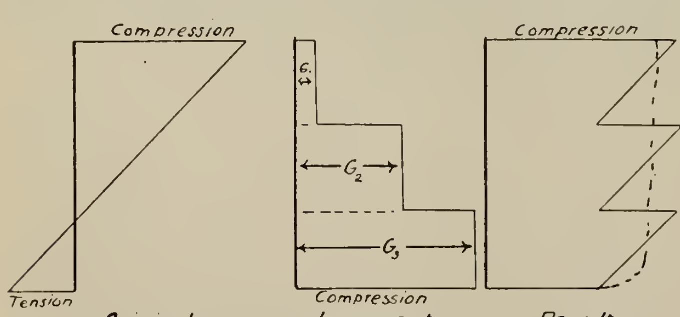

Figure No. 8.

Description of the Vogt Method

The Vogt method does not avoid the use of construction joints, in fact they are an essential feature in its operation. Figure No. 9 is a horizontal section across one of these joints as designed for use in the Vogt process. Positive water stops are provided as shown at two or more points dividing the joint into vertical compartments, usually two or three. These compartments are closed top and bottom by other stops, as shown in figure No. 10, which is a vertical section across the same joint. They are also subdivided into sub-compartments by other horizontal stops. Suppose one of these sub-compartments were filled with fluid grout and that, before it could set, the grout were subjected to

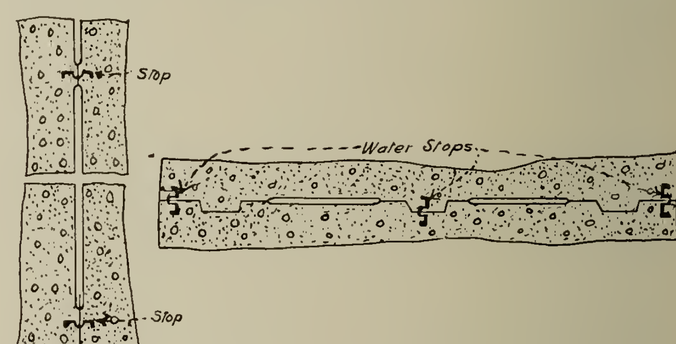

Figure No. 9. Figure No. 10.

the proper hydraulic pressure. The result would evidently be to force the sides of the compartment apart, just as the jacks would do in the previous illustration; in fact, the compartments are jacks of high efficiency on a very large scale. If this pressure were maintained until the grout had set hard, the condition of figure No. 8 would exist thereafter. Freed of detail, this is the method patented by Dr. Vogt.

Analysis of Arch Dams

An arched dam may be conceived as made up of a system of elementary horizontal arches superimposed one on another. Since the lowest arch of the system is constrained by the foundations and each of the rest is more or less constrained by its neighbours as well as at the abutments, these elementary arches cannot deform independently according to the load which each might be supposed to carry. In addition to this, the spans of the elementary arches all differ and so may their radii. As a result of all these and many other factors, the real condition of stress in an arch dam is so complex that an exact mathematical analysis is impossible. If any analysis at all is to be attempted, some simplifying assumptions must be made.

Simple Cylinder Hypothesis

In the earliest practice, it was assumed that each of the elementary arches carried its share of the load to the abutments as if it were a *complete cylinder*, free from constraint by its neighbours and able to deform in its own way; that is, the stresses due to deformation were ignored or assumed to be zero. This very convenient hypothesis is generally known as "the simple cylinder hypothesis" and it results in a very simple and easily applied formula. It was early realized that it gave a far from exact picture of the actual condition of things, and the unit stresses were always assumed at a very low value in order to compensate for the unknown factors. While very high unit cylinder stresses are found in some early examples, 940 pounds per square inch in one case, it is worth notice that, in over 100 dams, only eight show cylinder stress over 400 pounds per square inch, and in but three of these is the cylinder stress over 600 pounds. In these latter cases, the dams are thin and of long radius, conditions which are favourable to the simple cylinder hypothesis. The theory is still used to get the preliminary design for analysis by more exact processes.

The Modern Hypothesis

In the more modern dams, the analysis is based on a much more complex theory. The dam is assumed to be made up of a system of elementary horizontal arches superimposed on a system of intersecting elementary vertical cantilevers, and the water load is assumed to be divided between the two systems in such proportions that the deflection of any point, considered as a point on an elementary arch, will be the same as its deflection, considered as a point on the intersecting cantilever, when each element carries its proper share of the load. The tests of the experimental dam at Stevenson creek have shown that this hypothesis gives results which are sufficiently close to the truth for practical purposes of design. Any errors there may be are of a lower order of importance than the inevitable errors in choosing the elastic co-efficients and other constants involved. Analyzed on this hypothesis, the arch loads are generally found to be far from uniform around the arc. Moreover, there are shearing stresses, both radial and tangential, between the arches. For these reasons, among others, it is not possible to compensate for the deformation stresses at the crowns of the arches only, as we can do with a bridge arch. It is necessary to vary the compensation stresses at several points along the arch and also at several points on the cantilevers. For the ideal 100 per cent efficiency, it would of course, be necessary to have an infinite number of joints and an infinite number of compartments in each, and to apply different pressures in each compartment. This is, of course, impossible. For practical purposes, it is sufficient to divide the dam by the usual number of joints; to divide each joint into one or more vertical compartments, and each compartment into one or more sub-compartments. In this way, it is possible to get results within 60 per cent to 80 per cent of the ideal.

Cantilever Stresses

This process of forcing grout into the construction joints has the effect of lengthening the neutral axes of the arches and, hence, of forcing the arches upstream. This, in turn, forces the cantilevers to bend upstream. As the effect of the water load is to bend them downstream, the two effects are opposed, and the result is that the cantilevers are relieved of some of their load and the cantilever stresses are reduced.

Lamé Effect

It will be remembered that, when figure No. 1 was considered, it was stipulated that the walls of the cylinder must be thin relative to the external diameter. The stresses in the walls of a cylinder are never uniform under any circumstances. However, if the thickness does not exceed about one-fortieth of the diameter, they are so nearly uniform that the departure may be neglected. As the ratio increases, the departure also increases until, when it reaches one-quarter, the stress in the intrados may be about three times that at the extrados. This is known as "the Lamé effect" and is the same phenomenon which makes it necessary to build up a big gun by shrinking the outer hoops onto the inner tube. In a high dam of short radius, the thickness of the lower arches may be so great that they cannot be treated as thin cylinders and the arch stresses, quite apart from the stresses due to deformations, will be very far from uniform over the section. Dr. Vogt's system can compensate for this inequality in the same way as it compensates for the stresses due to deformation under load.

The Merits of the System

Summing up, the merits of the system described may be set out as follows:—

(1) It acts to equalize the arch stresses by correcting for the distortion caused by the water loads;

(2) It acts to equalize the, so-called, cantilever stresses and eliminate tension in the cantilever elements;

(3) It compensates for shrinkage and can, if necessary, accelerate the shrinking process;

(4) It compensates for the Lamé effect in thick arches.

If all the above actions were 100 per cent efficient, it would be possible to design by the simple cylinder formula with the assurance that the assumed cylinder stress would not be exceeded and that, so-called, cantilever stresses would not exist. In actual practice, the efficiency can be brought up to better than 80 per cent and the dam can be designed as a free cylinder on the basis of a unit stress 80 per cent of the maximum with the assurance that the prescribed stress will not be exceeded and that cantilever stresses will be of no importance, and certainly not show tension.

Examples of Practice

It may be said that all the above is very fine in theory, but what can the system accomplish in practice? The following examples may answer the question. Neither represents a structure which has actually been built, but they do show in a measure what results can be obtained.

Figure No. 11 shows plan, elevation and section of a dam designed by Dr. Vogt with the use of his method an essential factor in construction. The dam is 350 feet high with a span of 700 feet. It is of the variable radius type and its dimensions were determined by the simple cylinder formula using a unit stress of 420 pounds per square inch as a basis. The construction joints are spaced about 40 feet apart and are divided into compartments as indicated by the dotted lines on the cross-section. The design was then analyzed by the more exact hypothesis. Table No. 1, case No. I, gives the stresses so found. It is assumed that the construction joints have been filled up *after all the shrinkage has occurred*. In case No. II, the various compartments have been grouted, each with the proper pressure, varying from 380 pounds per square inch downward. Note that, in case No. I, both arch and cantilever stresses show tension of sufficient magnitude to crack the concrete, while in case No. II, there is no tension at all, not even in the cantilever elements where we should expect to find it in a dam of this sort. The high tension in the cantilever elements is an undesirable by-product of the variable radius and vertical downstream face. At the same time, the use of a variable radius makes for an enormous saving in masonry over a dam for the same site with constant radius. Without the use of the compensating process this dam could not be designed with variable radius and this saving could not have been effected. For this site, had a dam with constant radius been designed, the subtended angle of the lower arches would have been so small that arch action there would have been doubtful, to say the least. However, assuming that arch action would exist, the lower arches would have been so thick that the Lamé effect would govern for dimensions and the resulting dam would have approached the gravity section. It will be seen, therefore, that the differential grouting process effected a double saving, in that, it allowed the use of the variable radius, and the maximum stresses are very near the average. The maximum arch stress in case No. II is 490 pounds per square inch while the stress by the simple cylinder formula is 420 pounds. Thus, the efficiency is rather better than 80 per cent. The maximum cantilever stress is below 600 pounds per square inch. As good concrete will safely stand at least 800 pounds per square inch, the dam might have been made with a smaller section even than shown. If designed for a maximum of 800 pounds per square inch instead of 600 pounds per square inch, the saving in masonry would have been about 20 per cent.

The dam as designed is about 96 feet thick at the base, and half-way up it is still about 60 feet thick. Without artificial aid, it might require from five to nine years for all the chemical heat to dissipate. If the construction joints were filled up before this lapse of time, the remaining shrinkage would, at least, reduce the arch action and thus throw additional load on the cantilever elements, with horizontal cracks in the upstream face as a probable consequence. If the dam is designed for differential pressure grouting, the shrinkage can be much accelerated. Without artificial aid, all the chemical heat must be dissipated by conduction through the only available surfaces, i.e. the two faces of the dam; also the temperature gradient is fixed by the atmospheric temperature at these two faces. If cold water were circulated through the

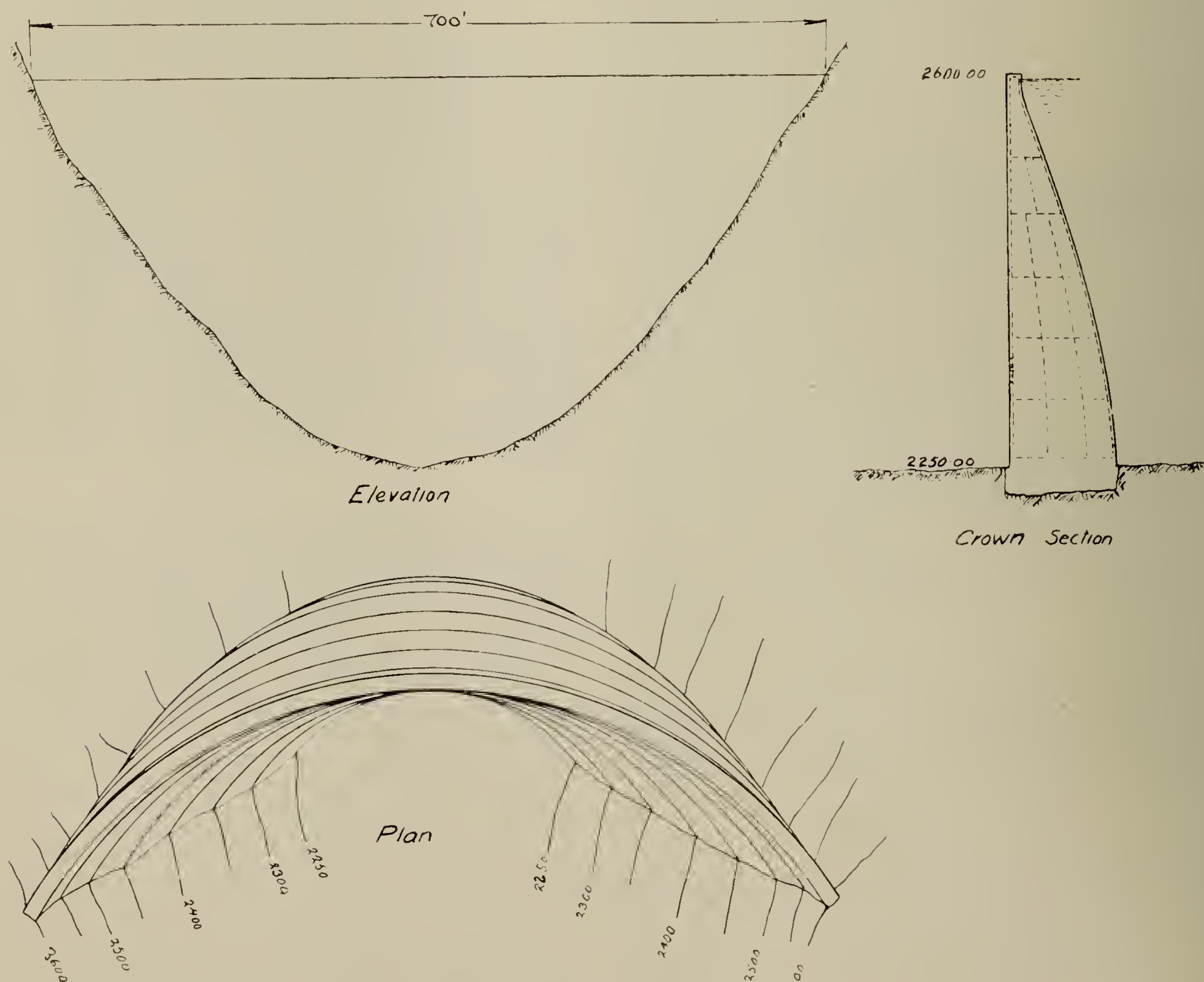

Figure No. 11.

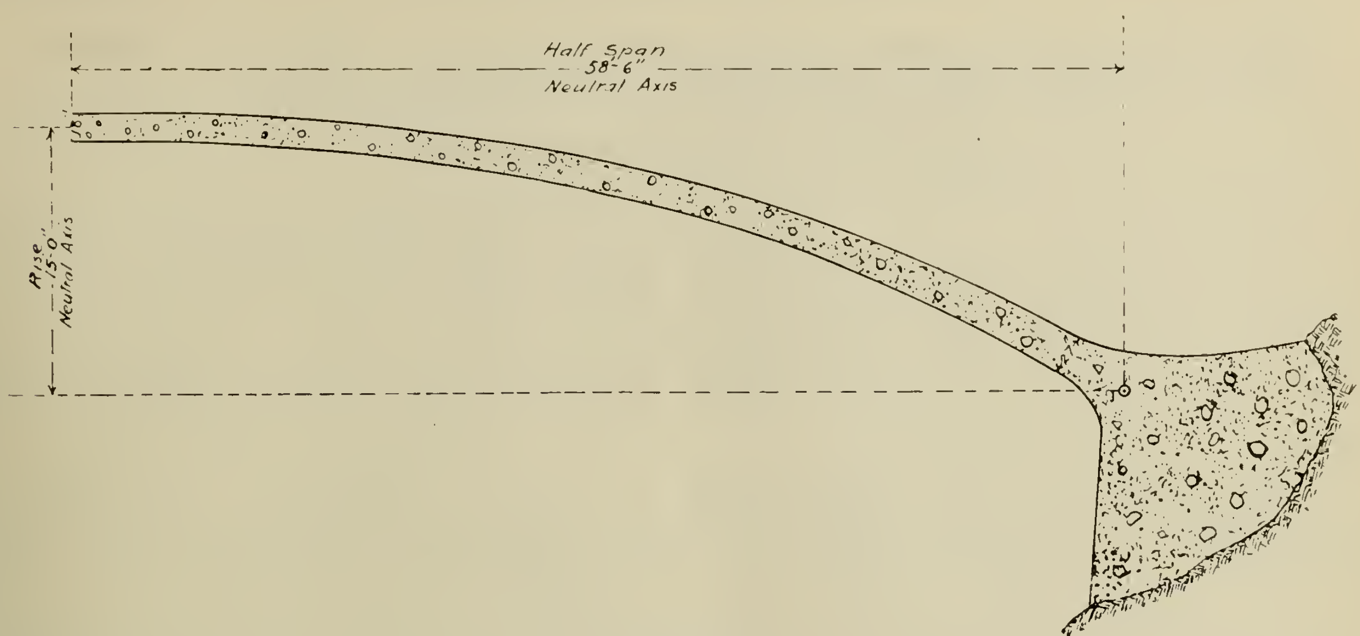

Figure No. 12.

grouting compartments, the available radiating surface would be about doubled and the temperature gradient increased about eight times. As a result, 90 per cent of the chemical heat could be dissipated in about one-tenth of the time otherwise necessary. To compensate for the whole of the shrinkage by pressure alone would require pressures in the order of 1,200 pounds per square inch while the remaining ten per cent would only need about 120 pounds per square inch.

Application to a Bridge Arch

As an example of this method of compensating for the deformation stresses as employed for a bridge arch, figure No. 12 is presented. The arch shown is one of a series of three for a highway bridge designed by the writer. It is a spandrel-filled arch with a span of the neutral axis of 117 feet and a rise of 15 feet. In a flat arch of this ratio, the stresses due to rib shortening and shrinkage reach very large proportions. In the particular example shown, they are so great that the arch would not be stable without reinforcement to the extent of one per cent of steel in each face. If these stresses could be neutralized, the arch would be stable with rather less than one-quarter per cent in each face. In order to do this, a grouting compartment is formed at the crown, eleven inches wide with its centre one inch below the neutral axis, and grouted at a pressure of 260 pounds per square inch. Table No. II shows the results. The stresses shown are calculated for the plain concrete rib without reinforcement and include dead and live load, rib shortening, shrinkage and temperature stresses. The residual tension at the springing line is due to temperature and might have been avoided by a slight increase in thickness. However, a small amount of steel is a wise precaution in a flat arch for reasons other than the possible stresses and it did not seem worth while to make the change. The saving in the weight of steel in the three arches amounts in money to about $9,500.00.

This arch ring is 30 feet wide and the total compensating force is, therefore, about 520 tons. To apply this force by jacks would require, say, 29 jacks, each of 18 tons capacity. On account of the limited room available, ordinary commercial patterns could not very well be used and they would have to be specially made in consequence. As the salvage, if any, would be small, the cost may be imagined. With the grouting method, there is no special plant to speak of, a small pump being all that is needed, so that cost would not be great.

As a further example, applied to a small arch dam designed by the writer, the grouting process worked a saving of about 900 cubic yards of concrete in a total of 4,000 cubic yards, which in money is worth about $16,000.00. Even if half this sum were needed for the grouting process, an impossible assumption, the remaining saving is by no means negligible.

Table No. I

350 feet variable radius arch dam, 700 feet span

		Stresses—lbs. per sq. in. tension minus: Maximum	Minimum
Case No. I	Uncompensated, Cantilever stresses	+ 940	− 160
	Arch stresses	+ 650	− 90
Case No. II	Compensated, Cantilever stresses	+ 590	+ 80
	Arch stresses	+ 490	+ 280

Table No. II

117 feet spandrel-filled arch bridge 15 feet rise

	Stresses—lbs. per sq. in. tension minus: Extrados	Intrados
Crown stresses:		
Compensated	+ 725	+ 113
Uncompensated	+ 908	− 92
Springing line:		
Compensated	− 116	+ 724
Uncompensated	− 409	+ 1,043

Acknowledgments

The writer is indebted to Dr. Vogt, patentee of the process, for the calculation of the first example, and to him and Mr. B. F. Jakobsen of Los Angeles for reviewing the paper and for much valuable advice in its preparation.

Discussion on "A Method of Equalizing Stresses in Masonry Arches with Particular Reference to Arched Dams"

Paper by H. B. Muckleston, M.E.I.C.[1]

C. R. Young, M.E.I.C.[2]

In the first paragraph there is too broad a statement with respect to the possibility of designing a rib in such a manner as to give uniform intensity of stress for every radial section. Obviously this would not be possible for any moving load such as might be realized on a bridge or roof arch. The author probably had the arched dam in mind when writing this paragraph and perhaps it would be well for him to make the limitation clear.

While entirely favourable to the publication of this paper, Professor Young is not sure that certain difficulties in practical carrying out of the method might not be encountered and that it might prove less satisfactory than a theoretical discussion would indicate. Concrete is notoriously porous, and the discussor wonders whether it would be possible to maintain a sufficient water-tightness by means of water stops, particularly at the corners of the open spaces, to make the development of large hydraulic pressures through a grouting machine possible. If the author knows of any actual tests of high pressure grouting, it might be useful to add some mention of it to the paper.

H. B. Muckleston, M.E.I.C.[3]

The author notes Professor Young's remarks concerning the porosity of concrete, and the possibility of maintaining sufficient water-tightness to make the development of large hydraulic pressure possible. It would, no doubt, be difficult if the operating fluid were water, but, even then, some fairly large water pressures have been retained in concrete cylinders. With a highly viscous fluid, such as fairly stiff grout, there should be no practical difficulty in holding the pressure for twenty-four hours, which is all that is necessary with high alumina cements. It is, of course, necessary to provide against the possibility of the stops being blown out. This is a mechanical problem. In the case of the bridge arch illustrated, it was proposed to make the grouting pocket a completely enclosed box of thin copper well tied across by wire to prevent bursting out at the ends.

The system is now being used on a dam designed by the writer for the water supply of Nanaimo, B.C. This dam is about 90 feet high with a crest span of 180 feet. The subtended angles vary from 120 degrees at the crest to 104 degrees near the bottom and the radius of the extrados from 97.5 at the crest to 70.7 at the bottom. At the centre of the crest, the dam overhangs the base about 27 feet and is only 7 feet thick at the base. It will be grouted at a maximum pressure of 110 pounds per square inch. It is hoped that this work will be the subject of a further paper, probably by a University of British Columbia student working on the job, who has commandeered the writing of it as a thesis for his final examination for registration with the Association of Professional Engineers of British Columbia.

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(1) This paper is published on page 632 of the November issue of The Journal.

(2) Professor of civil engineering, University of Toronto, Toronto, Ont.

(3) Consulting engineer, Vancouver, B.C.

The Annual General Meeting at Montreal, 1931

The Forty-fifth Annual General Meeting of The Engineering Institute of Canada is scheduled to convene at Headquarters, 2050 Mansfield street, Montreal, on January 22nd 1931, at 8.00 o'clock p.m., for the reading of the minutes of the last Annual General Meeting and the appointment of scrutineers and auditors, after which the meeting will be adjourned and reconvened on Wednesday, Thursday and Friday, February 4th, 5th and 6th, 1931.

The reconvened meeting and other functions will be held at the Windsor hotel, and arrangements have been made to accommodate a large number of out-of-town guests as well as the Montreal Branch members.

The programme of the functions is now being arranged and a most interesting three days are in prospect.

The tentative programme for the technical sessions indicates papers on many diversified subjects that should cover the various fields wherein members of The Institute practise their profession. For example, there will be a number of papers on interesting construction points of the Chute-à-Caron and other water power developments; a detailed paper on the fabrication of the lock gates of the Welland ship canal, and a complete set of papers on the Sun Life building, covering architectural details, construction problems and the design and installation of heating and ventilating systems and mechanical equipment, as well as numerous others. A number of inspection trips will be made to points of interest, including the Sun Life building and engineering developments under way in the vicinity of Montreal.

A committee has been appointed to take care of the ladies' activities, and it is hoped that a large number will attend, as they are sure to find the time well taken up.

The Montreal Branch has always done remarkably well in the manner in which they have staged the annual meetings held in their city, and they are sure to equal their enviable record, if not better it, in 1931.

By courtesy of International Airways Limited.

Arrange to Attend

The Annual Meeting in Montreal

Make a Note of the Dates

February 4th, 5th, and 6th, 1931

THE
ENGINEERING JOURNAL
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OF CANADA

VOLUME XIII NOVEMBER 1930 No. 11

The "Buy Canadian Products" Campaign

It is difficult to choose between the various prescriptions offered to us by doctors of economics as remedies for our present feeling of industrial and commercial ill-health. These physicians, indeed, do not agree on any one diagnosis of our trouble. Some would have it that we are merely victims of a state of mind and that all that is needed to promote prosperity is an outburst of enthusiasm to be generated by a high pressure campaign of publicity and maintained by suitable super-salesmanship. Others point to the mechanization of the age. They note such things as a crowd of unemployed watching a steam shovel moving more material than could be handled by hundreds of men, and they attribute our trouble to unemployment, caused by the substitution of machine for hand labour. Another expert, perhaps bewildered by the output statistics of our automobile or radio factories, blames mass production. His neighbour believes that all immigration should be stopped. On the other hand, another adviser would encourage immigration, and points to our slow increase in population as the root of the evil. The ideas of too much government interference with industry, or the apathy of the government towards industry, are in turn brought forward, and such topics as the dumping of Russian and Argentine wheat in Europe, the recurrence of business cycles, and many others are discussed without much regard as to whether they are causes or effects.

The fact remains that, for some reason or other, commercial and industrial activity has slackened in Canada and elsewhere. Employment is less active; people do not spend money as they did; there is a reduction in car loadings on our railways, the country's revenue has diminished, and, strangest of all, fewer automobiles are being built.

For some time there has been a growing sentiment in Canada that apart from all the theories as to the causes of industrial depression and unemployment, there is one remedy, possibly not a complete one, but easy to apply and reasonably certain in its results. Elsewhere in this issue will be found an announcement from the Minister of Trade and Commerce, pointing out that a large proportion of the goods imported into Canada are such as could have been produced by our own mines, farms or factories. When allowance is made for those commodities, such as cotton or rubber, which cannot be grown or produced in this country, it is surprising to learn that each individual in Canada consumes annually some eighty dollars worth of goods made or produced elsewhere, which could have afforded employment in Canada to our own people.

It is of course true that unless payment for our exports is made in gold or its equivalent, goods must be imported in return, but the suggested replacement of a large proportion of our present imports by Canadian products would eventually enable us to increase our consumption of those imported commodities which cannot be produced here.

The appeals sent out by Mr. Stevens should be heeded by all true Canadians, and will be backed by all who have at heart the welfare of their country and the prosperity of its people. If actively carried out, the policy of buying Canadian products will do much to promote a feeling of industrial independence and, by aiding the Canadian manufacturer and industrialist, will help those depending on him for employment. Canadian industry will have larger opportunities for demonstrating that its products compare favourably in quality and price with those with which they compete, a matter which has not always received the attention it deserves.

Canadian citizens will undoubtedly receive the minister's suggestion with approval and will be prepared to do their part in carrying it out, but it is little use advocating the purchase of Canadian products if the buyer, willing to pay an equal or even slightly higher price for domestic goods, finds that they are less satisfactory than those produced elsewhere, which he is asked to refuse.

A further responsibility is placed upon the leaders in Canadian industry and those charged with directing expenditure on large enterprises or public works, who should see to it that when scientific, technical or professional advice is required, foreign engineers, architects, chemists or technically trained men are called in only when no properly qualified Canadians are available for the work desired. In the past there have been cases where legitimate criticism on these points has been heard, and the success of the movement now initiated will only be insured if industry does its part as well as the general public.

List of Nominees for Officers

EXTRACT FROM BY-LAWS

Section 68—Not later than the seventh day of November, the Secretary shall mail to each corporate member of The Institute the list of nominees for officers, as prepared by the Nominating committee and the Council.

Additional nominations for the list of nominees for officers signed by ten or more corporate members and accompanied by written acceptances of those nominated, if received by the Secretary on or before the first day of December, shall be accepted by the Council and shall be placed on the officers' ballot. The words "Special Nomination" shall be printed conspicuously near such names, and the names of the members making such nominations shall be printed on some part of the officers' ballot.

Section 74—Notices shall be deemed to have been mailed to members as prescribed by the By-laws if such notices are printed in The Journal of The Institute and mailed by the dates prescribed in the By-laws.

Nominations

The report of the Nominating committee was presented to and approved by Council at the meeting held on September twenty-third, nineteen hundred and thirty. The following is a list of the nominees as prepared by the Nominating committee and now published for the information of all corporate members, as provided by Sections 68 and 74 of the By-laws:—

President:	S. G. Porter, M.E.I.C.	Calgary.
Vice-Presidents:		
*Zone "A"	H. B. Muckleston, M.E.I.C.	Vancouver.
	P. Philip, M.E.I.C.	Victoria.
*Zone "C"	O. O. Lefebvre, M.E.I.C.	Montreal.
Councillors:		
‡Halifax Branch	W. P. Copp, M.E.I.C.	Halifax.
	C. A. Fowler, M.E.I.C.	Halifax.
†Cape Breton Branch	A. L. Hay, M.E.I.C.	Glace Bay.
‡Saint John Branch	A. R. Crookshank, M.E.I.C.	Saint John.
	E. J. Owens, A.M.E.I.C.	Saint John.
†Moncton Branch	M. J. Murphy, A.M.E.I.C.	Moncton.
	G. C. Torrens, A.M.E.I.C.	Moncton.
‡Saguenay Branch	G. E. LaMothe, A.M.E.I.C.	Chicoutimi.
†Quebec Branch	Hector Cimon, A.M.E.I.C.	Quebec.
‡St. Maurice Valley Branch	B. Grandmont, A.M.E.I.C.	Three Rivers.
††Montreal Branch	C. V. Christie, M.E.I.C.	Montreal.
	A. R. Ketterson, A.M.E.I.C.	Montreal.
	E. A. Ryan, M.E.I.C.	Montreal.
	D. C. Tennant, M.E.I.C.	Montreal.
‡Ottawa Branch	John McLeish, M.E.I.C.	Ottawa.
	F. H. Peters, M.E.I.C.	Ottawa.
†Peterborough Branch	R. L. Dobbin, M.E.I.C.	Peterborough.
‡Kingston Branch	D. M. Jemmett, A.M.E.I.C.	Kingston.
‡‡Toronto Branch	Thomas Taylor, M.E.I.C.	Toronto.
†Hamilton Branch	E. H. Darling, M.E.I.C.	Hamilton.
‡London Branch	W. P. Near, M.E.I.C.	London.
	J. A. Vance, A.M.E.I.C.	Woodstock.
†Niagara Peninsula Branch	E. G. Cameron, A.M.E.I.C.	St. Catherines.
‡Border Cities Branch	A. E. West, A.M.E.I.C.	Walkerville.
†Sault Ste. Marie Branch	A. E. Pickering, M.E.I.C.	Sault Ste. Marie.
‡Lakehead Branch	C. H. Burbidge, M.E.I.C.	Port Arthur.
†Winnipeg Branch	N. M. Hall, M.E.I.C.	Winnipeg.
‡Saskatchewan Branch	R. W. E. Loucks, A.M.E.I.C.	Regina.
†Lethbridge Branch	G. N. Houston, M.E.I.C.	Lethbridge.
‡Edmonton Branch	A. W. Haddow, A.M.E.I.C.	Edmonton.
	R. W. Ross, A.M.E.I.C.	Edmonton.
†Calgary Branch	F. J. Robertson, A.M.E.I.C.	Calgary.
	R. S. Trowsdale, A.M.E.I.C.	Calgary.
‡Vancouver Branch	P. H. Buchan, A.M.E.I.C.	Vancouver.
	A. D. Creer, M.E.I.C.	Vancouver.
†Victoria Branch	H. F. Bourne, A.M.E.I.C.	Victoria.
	K. M. Chadwick, M.E.I.C.	Victoria.

*One Vice-President to be elected for two years.
†One Councillor to be elected for one year.
††Two Councillors to be elected for three years each.
‡One Councillor to be elected for two years.
‡‡One Councillor to be elected for three years.

Attention is drawn to the recent change in Section 13 of the By-laws, making the term of office for councillor two years instead of one year. To give effect to this arrangement council has decided that at the forthcoming election in 1931 one-half of the branches entitled to one councillor will elect their councillor for a one-year term, the remainder electing for two years. Accordingly, in 1931, the following branches will elect their councillor for one year, and in 1932 will elect for two years: Cape Breton, Moncton, Quebec, Peterborough, Hamilton, Niagara Peninsula, Sault Ste Marie, Winnipeg, Lethbridge, Calgary and Victoria. The following branches in 1931 will elect their councillor for two years, and will not elect a councillor in 1932: Halifax, Saint John, Saguenay, St. Maurice Valley, Kingston, London, Border Cities, Lakehead, Saskatchewan, Edmonton and Vancouver.

In 1932 and thereafter, all elections of councillors for such branches, will be for a two-year term, thus carrying out the intent of the amendment to the By-law, namely, to insure a measure of continuity in council membership.

Prizes and Medals of The Institute

Attention is drawn to the various prizes and medals to be awarded by The Engineering Institute of Canada at the end of the prize year, July 1st, 1930, to June 30th, 1931. The competitions for these distinctions are open to those belonging to The Institute and the regulations governing them will be found below.

The principal object of these prizes is to encourage a larger proportion of our members to contribute papers of merit, passing on the results of their experience for the benefit of others. But it should be remembered that the acceptance and publication of a good paper enhances the writer's professional status, and the discussion of his own, and his participation in the discussion of others' papers, make his name better known to his fellow-engineers. Also, the standing of The Engineering Institute of Canada among other engineering societies depends largely on the character of the papers contained in our publications, which is governed by the extent to which our members are prepared to put their experience and information on record.

The Council of The Institute would, therefore, ask members' consideration of the following:

Rules Governing the Award of the Prizes and Medals of The Institute

The Past-President's Prize

In recognition of the fund establish in 1923 by the then living past-presidents and contributed to by subsequent past-presidents, a prize, to be called "The Past-Presidents' Prize," may be awarded annually according to the following rules:—

1. The prize shall be awarded for the best contribution submitted to the council of The Institute by a member of The Institute of any grade on a subject to be selected and announced by the council at the beginning of the prize year, which shall be July first to June thirtieth.

2. In deciding on the subject to be specified, the council shall confer with the branches, and use its discretion, with the object of selecting a subject which may appear desirable in order to facilitate the acquirement and the interchange of professional knowledge among the members of The Institute.

3. The papers entered for the competition shall be judged by a committee of five, to be called the Past-Presidents' Prize committee, which shall be appointed by the Council as soon after the annual meeting of The Institute as practicable. Members and honorary members only shall be eligible to act on this committee.

It shall be within the discretion of the committee to refuse an award if they consider no paper of sufficient merit.

4. The prize shall consist of a cash donation of the amount of one hundred dollars, or the winner may select books or instruments of no more than that value when suitably bound and printed, or engraved, as the case may be.

5. All papers eligible for the competition must be bona fide work of the contributors and must not have been made public before submission to The Institute.

6. All papers to be entered for the competition must be received during the prize year by the General Secretary of The Institute, either direct from the author or through a local branch.

7. The award shall be announced in The Engineering Journal at the annual meeting, and, if possible, the presentation shall take place at that meeting.

Prizes to Students and Juniors

1. Five prizes may be awarded annually for the best papers presented by Students or Juniors of The Institute in the vice-presidential zones of The Institute, as follows:—

The H. N. Ruttan Prize,—in Zone A—The four western provinces.

The John Galbraith Prize,—in Zone B—The province of Ontario.

The Phelps Johnson Prize,—for an English Student or Junior in Zone C—The province of Quebec.

The Ernest Marceau Prize,—for a French Student or Junior in Zone C—The province of Quebec.

The Martin Murphy Prize,—in Zone D—The Maritime provinces.

2. Awards shall only be made if, in the opinion of the examiners for a zone, a paper of sufficient merit has been presented to a branch in that particular zone.

3. The winner of a prize shall be required to specify such technical books or instruments as he may desire to the total value of approximately twenty-five dollars when suitably bound and printed or engraved, as the case may be.

4. The award of prizes shall be for the year ending June thirtieth. On that date, each branch secretary shall forward to the examiners for his particular zone all papers presented to his branch by Students and Juniors during the prize year, regardless of whether they have been read before the branch or not.

5. The prizes shall be awarded only to those who are in good standing as Students or Juniors of The Institute on June thirtieth following the presentation of the paper.

6. The papers must be the bona fide production of those contributing them and must not have been previously made public or contributed to any other society in whole or in part. It is to be understood, however, that a paper which has won or been considered for a branch prize is nevertheless eligible for The Institute Prize. No paper shall be considered for more than one of the five prizes.

7. The examiners for each zone shall consist of the vice-president of that zone and two councillors resident in the zone, appointed by council. In the case of Zone C, two groups of examiners shall be appointed under the two vice-presidents, one for the English award and one for the French award. The awards shall be reported to the annual meeting of The Institute next following the prize year, and the prizes presented as soon thereafter as is reasonably possible.

The Gzowski Medal

A gold medal, to be called the Gzowski Medal, shall be struck each year and paid for from the annual proceeds of the fund provided for that purpose by Col. Sir Casimir Gzowski, A.D.C., K.C.M.G., late past-president of The Institute, which medal shall be awarded according to the following rules for papers presented to The Institute.

1. Competition for the medal shall be open only to those who belong to The Institute.

2. The award of medals shall not be made oftener than once a year, the medal year shall be the year ended June last previous to the annual meeting at which the award is to be made.

3. The papers entered for competition shall be judged by a committee of five, to be called the Gzowski Medal committee, which shall be appointed by the council as soon after the annual meeting of The Institute as practicable. Members and Honorary Members only shall be eligible to act on this committee.

4. Papers to be eligible for competition must be bona fide productions of those who contribute them, and must not have been previously made public, nor contributed to any other society in whole or in part.

5. The medal shall be awarded for the best paper of the medal year, provided such paper shall be adjudged of sufficient merit as a contribution to the literature of the profession of civil engineering, but not otherwise.

6. In the event of the committee not considering a paper in any one year of sufficient merit, no award shall be made; but in the following year or years, it shall be in the power of the committee to award the accumulated medals to the authors of different papers which may be deemed of sufficient merit.

7. The medal shall be suitably engraved by The Institute, and shall be handed to the successful authors at the annual meeting, or be given to them as soon afterwards as possible.

The Leonard Medal

A gold medal, called the Leonard Medal, shall be struck each year and paid for from the annual proceeds of the fund provided for that purpose by Lieut.-Col. R. W. Leonard, which medal shall be awarded in accordance with the following rules for papers on mining subjects presented either to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.

1. Competition for the medal shall be open to those who belong to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.

2. Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.

3. The medal shall be presented at annual meetings of The Engineering Institute of Canada.

4. A committee of five shall judge the papers entered for competition, all of whom shall be members both of The Canadian Institute of Mining and Metallurgy and The Engineering Institute of Canada, this committee to be appointed by the council of The Engineering Institute of Canada.

5. All papers presented shall be the work of the author or authors and must not have previously been made public, except as part of the literature of The Canadian Institute of Mining and Metallurgy or The Engineering Institute of Canada.

6. Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years, the committee shall have power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.

7. The medal shall be suitably engraved, containing the name of The Engineering Institute of Canada, and the words, "The Leonard Medal" together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

The Plummer Medal

A gold medal, to be called The Plummer Medal, shall be struck each year and paid for from the annual proceeds of the fund provided for that purpose by Mr. J. H. Plummer, D.C.L., which medal shall be awarded according to the following rules for papers on chemical and metallurgical subjects presented to The Institute.

1. Competition for the medal shall be open to those who belong to The Engineering Institute of Canada, and to non-members if their papers have been contributed to The Institute and presented at an Institute or Branch meeting.

2. Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.

3. The medal shall be presented at annual meetings of The Engineering Institute of Canada.

4. A committee of five shall judge the papers entered for competition, all of whom shall be members of The Engineering Institute of Canada, and shall be appointed by the council of The Institute.

5. All papers presented shall be the work of the author or authors and must not have previously been made public, except as part of the literature of The Engineering Institute of Canada.

6. Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years, the committee shall have the power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.

7. The medal shall be suitably engraved, containing the name of The Engineering Institute of Canada, and the words, "The Plummer Medal," together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

The Fourth Plenary Meeting of Council

The Fourth Plenary Meeting of the Council of The Institute was held on Monday, Tuesday and Wednesday, September 22nd, 23rd and 24th, 1930, the following members being present:

President A. J. Grant, M.E.I.C., in the chair; Past-Presidents A. R. Decary, D.A.SC., M.E.I.C., C. H. Mitchell, C.B., C.M.G., D.Eng., M.E.I.C., and H. H. Vaughan, M.E.I.C.; Vice-Presidents F. R. Faulkner, M.E.I.C., (Maritime Provinces), C. J. Mackenzie, M.E.I.C., (Western Provinces), George R. MacLeod, M.E.I.C., (Province of Quebec), and W. G. Mitchell, M.E.I.C., (Province of Quebec); Councillors L. M. Allan, A.M.E.I.C., (Border Cities), V. C. Blackett, A.M.E.I.C., (Moncton), H. F. Bennett, A.M.E.I.C., (Halifax), J. L. Busfield, M.E.I.C., (Montreal), H. Cimon, A.M.E.I.C., (Quebec), F. A. Combe, M.E.I.C., (Montreal), E. H. Darling, M.E.I.C., (Hamilton), R. L. Dobbin, M.E.I.C., (Peterborough), B. Grandmont, A.M.E.I.C., (St. Maurice Valley), G. N. Houston, M.E.I.C., (Lethbridge), W. J. Johnston, A.M.E.I.C., (Saint John), O. O. Lefebvre, M.E.I.C., (Montreal), T. Lees, M.E.I.C., (Calgary), W. L. Malcolm, M.E.I.C., (Kingston), D. A. R. McCannel, M.E.I.C., (Saskatchewan), P. B. Motley, M.E.I.C., (Montreal), W. P. Near, M.E.I.C., (London), C. H. Scheman, M.E.I.C., (Niagara Peninsula), E. Stansfield, M.E.I.C., (Edmonton), J. G. R. Wainwright, A.M.E.I.C., (Toronto), H. R. Wake, A.M.E.I.C., (Saguenay), L. W. Wynne-Roberts, A.M.E.I.C., (Toronto), R. B. Young, M.E.I.C., (Toronto), and Treasurer F. P. Shearwood, M.E.I.C., (Montreal). Mr. W. C. Adams, M.E.I.C., and Mr. A. C. Tagge, M.E.I.C., members of the Special Committee on the Publications of The Institute, were also present at the request of Council.

Expressions of regret at being unable to attend the meeting were received from Past-Presidents G. H. Duggan, D.Sc., M.E.I.C., J. M. R. Fairbairn, D.Sc., M.E.I.C., J. G. Sullivan, M.E.I.C., and George A. Walkem, M.E.I.C., and Councillors Sydney C. Mifflen, M.E.I.C., (Cape Breton), and A. E. Pickering, M.E.I.C., (Sault Ste Marie).

Monday, September 22nd

After a welcome to the visiting councillors from the President and the confirmation of the minutes of the last meeting, routine business arising from previous meetings was taken up.

On receiving the news of the death of George F. Porter, LL.D., M.E.I.C., a distinguished engineer and former member of Council, a resolution of regret and condolence was unanimously passed, and the Secretary was directed to communicate it to Mr. Porter's family.

Recommendations from the Finance committee were received and adopted, and the financial statement to August 31st, 1930, was submitted and approved.

A communication was presented from Councillor W. J. Johnston, A.M.E.I.C., drawing attention to the fact that competition for the prizes and medals of The Institute has not been so active as might be desired, and suggesting the consideration of certain changes in the method of awarding prizes for students. After considerable discussion, during which the importance of this matter was fully recognized, it was decided to appoint a small committee* to bring in a report at a later session of the meeting, and action was taken accordingly.

The President having asked J. L. Busfield, M.E.I.C., chairman of the Committee on Classification and Remuneration, to make a statement regarding the work of that committee, Mr. Busfield reported that in order to secure information regarding present day conditions with respect to the remuneration of the engineering profession, the committee had sent out a questionnaire to all corporate members and Juniors of The Institute. About eleven hundred replies had been received, the information thus secured had been summarized, and he presented a brief report for the confidential information of Council. He remarked that there seemed to be great diversity of opinion amongst engineers themselves as to the correct classification of engineers and their work, and asked for an expression of opinion from councillors present to assist him in preparing his final report.

During the discussion which followed, attention was drawn to the difficulty of drawing up for the purposes of such a report any system of classification of engineers which would be sufficiently flexible to include the many branches of engineering work existing to-day. Members present agreed that such a classification would be very useful for employers in considering engineers' remuneration, but that classification of engineers after they have reached positions of an executive nature would be almost impossible, either on the basis of years of experience or professional responsibility. It was felt that the information now before Council, being of a preliminary nature, should be treated as confidential until the completion of the committee's work, and it was hoped that it would be possible to have a report ready for presentation to Council prior to the next annual meeting.

In connection with the Forty-fourth Annual General and General Professional Meeting of The Institute, to be held in Montreal in February next, it was resolved, following the recommendation of the Finance committee, that an accountable advance of $500.00 be made to the Montreal Branch.

Considerable discussion followed as to the arrangements desirable for the programme and the annual dinner of The Institute, and a tentative programme was approved.

Applications for admission and transfer were next considered, and the following elections and transfers were effected:

Elections		*Transfers*	
Members	1	Junior to Assoc. Member	8
Assoc. Members	6	Student to Assoc. Member	3
Juniors	6	Student to Junior	4

At the beginning of the afternoon session attention was drawn to the desirability of improvement in the arrangements for securing technical papers for professional and branch meetings, and particularly in promoting good discussions, and members present were in agreement as to the importance of this matter. It was pointed out that many of the branches of The Institute have experienced increasing difficulty in obtaining speakers and papers of merit for their meetings, and, on the suggestion of Mr. Busfield, general approval was expressed of a proposal to appoint Institute or branch committees from time to time to make definite technical reports on certain subjects or projects. In the opinion of many, the apparent reluctance of members to prepare technical papers was largely due to the trend of the times, and particularly to the remarkable growth of technical periodicals in recent years. After further discussion the matter was referred to the Papers committee, with the request that they take it up with all the branches and report to Council before the end of the year.

Tuesday, September 23rd

The Secretary reported the receipt of information from Professor E. A. Allcut, M.E.I.C., to the effect that the Institution of Mechanical Engineers may possibly come to Canada for the purpose of holding their summer meeting in 1932. Mr. Calvin Rice, the Secretary of the American Society of Mechanical Engineers, had also stated that the American Society of Mechanical Engineers is making arrangements for a Summer Meeting in 1932 in Ontario. It was unanimously resolved that the Secretary be instructed to write to the Institution of Mechanical Engineers and the American Society of Mechanical Engineers offering the co-operation of The Engineering Institute of Canada in connection with their meetings if held in Canada in 1932.

The President asked Mr. W. C. Adams to present the Report of the Special Committee on the Publications of The Institute,† which was accordingly done. The report first discussed the general problem of the publications of The Institute, stressing their importance to the welfare of The Institute. The committee was convinced of the desirability of making The Institute's papers available in a permanent and convenient form, namely, in the shape of Transactions. The committee was also of the opinion that while the Journal in its present form was in many respects an excellent paper, a number of improvements could be suggested. The committee's report covered first, those points on which it was prepared to make definite recommendations to Council, and, secondly, a number of suggestions as to matters which might with advantage be dealt with at a later period and when the finances of The Institute would permit.

The recommendations for immediate action included an increase in the advertising rates; the discontinuance of the publication of the Engineering Index in The Journal; the issue of Transactions; the appointment of a whole-time editor at Headquarters for work on the publications of The Institute; proposals for obtaining a better supply of technical papers; the continuation of the E-I-C News, and the annual publication of the Year Book.

Suggestions made for action at a later time included the holding of a professional meeting each year in each zone; arrangements for taking stenographic reports of discussions at branch meetings; the appointment of an assistant secretary for each province, with a suitable honorarium, his duties being to co-operate with the General Secretary and branch secretaries; the appointment of selected committees to prepare reviews of engineering development in Canada and abroad; the appointment of a member of the Headquarters' staff to prepare abstracts of engineering articles and other publications; and, when Transactions are available, the publication of technical papers in The Journal only in abstract form, these papers, with their discussions, to be published in full in the Transactions.

Prolonged discussion followed the presentation of this report, after which the following decisions were reached in connection with the committee's definite recommendations. The Secretary was directed to increase the advertising rates in The Journal approximately twenty-five per cent. He was also directed to discontinue the publication of the Engineering Index at the end of the present volume of

*Brig.-Gen. C. H. Mitchell, M.E.I.C., Chairman.
J. L. Busfield, M.E.I.C.
W. J. Johnston, A.M.E.I.C.
C. J. Mackenzie, M.E.I.C.
W. L. Malcolm, M.E.I.C.

†W. C. Adams, M.E.I.C., Chairman.
F. P. Shearwood, M.E.I.C.
A. C. Tagge, M.E.I.C.

The Journal. The publication of Transactions was decided upon, paper covered volumes to be issued free to members, with an extra charge for binding.

These decisions having been reached, Mr. Adams drew attention to the representations which had been made for some time by the Niagara Peninsula Branch as to the desirability of reducing the size of The Journal, and pointed out that his committee, while giving expression to its own opinion on this matter, had purposely refrained from making a definite recommendation as to the size of The Journal.

Mr. Scheman presented, for the consideration of Council, a specially prepared dummy of a Journal in the 6 by 9 size, and pointed out the advantages which, in the opinion of the Niagara Peninsula Branch Executive committee, would result from the adoption of this make-up for The Journal, and Mr. Scheman hoped that this proposition, and the arguments for it, would be placed before all the branches of The Institute. Mr. Adams gave the results of his committee's investigations on the question of size, which indicated that while there would be little difference either way in the cost of publishing The Journal in the 6 by 9 size as compared with the 9 by 12, their inquiries had indicated that the 9 by 12 size was more advantageous in other respects, his committee's reasons for this view having been given in an appendix to the committee's report.

General Mitchell reminded the Council that this matter had been thoroughly discussed at the last Plenary Meeting of Council, and had already been brought to the attention of the branches in various ways, and he felt sure that if there were any widespread desire on the part of members for a reduction in the size of The Journal the Council would have been informed of it. He complimented the Niagara Peninsula Branch on the thorough way in which they had gone into the question, but felt that the opinion reached by Mr. Adam's committee, after consultation with many experts, was convincing.

After further discussion it was unanimously decided that the committee's recommendation providing for the publishing of Transactions in the size 8⅝ by 11¼ be adopted, and that the question of the size of The Journal be closed forthwith.

Discussion followed on the other definite recommendations of the committee, and while Council was entirely in accord with the recommendation that an editor of The Journal should give his undivided attention to The Journal and the E-I-C News, it was felt impossible to take action on this as the means are not available at the present time. The Treasurer was asked to bring in a report on this matter for consideration at the annual meeting. The committee's recommendations as regards the obtaining of technical papers, the continuation of the E-I-C News, the publication of by-laws, and the annual publication of the Year Book, were unanimously adopted.

The further suggestions made by Mr. Adams' committee, but not covered by their definite recommendations, were then considered, and Mr. Adams stated that his committee was particularly anxious that these should be put into effect as soon as conditions would permit, but thought that it was perhaps somewhat premature to discuss them in detail at this meeting. It was accordingly unanimously resolved that the suggestions for improvement, not covered by definite recommendations, be referred to the committees concerned and to Council for further consideration, and the thanks of the Council were extended to Mr. Adams' committee for their services, and to the Niagara Peninsula Branch for their efforts in this matter. The Special Committee on the Publications of The Institute was then discharged.

General Mitchell reported that the committee appointed to study the question of The Institute prizes had met and reviewed the whole situation, and after considerable discussion had come to the conclusion that the five existing prizes of twenty-five dollars awarded to Students and Juniors should remain as at present. They considered it very desirable that these should be continued.

The committee further recommended that a new group of prizes be instituted to be known as "The Engineering Institute of Canada Prizes," and to be offered annually for competition among the registered students in the year prior to the graduating year in the engineering schools and applied science faculties of the following institutions:

University of Alberta
University of British Columbia
Ecole Polytechnique, Montreal
University of Manitoba
McGill University
University of New Brunswick
Nova Scotia Technical College
Queen's University
Royal Military College
University of Saskatchewan
University of Toronto

Each prize should consist of twenty-five dollars, and should be awarded by the university authorities to the student who had proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the students' engineering organization, or in the local branch of a recognized engineering society. The committee's suggestion met with general approval, and the recommendation was unanimously adopted, the Secretary being directed to communicate as soon as possible with the various universities concerned.

The list of nominees for officers for 1931, prepared by the Nominating committee, was presented, and approved by Council. This list will be found elsewhere in this issue of The Journal.

Attention was drawn to the recent change in Section 13 of the By-laws, which becomes effective at the elections of 1931, making the term of office for councillor two years instead of one year. In order to carry out this arrangement it was decided that at the 1931 election one half of the branches entitled to one councillor should elect a councillor for two years, the other half electing their councillor for a one year term. In 1932 the only branches entitled to one councillor which would hold an election would be those electing a councillor for one year only in 1931. In 1932 and thereafter all elections for such branches would be for a two-year term, so that about half the membership of Council would change each year. The Secretary's suggestion that the two and one year terms for 1931 be allocated alternately to the branches across the country was unanimously approved.

Following this action, Mr. Busfield drew attention to the fact that, with the present organization of the Nominating committee, and the recent change in Section 67 of the By-laws providing that the list of nominees for officers shall "contain the names of one or more nominees for each office to be filled," it appeared possible for a single member of the Nominating committee, without consultation with any other person, to submit one name to the Nominating committee for any particular vacancy for councillor or vice-president. This would probably result in the election of the person so named. Council was of the opinion that this matter should be considered, and the president appointed a small committee* to study the matter and bring in recommendations at a later period of the meeting.

*J. L. Busfield, M.E.I.C., Chairman.
W. J. Johnston, A.M.E.I.C.
T. Lees, M.E.I.C.
W. G. Mitchell, M.E.I.C.
R. B. Young, M.E.I.C.

A report was presented from the committee* appointed by Council on May 30th, 1930, to consider recommendations contained in a report to Council from the Ottawa Branch regarding the formation of professional sections, and the affiliation of these sections with engineering societies in other countries. The work of this committee had special reference to the desirability of making provision for the formation of professional sections dealing with aeronautical and radio work. The report recommended the acceptance by Council of the main recommendations received from the Ottawa Branch in May last, but was of the opinion that instead of amending The Institute's by-laws so as to provide for professional sections of The Institute, it would be more advantageous to conform to the existing structure of The Institute by providing for affiliation of technical sections of branches with other engineering societies. The committee recommended the favourable consideration of the arrangements outlined in a draft agreement prepared by the Secretary of The Institute and the Secretary of the Royal Aeronautical Society, which was ready for submission to Council.

The Secretary reported that while Mr. McCrory's report was being prepared, he had, in accordance with Council's instructions, discussed the matter with Group-Captain E. W. Stedman, M.E.I.C., and J. L. Pritchard, the Secretary of the Royal Aeronautical Society, who had visited Canada with a view of ascertaining the possibilities of forming a Canadian section of the Royal Aeronautical Society. As a result of several conferences with Mr. Pritchard, a draft agreement between the Councils of The Engineering Institute of Canada and the Royal Aeronautical Society had been drawn up, copies of which had been submitted to all members of Council for their consideration, and which would be placed before the Council of the Royal Aeronautical Society at their September meeting.

The Secretary pointed out that it had been possible to draw up this proposed agreement in its present form, because the branch organization of the Royal Aeronautical Society was somewhat similar to that of The Engineering Institute. The Society was one of the leading aeronautical engineering societies in the world, and had recently united with the Institution of Aeronautical Engineers; the membership at the present time consisted of members and fellows, the original members of the Institution of Aeronautical Engineers being called members, and the original members of the Aeronautical Society being called fellows. The corporate or technical membership thus included fellows, associate fellows, members and associate members. In addition there were in the local branches many local branch members, not necessarily qualified engineers, who corresponded to our branch affiliates in being members of the branches, but not members of the Society itself.

The Secretary read the draft agreement as submitted to the members of Council, and expressed the hope that the Council would give very careful consideration to this proposal, as the adoption of the policy involved would not only afford an opportunity of affiliation with the Royal Aeronautical Society, but would offer the possibility of similar arrangements with organizations in other specialized branches of engineering. The question of radio engineers had already come up, and a copy of the proposed agreement had been sent to the Secretary of the Institution of Electrical Engineers with a view of ascertaining whether the Council of that Institution would be willing to consider such a proposal in connection with their Wireless section. Professor Malcolm understood that very shortly a communication might be received by the Council of The Institute from the Military Engineers' Institute of Canada with a similar request for co-operation.

Council then proceeded to the consideration of the draft agreement with the Council of the Royal Aeronautical Society, the provisions of which met with general approval, with the exception of section 4, dealing with the officers of an Aeronautical section of a branch of The Institute, which was amended so as to provide that as far as possible an equal number of corporate members of The Engineering Institute of Canada and technical members of the Royal Aeronautical Society should be included.

After further discussion the general principle of forming professional sections of branches rather than professional sections of The Institute, and the advisability of affiliating such professional sections with other engineering societies of high standing and dealing with specialized branches of engineering, was approved, and on the motion of Mr. Busfield, seconded by Mr. Wynne-Roberts, it was unanimously resolved that the report of Mr. McCrory's committee be accepted, and that the proposed draft agreement between The Engineering Institute of Canada and the Royal Aeronautical Society, with section 4 amended as above, be approved. The Secretary was directed to notify the Royal Aeronautical Society of Council's decision in this matter, and it was decided that should proposals be received from other societies for affiliation or co-operation, each application would be considered by Council on its own merits.

George R. MacLeod, M.E.I.C., chairman of the Finance committee, in reviewing the financial situation, pointed out that this year the expenditure and income had been substantially in accordance with the budget, and drew attention to the fact that Council's proposal for an increase in annual fees had been defeated two years in succession. Mr. MacLeod did not believe that The Institute could carry on efficiently its present activities, much less improve the service to members, without additional revenue.

In Mr. Shearwood's opinion the Council should go to the membership again with the same proposal for an increase in the annual fees. The annual fees of other national engineering societies were much higher than those of The Engineering Institute of Canada.

Council was reminded that in December last a resolution had been received from the Hamilton Branch suggesting amendments to certain sections of the By-laws involving changes in members' annual fees, and in the rebate system, with a view to obtaining additional revenue for The Institute. In view of the proposal for an increase in fees being put before the annual meeting by the Council, the Hamilton Branch, at Council's request, had then withdrawn their proposal.

A further communication under date of September 19th, 1930, had now been received from the Hamilton Branch, in which it was stated that in view of the fact that Council's proposals had been lost, the Hamilton Branch now presented, over the signature of twenty-one corporate members, certain amendments to the By-laws intended to give about the same increase as Council's proposals. According to these proposals non-resident fees would be done away with, and Associate Members, after ten years in that class, would be required to pay the same fees as Members, whether or not they transferred to the higher class.

Mr. Darling stated that the proposed amendments now submitted by the Hamilton Branch were the result of very extensive study, particularly on the part of W. F. McLaren, M.E.I.C., past-secretary and past-councillor of the branch, and he hoped that they would receive the careful consideration of Council.

*J. A. McCrory, M.E.I.C., Chairman.
J. E. N. Cauchon, A.M.E.I.C.
P. L. Pratley, M.E.I.C.
L. W. Wynne-Roberts, A.M.E.I.C.

Prolonged discussion took place, and it was the feeling of the meeting that Branch non-residents would strongly object to being required to pay the same fees as those to whom the advantages of Branch membership are available; that it was only fair that Montreal resident members should pay a higher fee than those members who cannot make use, to the same extent, of the facilities of the headquarters' building; and that many Associate Members of over ten years standing might not be eligible for transfer to the class of Member, and could hardly be expected to pay the same fee as Members. The Council was in accord with the proposal increasing the rebates to smaller branches, but as this would involve additional expenditure, it could only be considered after additional funds had become available.

After further discussion, on the motion of Mr. MacLeod, seconded by Mr. Lefebvre, it was unanimously resolved that Council's proposal of last year to amend Section 34 so as to provide for an increase in the annual fees of $3.00 for Members, $2.00 for Associate Members, and $1.00 for Juniors, be submitted for the consideration of the next annual meeting.

The Secretary was directed to convey to the Executive committee of the Hamilton Branch Council's appreciation of the work they had done in connection with the proposals submitted; to give Council's reasons for not being able to agree with their suggestions, and to ask the members signing them if they would be good enough, in view of the fact that Council has decided that the proposals of last year should again be placed before the membership, to withdraw the proposals conveyed in their letter of September 19th, 1930.

Wednesday, September 24th

On the assembly of the Council on Wednesday morning, the president welcomed Past-President H.H. Vaughan, M.E.I.C., and asked him if he would present the report of the sub-committee* of the Committee on the Relations of The Institute with the Provincial Associations of Professional Engineers, of which he was chairman.

Mr. Vaughan explained that the sub-committee had not been able to accomplish very much during the summer months, as Dr. Lefebvre had been away attending the World Power Conference, and he himself had been extremely busy. A meeting of the sub-committee had been held however, and a report had been prepared for the consideration of Council, in the hope that a course of action could be decided upon and proceeded with.

The duty of the sub-committee was "To approach the Provincial Associations and in conjunction with them devise a detailed proposal to bring about a co-ordination of interests and activities of the various professional associations and The Engineering Institute of Canada." This purpose, of course, could only be achieved by co-operation with committees appointed by the several Provincial Associations.

Mr. Vaughan presented the report and explained the views of his sub-committee as embodied therein. They were of opinion that a study of the possibilities in this matter should be made by a committee of members nominated by all of the Provincial Associations and The Engineering Institute, and suggested that this committee should be known as "The National committee." It was felt also that until this National committee could be organized, The Engineering Institute's sub-committee might be permitted to act in making the necessary preliminary arrangements for the mutual interchange of views and suggestions. Members of the National committee had already been nominated by the Provincial Associations of Nova Scotia, New Brunswick, Ontario, Quebec and Manitoba, and he would suggest that the associations which had not already nominated members should be asked to do so. When this had been done, the report proposed that the preparation of an analysis and comparison of the various provincial acts and requirements for admission to membership should be undertaken in so far as they might affect the subject under consideration, and this work, it was thought, could be best done by one man having suitable training, at a cost which they did not think would exceed $500 00. This analysis having been prepared, it was suggested that three members should be selected by the National committee from among its members, representing respectively the Maritime provinces, Ontario and Quebec, and the provinces west of Ontario, these three members to meet and prepare a draft set of by-laws and requirements for membership that could apply to all the Provincial Associations and to The Engineering Institute of Canada. His committee, further, was of the opinion that when this draft had been prepared it should be communicated to all members of the National committee for their criticisms, and when reasonable agreement had been obtained by correspondence, a meeting of the National committee should be held. It was hoped that this meeting might agree on a definite set of draft requirements, which could then be submitted to the Councils of the Provincial Associations and The Engineering Institute of Canada. Several of the Councils of the Professional Associations had already undertaken to contribute towards the cost of all this work.

Discussion followed, during which Dean Mackenzie outlined the principal features of the new Saskatchewan Act, and Professor Faulkner drew attention to the fact that a clause regarding the requirements for admission to the Nova Scotia Association is embodied in the Act itself, and any amendment in this connection would have to go before the Legislature.

After further discussion, the recommendations of the report were unanimously adopted, and the Secretary was directed to forward a copy of the report to the Councils of the various Associations with a covering letter asking for their co-operation along the lines suggested.

The report of the committee appointed to investigate the procedure with regard to the nomination and election of officers was next presented by Mr. Busfield. This report recommended that Council propose an amendment to Section 66 of the By-laws to provide for the following:

1. The appointment each year by Council of a Nominating committee of five members consisting of one member from each of the vice-presidential zones, together with a chairman. The Honorary Councillors shall be ex-officio members of the Nominating committee.
2. The requirement: that the Nominating committee shall obtain recommendations from Branch Executive committees for nominees to the vacancies on the Council, and shall in turn submit to Council the list of nominees for office as under present procedure.
3. That no changes be made regarding such points as members of the Nominating committee not being officers of The Institute, the acceptance of nomination by the nominees, term of office of councillors, provision for independent nominations, method of ballot and so forth.

*J. M. R. Fairbairn, M.E.I.C., Honorary Chairman.
H. H. Vaughan, M.E.I.C., Chairman.
A. R. Decary, M.E.I.C.
O. O. Lefebvre, M.E.I.C.
A. D. LePan, A.M.E.I.C.
George R. MacLeod, M.E.I.C.

Discussion took place as to the difficulty which might arise in connection with the appointment of the zone representatives on the Nominating committee, and Mr. Young considered that it would be better if the members of the last year's Nominating committee were made ineligible for re-appointment to that committee.

After further consideration, it was unanimously resolved that the report of the committee be adopted, provided that the third recommendation be amended by the insertion of the words "nor members of last year's Nominating committee" after the word "Institute." The Secretary was directed to refer this report to the Legislation committee with the request that they prepare the necessary proposal for the amendment of section 66 of the By-laws.

The next subject to be dealt with was that of the membership of The Institute, attention being drawn to a communication addressed to Council last year by W. C. Adams, M.E.I.C., pointing out that an active policy for enrolling new members was being carried out by the American Institute of Electrical Engineers and other similar bodies, and suggesting the advisability of the adoption of similar methods by The Engineering Institute of Canada. The subject had been held over for consideration by the Plenary Meeting.

Prolonged discussion followed, during which it was remarked that this matter had already been brought up at many Council meetings. It was felt that the efforts being made at the universities to induce the student body to join The Institute had not been so effective as might be desired, and that the work and objects of The Institute were not being brought to the attention of the growing number of industrial engineers in the way that they should be.

Mr. Shearwood observed that a great many of the men who were doing engineering work in the industrial organizations throughout the Dominion were not members of The Institute. In most large industrial organizations a great deal of the detailed engineering work, such as designing of details in connection with bridge or structural work, etc., was being done by men who are not college graduates. He thought that more of these positions should be filled by graduate engineers, and believed that in the near future practically all superintendents, chief inspectors, etc., would be college graduates.

Mr. Busfield remarked that the principal object of The Institute was to facilitate the acquirement and interchange of professional knowledge amongst its members. To-day the tendency seemed rather towards making the profession a closed one by making it increasingly difficult for the man who was not a college graduate to get into The Institute. In his opinion, if we wished to facilitate the acquirement and interchange of professional knowledge, we ought to be helping non-graduates to get in, so that thereby we could help them to develop professionally. These were the men who were not in The Engineering Institute to whom Mr. Shearwood had drawn attention. The Institute should be definitely looked upon as an educational body, carrying its members on from the day that they left college.

In working out a scheme of co-ordination with the Professional Associations it might perhaps be arranged to have one class of members of The Engineering Institute confined to men who are licensed to practise, and another class (say of Associate Members) to take care of the men of a less purely professional status whom we should also have in The Institute. The Institute could then be something very much larger and more progressive than at present.

Mr. Lefebvre thought the present meeting afforded an excellent opportunity to obtain expressions of opinion from the different branches which were represented. In his opinion the solution of the membership problem lay in the plan of federation with the Professional Associations, and he was opposed to the admission to The Institute of specialists in certain limited fields who were not fully trained as engineers. He did not think it fair that such men, although experts in their own particular duties, should be admitted to The Institute as corporate members.

Professor Faulkner wondered how many members of The Institute, in interviewing applicants for positions, asked what their standing was in The Engineering Institute of Canada. He thought this practice might bring in additional members.

Mr. Houston thought that the men we should try to get in The Institute were the large number of men who occupy responsible positions, and who are recognized by the public as occupying such positions, and yet who do not belong to The Engineering Institute of Canada. If these men joined The Institute he felt sure that the rank and file would want to come in. There should not be restrictions which keep those men out on account of their education if they have reached a position of responsibility in the profession.

Mr. Bennett felt that the present situation was largely due to a lack of enthusiasm and organized effort on the part of the members of The Institute generally. As in all societies, continuous work was required to maintain and increase the membership of The Institute, and a great deal of this effort must necessarily fall upon the branches. Members of Council could do much to awaken interest in this matter in their branches. He would endeavour to do this, and on his return to Halifax he also intended to propose to the branch executive committee a determined effort to get more students to join.

Mr. MacLeod thought that after this discussion a committee should study the question, and on the motion of Mr. MacLeod, seconded by W. G. Mitchell, M.E.I.C., it was unanimously resolved that a committee be appointed to study the whole question of membership, and bring in a report to Council in time for presentation to the Annual Meeting of The Institute.

The President appointed the following committee: Brig.-Gen. C. H. Mitchell, M.E.I.C., chairman; Messrs. W. C. Adams, M.E.I.C., H. F. Bennett, A.M.E.I.C., C. J. Mackenzie, M.E.I.C., and D. C. Tennant, M.E.I.C., with power to add to their number.

Mr. Bennett drew attention to the fact that it had been the policy of The Institute to have the General Secretary visit as many of the branches as possible each year, and he suggested as a possible alternative that the Council consider the desirability of having each vice-president visit the branches in his zone, the expenses in connection with such visits to be paid by The Institute.

Discussion of this suggestion followed, and it was unanimously resolved that this Council go on record as endorsing the policy of the vice-presidents visiting the branches in their several zones, the Council, if possible, to meet the expenses of such visits.

Attention was drawn to the fact that Professor W. F. McKnight, A.M.E.I.C., who had attended the last Plenary Meeting of Council as the representative of the Halifax Branch, had passed away during the summer, and on the motion of Professor Faulkner, seconded by Mr. Bennett, it was unanimously resolved that this meeting go on record as expressing appreciation of his work in the interest of the profession and deeply regretting the loss sustained by The Institute. The Secretary was directed to send a copy of the resolution to his widow.

On the motion of Dr. Lefebvre, seconded by Mr. MacLeod, it was unanimously resolved that a hearty vote of thanks be extended to the President for the able and dignified manner in which he had presided at all the sessions of this Plenary Meeting.

The meeting then adjourned.

Members of Council at Plenary Meeting.

1. R. L. Dobbin, M.E.I.C.
2. F. P. Shearwood, M.E.I.C.
3. W. P. Near, M.E.I.C.
4. C. H. Scheman, M.E.I.C.
5. L. M. Allan, A.M.E.I.C.
6. W. L. Malcolm, M.E.I.C.
7. C. J. Mackenzie, M.E.I.C.
8. D. A. R. McCannel, M.E.I.C.
9. E. H. Darling, M.E.I.C.
10. A. J. Grant, M.E.I.C.
11. C. H. Mitchell, M.E.I.C.
12. F. R. Faulkner, M.E.I.C.
13. V. C. Blackett, A.M.E.I.C.
14. H. F. Bennett, A.M.E.I.C.
15. T. Lees, M.E.I.C.
16. W. J. Johnston, A.M.E.I.C.
17. J. L. Busfield, M.E.I.C.
18. R. B. Young, M.E.I.C.
19. J. M. H. Cimon, A.M.E.I.C.
20. O. O. Lefebvre, M.E.I.C.
21. J. G. R. Wainwright, A.M.E.I.C.
22. R. J. Durley, M.E.I.C.
23. B. Grandmont, A.M.E.I.C.
24. G. N. Houston, M.E.I.C.
25. J. F. Plow, A.M.E.I.C.

Members of Council present at the Plenary Meeting, but not included in the photograph are:

A. R. Decary, M.E.I.C.
H. H. Vaughan, M.E.I.C.
George R. MacLeod, M.E.I.C.
W. G. Mitchell, M.E.I.C.
F. A. Combe, M.E.I.C.
P. B. Motley, M.E.I.C.
E. Stansfield, M.E.I.C.
H. R. Wake, A.M.E.I.C.
L. W. Wynne-Roberts, A.M.E.I.C.

Meeting of Council

A meeting of Council was held on Friday, October 17th, 1930, at eight o'clock P.M., with Vice-President George R. MacLeod in the chair, and six other members of Council present.

With regard to the publication of Transactions it was noted that the last volume, issued in 1927, had included twelve of the outstanding papers presented during the years 1923, 1924 and 1925. It was decided that the Publication committee of The Institute be asked to review the papers published during the years 1926 to 1930 inclusive, and make a recommendation to Council as to their inclusion in the new volume or volumes of Transactions and as to the arrangements necessary for their publication.

The chairman of the Legislation committee presented a draft of the proposed amendments to Sections 66 and 67 of the By-laws, putting into effect the recommendations approved at the Plenary Meeting of Council regarding the membership of the Nominating committee. These amendments were approved for communication to the membership, and for presentation at the Annual Meeting.

The membership of the Leonard Medal committee, as submitted by the chairman, was approved as follows:

F. W. Gray, M.E.I.C., Chairman
F. D. Adams, Hon. M.E.I.C.
L. H. Cole, M.E.I.C.
S. C. Mifflen, M.E.I.C.
W. S. Wilson, A.M.E.I.C.

The resignation of Professor T. R. Loudon, M.E.I.C., as chairman of the Papers committee of The Institute, was accepted with regret, and it was unanimously resolved that R. B. Young, M.E.I.C., be appointed chairman of this committee, and asked if he would be good enough to carry out the programme which had been suggested at the Plenary Meeting regarding the preparation of papers.

The request of the Executive committee of the Montreal Branch that the dates of the Annual General and General Professional Meeting be changed from Thursday, Friday and Saturday, February 5th, 6th and 7th, 1931, to Wednesday, Thursday and Friday, February 4th, 5th and 6th, 1931, was considered, and it was unanimously resolved that this change in dates be approved. The tentative programme as submitted by the Secretary was approved.

Arrangements were made for the appointment of representatives from The Institute on the Council of the International Federation for Housing and Town Planning.

One resignation was accepted; two reinstatements were effected, and one Life Membership was granted.

A number of applications for admission and transfer were considered, and the following elections and transfers were effected:

Elections		*Transfers*	
Assoc. Members	7	Assoc. Member to Member	2
Juniors	5	Junior to Assoc. Member	8
Students admitted	4	Student to Assoc. Member	3
		Student to Junior	5
		Student to Affiliate	1

The Council rose at ten forty-five P.M.

OBITUARIES

Henry Martyn MacKay, M.E.I.C.

It is with deep regret that we record the death, on October 25th, 1930, of Henry Martyn MacKay, M.E.I.C., Dean of the Faculty of Applied Science and William Scott Professor of Civil Engineering in McGill University, Montreal. Born in Nova Scotia in 1868, he was educated at the Pictou Academy; Dalhousie University, where he graduated in Arts with Honours in 1888, and at McGill University, where he gained the Governor-General's Medal in 1894. Among his other distinctions may be noted the Honorary Degree of LL.D., which he received from Dalhousie University in 1929. On the completion of his university course, he served from 1894 to 1897 as assistant engineer of tidal surveys with Dr. W. Bell Dawson, M.E.I.C., in the Department of Marine and Fisheries, and then spent two years as mathematical master at his old school at Pictou. In 1899 he took up the branch of engineering with which he was to be chiefly identified during

H. M. MacKAY, M.E.I.C.

his professional career, and joined the staff of Waddell and Hedrick, consulting engineers of Kansas City, Missouri. For six years he was engaged in the design and field construction of a large number of important railway and other bridges and railway shops in the United States and Mexico, having charge, also, of many extensive investigations and reports. In 1905 he was invited to return to his old university as assistant professor of civil engineering, becoming associate professor in 1907, and professor in 1908. On the retirement of Dean F. D. Adams, Hon.M.E.I.C., in 1924, he was appointed Dean of the Faculty of Applied Science of McGill University, and all who knew him felt that a worthy successor has been found to that distinguished man of science.

Dr. MacKay joined the Canadian Society of Civil Engineers as a Student in 1894, became Associate Member in 1906, and was transferred to the class of Member in 1913. He served on Council from 1914 to 1916, and while, in later years, pressure of other duties prevented him from taking a very prominent part in the affairs of The Engineering Institute of Canada, he was a frequent contributor to the meetings and discussions. In 1915, jointly with Professor Ernest Brown, M.E.I.C., and C. M. Morssen, M.E.I.C., he was awarded the Gzowski medal for a paper on tests on the shearing resistance of reinforced concrete beams. His other contributions to the publications of The Institute included a report on the Strength of Steel I-beams Haunched with Concrete, based on extensive investigations carried out jointly with the late Professors Peter Gillespie and C. C. Leluau, and published in volume XXXV of the Transactions; a paper on Some Secondary and Impact Effects in Pony Truss Railway Bridges, presented before the Montreal Branch in February 1924 and based on investigations made for the Canadian National Railways, and an illuminating paper on Engineering Education, presented at the Annual General Professional Meeting in Montreal in January 1925.

Dr. MacKay was elected a member of the American Society of Civil Engineers in 1907; he was also a prominent member of the Society for the Promotion of Engineering Education, and the American Society for Testing Materials. He belonged to the Sigma Xi Society, and was president of the Graduates Society of McGill University from 1926 to 1928.

While carrying on his academic duties he found time for a considerable amount of important engineering work, largely in the nature of research. From 1913 to 1918, jointly with Professor E. Brown, M.E.I.C., and J. E. Howard of the United States Bureau of Standards, he directed important laboratory tests made in connection with the construction of the Quebec bridge, comprising investigations on the strengths of large columns and eye-bars, and on the distribution of stress in wide flat plates. His work for the Canadian National Railways, on the determination of secondary stresses in rivetted trusses, was of a remarkable character, and involved difficult experimental work on bridges under actual traffic conditions. In the civil engineering laboratories at McGill University, under his direction, much important work has been done on the strength of rivetted joints, and at the time of his death he was engaged on an investigation on welded joints and the internal stresses in structural members arising from welding. His services on the Board of Advisory Engineers on the Montreal Harbour bridge from 1924 to 1929 will be recalled by all who have had to do with that important structure.

During his term of services as Dean, he undertook an interesting and important inquiry as to the careers of the engineering graduates from the university, the results of which were communicated to the Society for the Promotion of Engineering Education, in the work of which body Dr. MacKay took a very active interest. His professional attainments as a mathematician, structural engineer, and investigator of engineering problems were outstanding. His reputation as an authority on engineering education was equally distinguished. Eminent as a teacher, it was a matter of great regret to past-graduates and to the undergraduate body that, when he became Dean, Dr. MacKay had no longer the same opportunity of taking part in the actual teaching work of the faculty. His loss will be keenly felt, not only by his colleagues and the student body at his university, but also by the many engineers now in active work who were formerly his students, and who owe so much to his teaching, influence and guidance. All who came in contact with him were attracted by his kindly personality, his modesty, his fairness and wisdom as an administrator, and his thorough grasp of his profession, and few who have been at the head of great engineering schools leave behind them a more enduring monument in the affection and memories of their old students.

William Robert Warren, A.M.E.I.C.

Members of The Institute will learn with regret of the death of William Robert Warren, A.M.E.I.C., of Regina, Sask., which occurred at Vancouver, B.C. on September 12th, 1930.

Mr. Warren was born at Taunton, England, on March 25th, 1876, and received a general school education and private tuition in electrical engineering. At the time of his death, Mr. Warren was deputy minister and chief engineer for the Saskatchewan Department of Telephones. His connection with the provincial telephone system of Saskatchewan dates back to August 1908, when he was appointed engineer of the system. In 1912 Mr. Warren was promoted to chief engineer and in this capacity was in charge of construction, maintenance and operation until 1927, when he was appointed deputy minister and chief engineer. Prior to going to Saskatchewan, Mr. Warren was local superintendent in charge of construction, maintenance and operation of the telephone system in Winnipeg, Man. He was an Associate Member of the Institution of Electrical Engineers.

Mr. Warren became an Associate Member of The Institute on May 21st, 1918, and took a keen interest in Institute affairs, acting as Chairman of the Saskatchewan Branch in 1921.

Arthur Lees Mellor, A.M.E.I.C.

Regret is expressed in recording the death of Arthur Lees Mellor, A.M.E.I.C., which occurred in September, 1930, at Montreal, Que.

Mr. Mellor was born at Stalybridge, Cheshire, England, on October 24th, 1877, and received his education at Rossall School, Fleetwood, Lancs. From 1899 to 1926, Mr. Mellor was in the employ of Messrs. G. H. Hill and Sons, at Manchester, England, first as a pupil, and later as assistant on their staff. From 1920 to 1926 he was resident engineer for the company on the construction of an impounding reservoir with a capacity of 210,000,000 gallons with subsidiary works for the Stalybridge and Dukinfield (District) Joint Water Board. In 1927 Mr. Mellor came to Canada and was for a time engaged by the Milton Hersey Company, Ltd., Montreal, on the construction of the Montreal Harbour bridge.

Mr. Mellor joined The Institute as an Associate Member on May 18th, 1928.

Percy Edward Hart, M.E.I.C.

Deep regret is expressed in recording the death of Percy Edward Hart, M.E.I.C., which occurred at Toronto, Ont., on September 12th, 1930. Mr. Hart was born at Turnchapel, near Plymouth, England, on January 9th, 1870, and received his early education in the School of Science, Cardiff, Wales.

He came to Canada in 1888, and in 1889 took charge of the plant of the Brandon Electric Light Company, Brandon, Man. In 1891 Mr. Hart joined the Edison General Electric Company, later the Canadian General Electric Company, and from 1893 to 1895 was superintendent of construction for the Maritime Provinces for this company, with headquarters at Halifax, N.S. In 1895 he was appointed special expert on heavy installations for the same company, and in 1901 he was transferred to the head office of the Canadian General Electric Company, where he was in charge of contracts and later chief estimating engineer in the contract and sales department. In 1913 Mr. Hart joined the staff of the Toronto Hydro-Electric System as electrical engineer, he was later appointed managing engineer and finally, chief engineer, the position he occupied at the time of his death.

Mr. Hart was a Fellow of the American Institute of Electrical Engineers, and a registered professional engineer of Ontario. He was also a member of the Engineers' Club of Toronto.

He joined The Institute as a Member on October 22nd, 1918.

PERSONALS

Percy G. Delgado, A.M.E.I.C., for the past sixteen years assistant city engineer of the city of Westmount, Que., has been appointed city engineer of that municipality.

Ross White, M.E.I.C., formerly superintendent of the Alcoa Power Company, Ltd., Kenogami, Que., is now with the Dominion Construction Company, Ltd., at Fraserdale, Ont..

Hugh C. Ritchie, A.M.E.I.C., has been appointed city engineer of Moose Jaw, Sask. Mr. Ritchie, who was formerly city engineer of Medicine Hat, Alta., is a graduate of the School of Practical Science, University of Toronto, of the year 1910.

T. V. McCarthy, A.M.E.I.C., is now with the Dominion Construction Company, Ltd., at Abitibi Canyon, Ont. Mr. McCarthy who was formerly with H. G. Acres and Company Ltd., was at one time assistant laboratory engineer with the Hydro-Electric Power Commission of Ontario.

J. B. Barnum, A.M.E.I.C., has joined the staff of the Beauharnois Power Corporation, Beauharnois, Que. as field engineer. Mr. Barnum was formerly with the Gatineau Power Company, Ottawa. He has at various times been connected with the Foundation Company of Canada and the Riordon Pulp Corporation.

Gordon Mitchell, A.M.E.I.C., formerly superintendent of construction with the Hydro-Electric Power Commission of Ontario, at Nipigon, Ont., is at present with the Dominion Construction Company at Fraserdale, Ont. Mr. Mitchell was at one time resident engineer for the Spruce Falls Power and Paper Company at Smokey Falls, Ont.

C. W. Justice, Jr.E.I.C., is at present engaged as electrical demonstrator at the University of Manitoba, Winnipeg, Man. Mr. Justice graduated from the University of Manitoba, with the degree of B.Sc., in 1926, following which he took a test course with the Canadian General Electric Company. Prior to accepting his present appointment, Mr. Justice was in the engineering department of the Canadian General Electric Company at Peterborough, Ont.

C. S. MacLean, A.M.E.I.C., is employed in teaching technical subjects by the school board of the city of Calgary, Alta. Mr. MacLean, who is a graduate of the University of New Brunswick of the year 1913, was formerly engaged on general mechanical engineering in connection with the design and manufacture of valves and specialties and sulphite pulp mill apparatus, with T. McAvity and Sons, Ltd., Saint John, N.B.

F. Gordon Green, A.M.E.I.C., is now assistant to the chemical director of International Combustion Tar and Chemical Corporation, New York. Following graduation from McGill University in 1921 with the degree of B.Sc., Mr. Green was with the D'Arcy Exploration Company, Wallace process oil shale plant (experimental) at Rosevale, N.B., first as chief chemist and later as plant superintendent. In 1922 he became connected with the N-Y-U Company, at Santa Maria, California, as superintendent on standardizing operation of twenty-ton experimental plant (oil shales) construction and operation of forty ton unit.

P. E. Jarman, A.M.E.I.C., has been appointed general manager of the city of Westmount, Que. Mr. Jarman, who is of English birth, came to this country as a youth, and from 1904 to 1906 was inspector of structural steel work for the Dominion Bridge Company. From 1906 to 1908 he was assistant town engineer of the town of Outremont, Que. In 1908 Mr. Jarman joined the staff of the city of Westmount as assistant city engineer, being appointed city engineer in June 1913.

A. N. Ball, A.M.E.I.C., has accepted a position with the McIntyre Porcupine Mines, at Timmins, Ont. Mr. Ball, who was formerly in the engineering department of Fraser Companies Ltd., at Edmundston, N.B., is a graduate of Queen's University of the year 1914. In 1919 he was engineer and surveyor with the Parson Engineering Company, in 1926 he was with the St. Lawrence Paper Mills Ltd. at Three Rivers, Que., and in 1927 Mr. Ball was connected with Morrow and Beatty at Kapuskasing, Ont.

D. Simpkin, Jr.E.I.C. has returned to Tocopilla, Chile, as construction foreman with the Anglo-Chilean Consolidated Nitrate Corporation. Following his graduation from the University of Alberta in 1922 with the degree of B.Sc., Mr. Simpkin became a steel detailer with the Bethlehem Steel Company at Buffalo, N.Y. and in 1923 held the same position with the McClintic Marshall Construction Company in Pittsburgh, Pa. In June 1923 he went to Chile as structural draughtsman with the Braden Company, and in 1925 he joined the staff of the Anglo-Chilean Consolidated Nitrate Corporation at Tocopilla, Chile, as steel and concrete designer. In 1929 Mr. Simpkin returned to Canada and joined the staff of the Horne Copper Corporation at Noranda, Que.

S. E. McColl, A.M.E.I.C., of McColl Brothers, Winnipeg, Man., has been appointed Director of Surveys by the Manitoba government. Mr. McColl will head a new engineering division operating under the Department of Mines and Natural Resources of the Dominion. Among the important matters to be undertaken by Mr. McColl are the construction of the town of Churchill, Man., the setting aside of mining areas in the north and areas destined to be public shooting reserves and the handling of fur-ranching territory. Mr. McColl is a graduate of the University of Manitoba of the year 1907. He secured his commission as a Manitoba Land Surveyor in 1909, and that as Dominion Land Surveyor in 1911. He has been a member of the firm of McColl Brothers, surveyors and engineers, since 1912.

L. L. Bolton, M.E.I.C., assistant deputy minister of the Department of Mines, Ottawa, Ont., has been appointed as acting chairman of the Dominion Fuel Board. Following his graduation from Queen's University in 1906 with the degree of B.Sc., Mr. Bolton was student assistant with Dr. R. W. Brock, M.E.I.C., engaged in studying for the Geological Survey the economic geology of Rossland mining camp. From 1907 to 1914 he was employed by the mines department of the Lake Superior Corporation as geologist and utility engineer, and from 1915 to the present time Mr. Bolton has been in the service of the Federal Department of Mines. In 1915 he was assistant mining engineer in the division of Mineral Resources and Statistics, Mines Branch, and there assisted in the compilation of "Iron Ore Occurrences of Canada." In 1916 Mr. Bolton was transferred to the office of the Deputy Minister as private secretary, the work of the office growing to such an extent that in 1919 his position was designated as secretary, Department of Mines. In April 1925 he was appointed assistant deputy minister.

F. S. B. Heward, M.E.I.C., forms New Company

F. S. B. Heward, M.E.I.C., recently resigned his position as president and general manager of Affiliated Engineering

F. S. B. HEWARD, M.E.I.C.

Companies, Ltd., Montreal, and has formed F. S. B. Heward and Company, Ltd., Montreal, for the purpose of carrying on in Canada the sale, service and installation of engineering products. Mr. Heward graduated from McGill University in 1912, with the degree of B.Sc., and subsequently became manager in the United States and Canada of James Howden and Company Ltd., manufacturers of steam turbines, condensing plant, high-speed engines, etc. In 1918 he became director and works manager of James Howden and Company of America, Inc., and later was also director of Combustion Engineering Corporation, Ltd.

W. H. Greene, M.E.I.C., formerly with the Canada Creosoting Company at Edmonton, Alta. is at present with the Alberta Wood Preserving Company, and is located at Calgary, Alta. Mr. Greene was for a number of years assistant city engineer of Moose Jaw, Sask. He is a graduate of the University of Toronto, having received his degree in 1909, following which he joined the staff of the Teton County Co-operative Irrigation Company as district engineer on irrigation construction in Montana, U.S.A. In 1910 he was appointed by the Department of the Interior as engineer-in-charge of a party investigating the Moose Jaw river as a source of water supply for the city of Moose Jaw, and in the following year carried out, for the same department, an investigation of stream-flow under ice cover in southern Alberta. In 1912 Mr. Greene received his appointment as assistant city engineer of Moose Jaw, and in 1921 was made superintendent of waterworks and building inspector in addition to his duties as assistant city engineer.

The Dunham-built Dwyer unit heater made in Canada by C. A. Dunham Company, Ltd. is gaining wide acceptance in industrial heating. This type of heater is manufactured in four sizes with normal heat output capacities ranging from 50,000 to 272,000 b.t.u.'s per hour. A large air delivery, two-speed motor, and replaceable tube construction are features.

Frick Company, Incorporated. Waynesboro, Pa. announce the publication of bulletin No. 198-A, entitled "Ice and Frost," which describes and illustrates modern indoor ice-skating rinks. Copies of this bulletin are obtainable from the offices of the company upon request.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 22nd, 1930, the following elections and transfers were effected:

Member

STAIRS, Denis, B.E., (Dalhousie Univ.), chief engr., Montreal Engineering Company, 244 St. James Street, Montreal, Que.

Associate Members

ANDERSON, Yngve Ragnald, B.E., (Univ. of Sask.), ceramic engr. and plant manager, International Clay Products, Ltd., Prince Albert, Sask.

ASHFORD, Arthur George, bridge dept., C.P.R., Montreal.

ELLIS, Norman Thomas, Major, M.C., res. engr., Thomsen & Clark Timber Co., Bowser P.O., Vancouver Island, B.C.

FYFE, Robert John, (Univ. of Sask.), managing director, R. J. Fyfe Ltd., 200 Broder Building, Regina, Sask.

VICKERS, Harold, (Liverpool Univ.), dftsman., Consolidated Mining & Smelting Company, Trail, B.C.

WALLACE, David Gemmell, B.Sc., (Glasgow Univ.), designing engr., Dominion Bridge Company, Limited, Montreal, Que.

Juniors

ANDREWES, William Edward, B.Sc., (McGill Univ.), Lieut., Royal Canadian Engineers, Halifax, N.S.

DURNIN, Edward James, B.Sc., (Univ. of Man.), Saskatchewan Power Commission, Regina, Sask.

MacCARTHY, Henry Blair, B.Sc., (McGill Univ.), 110 Lisgar Street, Ottawa, Ont.

MACLEOD, Ernest M., B.Sc., (N.S. Tech. Coll.), control wireman, Shawinigan Engineering Company, Grand Mere, Que.

PYLE, John (Grad., Inst.M.E.), works manager, Thornycroft (Canada) Limited, Montreal, Que.

RAMSTAD, Ivar Asbjoern, C.E., (Tech. Univ. Norway), dftsman., Shawinigan Engineering Company, St. Michel des Saints, Que.

Transferred from the class of Junior to that of Associate Member

BISSELL, Harold Rudolph, B.Sc., M.Sc., (McGill Univ.), manager, Stirling Mines Ltd., c/o The British Metal Corporation, Stirling, N.S.

CHISHOLM, Joseph Donald, B.Sc., (McGill Univ.), Sales engr., Harland Engineering Company, Ltd., Montreal, Que.

HUGHES, Chester Arthur, B.A.Sc., M.A.Sc., (Univ. of Toronto), asst. prof. of structural engrg., University of Minnesota, Minneapolis, Minn.

JOHNSTON, Clifford Milton, B.Sc., (Queen's Univ.), vice-pres. and sec.-treas., Welch & Johnston Ltd., Ottawa, Ont.

McMULKIN, A. Frank, (Mt. Allison Univ.), asst. engr., Montreal Terminal Development, C.N.R., Montreal, Que.

RICHARDSON, Roderick McDougald, B.Sc., (McGill Univ.), divn. constrn. supt., Eastern Ontario Divn., Bell Telephone Company of Canada, Ottawa, Ont.

STILES, Raymond Donald, B.Sc., (N.S. Tech. Coll.), asst. engr., transformer section, General Electric Company, Lynn, Mass.

WELCH, Henry R., B.Sc., (Queen's Univ.), pres., Welch & Johnston Ltd., Ottawa, Ont.

Transferred from the class of Student to that of Associate Member

BASTABLE, Ross Waller, B.Sc., (McGill Univ.), supervisor of bldgs., eastern area, Bell Telephone Company of Canada, Montreal, Que.

BOWN, William Edmund, B.Sc., (McGill Univ.), asst. supt., coke oven dept., Dominion Iron & Steel Company, Ltd., Sydney, N.S.

McINTOSH, James Harrington, B.A.Sc., (Univ. of Toronto), asst. works mgr., British Columbia Cement Co. Ltd., Bamberton, Tod Inlet, B.C.

Transferred from the class of Student to that of Junior

GILMOUR, William Alexander Turner, B.Sc. (Mech.), B.Sc. (Elec.), (McGill Univ.), chief dftsman and engr., The Smart Turner Machine Company, Ltd., Hamilton, Ont.

LYONS, Gerald Stanley, B.Sc., (Queen's Univ.), toll cable engr., Quebec Divn. Plant, Bell Telephone Company of Canada, Montreal, Que.

POUND, William Thomas, B.Sc., (Queen's Univ.), Ontario Paper Company, Thorold, Ont.

ROCHESTER, Bertram Cole, B.Sc., (McGill Univ.), head of eastern sales, McCarthy & Robinson, 821 Castle Building, Montreal, Que.

At the meeting of Council held on October 17th, 1930, the following elections and transfers were effected:

Associate Members

ARVESEN, Ragner Woll, (Grad., Porsgrund Tech. Coll.), designer, Abitibi Power & Paper Co., Sault Ste Marie, Ont.

BARTLETT, Oswald Willoughby, B.Sc., (Univ. of London), A.C.G.I., asst. elect'l. engr., Fraser Brace Engineering Co. Ltd., Montreal, Que.

BERLYN, Martin John, M.A. (Hons. Mech. Sci. Tripos), (Cambridge Univ.), on technical staff, hydraulic dept., Dominion Engineering Works, Lachine, Que.

DELGADO, Percy George, asst. city engr., City of Westmount, Que.

FEETHAM, Luke Bernard, B.Sc., (N.S. Tech. Coll.), asst. engr., Halifax Harbour Commission, Halifax, N.S.

MATHEWS, Henry Mends, (Diploma, Faraday House Elect'l. Engrg. Coll.), Canadian representative, Messrs. Merz & Partners, Montreal, Que.

PORTER, William Thompson, asst. mech'l. engr., Welland Ship Canal, St. Catharines, Ont.

Juniors

ANDERSON, William Galloway Macdonald, engrg. dept., Price Bros. & Co. Ltd., Quebec, Que.

de CHAZAL, Philippe, instr'man., Shawinigan Engineering Company, Montreal, Que.

MOULD, John, B.E., (Univ. of Sask.), res. engr., Dept. of Highways, Prince Albert, Sask.

SIMMONS, William Raymond, B.A.Sc., (Univ. of Toronto), elect'l. engrg. dept., Montreal Tramways Company, Montreal.

STENDAL, Lars, C.E., (Tech. Inst. of Norway), reinforced concrete and structural steel designing dftsman., Power Engineering Company, Montreal, Que.

Transferred from the class of Associate Member to that of Member

KNIGHT, James A., B.A.Sc., (Univ. of Toronto), designing engr., Beauharnois Construction Company, Beauharnois, Que.

WEST, Arthur Elemere, operating manager, Canadian Bridge Co. Ltd., Walkerville, Ont.

Transferred from the class of Junior to that of Associate Member

BUDDEN, Arthur Napier, B.Sc. (Mech.), B.Sc. (Elec.), (McGill Univ.), supt., Laurentide power house, Shawinigan Water & Power Company, Grand Mere, Que.

COOIL, Thomas Reginald, B.Sc., (Univ. of Sask.), city engr., North Battleford, Sask.

DeLONG, Robert Keys, division engr's. office, C.N.R., Moncton, N.B.

DICK, Victor William, B.Sc., (Univ. of Man.), elect'l. designer, Northwestern Power Co. Ltd., Winnipeg, Man.

MAXWELL, Edward Gerrard, B.Sc., (McGill Univ.), plant efficiency engr., Pittsburgh Plate Glass Co., Creighton, Pa.

OAKS, Harold Anthony, B.A.Sc., (Univ. of Toronto), director of aerial operations and asst. gen. mgr., Northern Aerial Minerals Exploration Ltd., Toronto, Ont.

POOLE, John Maurice, dfting. and outside engrg. work, Halifax Harbour Commission, Halifax, N.S.

ROSS, Malcolm Vaughan, B.Sc., (McGill Univ.), asst., elect'l. dept., Brown Corporation pulp mill at LaTuque, Que.

Transferred from the class of Student to that of Associate Member

CHADWICK, Austin Ralph, B.A.Sc., (Univ. of Toronto), manager and director, Construction Equipment Co. Ltd., Montreal, Que.

CHAMPION, Cecil Hugh, B.Sc., (McGill Univ.), i/c mech'l. dept., Price Bros. & Co. Ltd., Kenogami, Que.

MUELLER, Emil Karl, B.A.Sc., (Univ. of Toronto), district plant engr., central northern divn., Bell Telephone Company of Canada, Toronto, Ont.

Transferred from the class of Student to that of Junior

DAVIS, George Roland, B.Sc., (Queen's Univ.), asst. dist. meter and relay engr., H.E.P.C. of Ontario, Smiths Falls, Ont.

FOX, John H., B.A.Sc., (Univ. of Toronto), asst. engr., C. A. Dunham Co. Ltd., Toronto, Ont.

KYLE, John Sheridan, B.Sc., (Univ. of Alta.), elect'l engr., C.N.R., Toronto, Ont.

McKILLOP, Douglas Bruce, B.Sc., (Queen's Univ.), res. engr., bridge engr's. dept., C.N.R., Carnduff, Sask.

McMILLAN, Ralph Edwin, B.Sc., (McGill Univ.), elect'l. designer, Fraser Brace Engineering Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Affiliate

THOMPSON, Frank Blashford, manager, technical and trade papers divn., Ronalds Advertising Agency, Ltd., Montreal, Que.

Students Admitted

BURNS, Edward Thompson, B.A.Sc., (Univ. of Toronto), student test course, Canadian General Electric Co. Ltd., Peterborough, Ont.

GROSSMAN, Ralph, electrician, Angus shops, C.P.R., Montreal, Que.

LANCTOT, Guy, (Undergrad., Ecole Polytech.), 1908 Van Horne Ave., Montreal, Que.

SWARTZMAN, Lewis, (Undergrad., Univ. of Man.), 381 Selkirk Ave., Winnipeg, Man.

Reinforced Concrete Bridge at Plougastel, France

Figure No. 1.—Condition of bridge nearly completed, in June 1930.

Figure No. 2.—The timber centring, originally built on shore, having been used for the first arch, has been lowered on to barges and is being moved to the site of the centre arch. In the background can be seen the pre-cast pier tops to which the centring will be secured.

The Plougastel Bridge

This remarkable reinforced concrete arch bridge is situated six kilometres east of Brest and has recently been completed. It carries a 26-foot roadway on the upper deck, with a single track railway on a lower deck, and crosses the estuary of the River Elorn, where the tidal range is 26 feet. It consists of three arches, each 610 feet centre to centre of piers; the vertical clearance is 118 feet, and the bridge has a total length of 2,887 feet. These are the largest concrete arches yet undertaken, and their construction involved many novel and ingenious features.

The arch section consists of an upper and lower slab 31.1 feet wide, connected by four vertical walls, the maximum thickness of which at the abutments is about three feet. Internal tension resulting from permanent shortening was relieved by the use of jacks placed in a niche in the arch crown. A small amount of steel reinforcement was used to take care of secondary stresses. The arches were designed for a total maximum stress of 1,000 lbs. per square inch, and were built by the use of a timber centring with reinforced concrete ends, which was floated into place, lifted into position by jacks on the piers, and secured to the pier tops, being afterwards removed and used for the next arch.

The two land abutments were constructed in circular reinforced concrete cofferdams. The two river piers were built by the use of a concrete caisson, employed as a diving bell for founding the first pier in shallow water, and then floated off and used as a pneumatic caisson for the second pier. The pier tops, forming the lower parts of the arches, were precast on shore, floated out, and attached to the pier shafts. Where the piers are exposed to tidal range, alumina cement was employed.

For handling materials to the arches and for unloading barges, etc., two cableways were used, each 250 feet above low water, and 2,260 feet span, suspended from timber towers.

The accompanying photographs are reproduced through the courtesy of "L'Illustration."

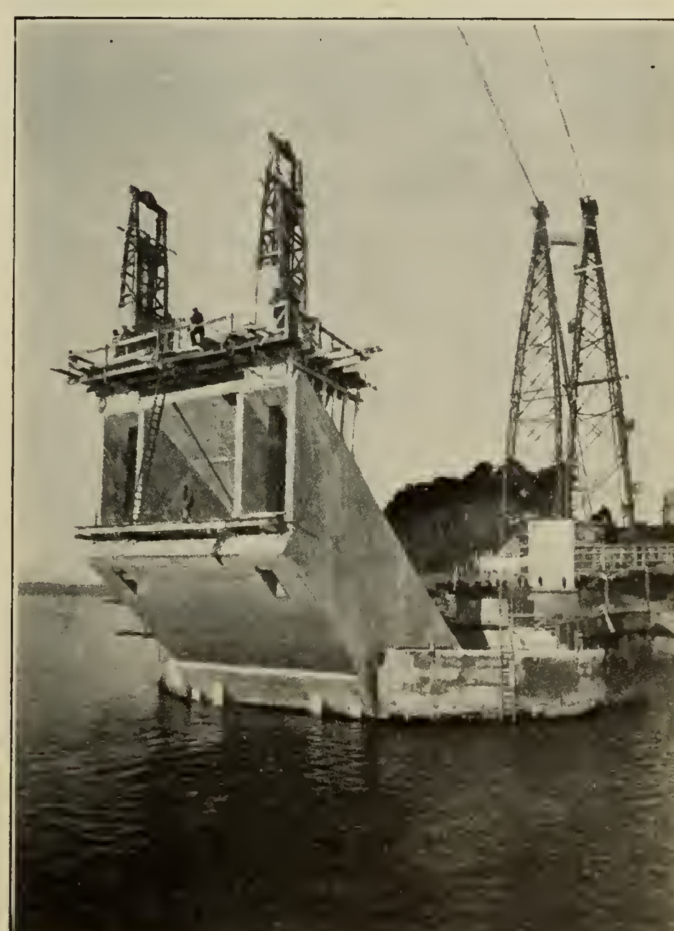

Figure No. 3.—Brest abutment ready to receive the centring and showing cross section of arch.

BOOK REVIEW

Bearing Metals and Bearings

(American Chemical Society Monograph Series.)

By W. M. Corse. Chemical Catalog Company, Inc., New York, 1930, cloth, 6 x 9 in., 383 pp., tables, $7.00.

The book is divided into four parts, viz., part I, History; part II, Bibliography, with Literature References from 1900 to 1928, inclusive; part III, Abstracts of Selected Papers; and part IV, Tables Showing Properties of Bearing Metals.

Part I, dealing with history, is clearly written and gives in a condensed form an excellent idea of the subject of bearing metals and bearings.

The bibliography contained in part II is very complete and is written in a manner that makes it a matter of easy reference.

The abstracts of selected papers, forming part III of the book, comprise perhaps its most valuable section. These have evidently been written by a man well versed in the science, who is, therefore, able to give the essential features of the papers, so that they are really of practical value to the reader without necessitating his securing the paper itself. Further, this also means that one has sufficient knowledge of the paper to avoid the necessity of searching out a number of papers only to find that they do not contain the details expected.

Part IV, giving tables showing properties of bearing metals, brings together within the limits of a few pages a mass of valuable data, much of which have not been previously available in any one publication.

From personal knowledge, covering an experience of some twenty-five years, the reviewer realizes that the book is up to date, and takes into consideration the most recent bearing metal alloys.

The author index and subject index are adequate and of practical value.

If there were more monographs of this nature they would be much appreciated, particularly by technologists in the various metal plants of the world.

Harold J. Roast, *General Manager,*
National Bronze Company, Limited, Montreal.

CORRESPONDENCE

Engineering Education

October 1, 1930.

To the Editor of The Engineering Journal.

Dear Sir:

In your September issue I have read with deep interest your "Abstracts of the Seven Papers Submitted for the Past-Presidents' Prize of 1929," on the subject of "Engineering Education"; and beg to register respectfully my approval of not only the action of the past-presidents in establishing such an annual competition, but also in the choice of the topic for last year.

For nearly half a century I have been writing periodically on technical education; and for several years past I have served (and am still serving) as the chairman of the committee on Engineering Education for the American Association of Engineers. For these reasons I am taking the liberty of sending you this letter, and discussing therein some of the opinions of the aforesaid seven writers on certain salient points in technical education. With most of these opinions I heartily agree; but there are some to which I shall have to take exception.

My discourse will be divided into the following headings:

A. Chief weaknesses in engineering education.
B. Teachers of technical students.
C. Preliminary training and entrance requirements.
D. Scholarships and loan-funds.
E. Layout of the curriculum.
F. Teaching methods.
G. Post-graduate study.

Before beginning my dissertation, it might be well for me to state why I feel qualified to pass judgment on matters of technical education. My reasons are these:

First. When I was a young man, I taught engineering for six years, all told, two at Rensselaer, my alma mater, as assistant in "Rational and Technical Mechanics," and four in the Imperial University of Japan at Tokyo, where I occupied the chair of Civil Engineering.

Second. I am a charter member of the Society for the Promotion of Engineering Education; and, ever since its inauguration, I have taken part in its functioning.

Third. Last year at Shanghai, when acting as Technical Advisor to the National Government of China, one of my numerous duties was laying out and inaugurating for Nanyang University, the principal technical school of the republic, a new, practical course in civil engineering—also the supervision for a few months of its running with the aid of two young men imported specially for the purpose from my New York office.

Chief Weaknesses in Engineering Education

In February, 1926, I delivered an address to a joint meeting of the departments of Civil Engineering of Lafayette College and Lehigh University and the Lehigh section of the American Society of Civil Engineers, entitled "In What and Why Does Engineering Education Fail to Attain Its Greatest Possibilities?";* and in it I listed the principal shortcomings, as follows:

A. Graduating many men who are lacking in breadth or vision, or, in slang parlance, who are narrow-gauge—also some who are absolutely unfit for engineering practice.
B. Failure to train students adequately in the use of their mother tongue—in both writing and speaking.
C. Neglecting to inculcate in the young men the principles of neatness, accuracy, and system.
D. Omitting to provide adequate instruction in economic subjects, especially engineering economics.
E. Allowing men to graduate who are incapable of doing satisfactory drafting, lettering or tracing.
F. Turning out graduates who are utterly ignorant of the first principles of business, accounting and auditing.
G. Omission of instruction in the elements of architecture and in esthetics of design.
H. Ignoring the necessity of teaching students how to make freehand drawings approximately to scale and how to do field sketching—as it is taught to army engineers.
I. Neglecting to instruct students concerning engineering as a profession, the ground it covers, its history, its importance to humanity, its ethics and the names and lives of its great leaders.
J. Permitting the wasting of too much of the students' valuable time on outside activities.

Concerning this matter of shortcomings, the author of paper No. 2 says:

"The chief weakness of engineering education is the lack of relation in the student's mind of things read or heard, or supposedly learned, to practical work.

"There is a lack of connection between school studies and the daily life and work of the engineer. Some engineering executives, who have achieved great material success, have become almost obsessed with the unpracticability of college education."

Teachers of Technical Students

To the preceding reasons for weaknesses in engineering education might be added the employment of young, inexperienced, and inefficient teachers, mainly because of the low salaries they are willing to accept, and the retention, through either misplaced sympathy or sheer force of habit, of old, fossilized instructors. Such men, through their lazy habits, inefficiency and indifference, do an untold amount of injury to the young minds entrusted to them for training. If such men were allowed to work without any salary whatsoever, they would by no means be an economic asset to the institution; because the harm they do by their bad example to the students much more than offsets the apparent value of their labour as instructors.

In general, it may be stated that a good teacher is born—not made, and that unless a man has in him the faculty of communicating his knowledge to others, *and really loves to do so*, he should not attempt teaching as a career or even as a means of tiding over a spell of bad times.

If the salaries of all the really good technical teachers of North America were doubled, and if all the poor ones there were discharged, a strikingly great advance in engineering education would result; but, to secure the maximum of benefit, this policy should be applied also to the instructors in the preparatory schools.

The author of paper No. 1 very tersely remarks that:

"The greatest difficulty in organizing engineering education is in providing teachers who will command respect, enforce discipline, inspire a love of study, and train the students to be seekers after knowledge."

This statement condenses the matter into a nutshell.

The same author says:

"If the teachers in our technical schools spend part of their lives in outside work, it will enable them to be more independent, to command higher salaries, and be worth more in particular as educators."

This is certainly true, and the doing of outside practice by engineering teachers should be made obligatory; but the amount of time spent thereon should have a reasonable limit, for otherwise their scholastic work would be neglected. Some years ago I was consulted by an eminent engineering professor as to how much time should be devoted to outside practice. My reply was "Either one-quarter of the scholastic year plus all vacations, or, preferably, one-third of the scholastic year plus two-thirds of the total vacation time."

*Reproduced in "Memoirs and Addresses of Two Decades," a book edited lately by Frank W. Skinner, consulting engineer, and published by The Mack Printing Company of Easton, Pa.

The author of paper No. 4 says:

"Too many teachers are graduates of the institution they serve, with limited knowledge and experience. No one should be permitted to teach in a school from which he has graduated, until he has spent an apprenticeship in teaching elsewhere. No one should be allowed to serve as an engineering teacher who has not had some years of practical experience. The Scottish practice, whereby assistant professors have greater chances of advancement by transferring to other colleges, is recommended."

This is truly-sound doctrine; and I have been advocating it both orally and in print for nearly half a century. The practice of taking into the faculty members of the graduating class, which custom is far too common, is most reprehensible. In my opinion, no one who has not had at the very least three years of practical experience in office and field should be allowed to teach, even in a minor capacity, in any engineering school; and the professors should have at the very least five full years of such practical experience. The young instructors can secure thereof about three months per annum by doing outside practical work during vacation time.

It is the opinion of many deep-thinking persons that inbreeding in the faculties of schools is just as pernicious in its results as it is among both humans and animals. For all of fifty years I have vigorously opposed such inbreeding in our technical institutions of learning.

There is a winked-at custom that I desire again to condemn, viz., that of professors utilizing the services of their students to aid them in doing their outside engineering work—on the plea that such experience is valuable to the young men. It certainly has some value, but not by any means enough to compensate for the time thus taken from their scholastic work. This restriction applies also to research work done by the professors; for, while the making of scientific and industrial investigations is good for both the professors and the school, and also indirectly for the undergraduates, in that they can see it going on and are told of its value by the faculty, it is only post-graduate students who should be called upon for assistance therein. There are two sound reasons for this—the undergraduates cannot spare the time, and they are not skillful enough, while the post-graduates have the requisite leisure and are more highly educated and better trained in practical matters.

The author of paper No. 7 says:

"Engineering professors should attend engineering-society annual meetings as the representatives of their university, the expenses to be provided for annually in the budget of the university."

This statement I most heartily endorse, and specially in respect to the meetings of the Society for the Promotion of Engineering Education.

Technical institutes should encourage their young professors to attend the "Summer School for Engineering Teachers," established a few years ago by the Society for the Promotion of Engineering Education; and, in the case of impecunious young men, should aid in defraying the expenses involved—at least to the extent of caring for tuition and railroad fares. That school, if well managed, should accomplish a vast amount of good in the development of technical teaching, and consequently should greatly benefit the entire engineering profession. On this matter I can speak with some authority; for last July, at Yale University, I lectured on "Bridge Economics" to the said school.

Preliminary Training and Entrance Requirements

The author of paper No. 1 says:

"It is desirable to weed out of the technical school and university the unfitted, the uninterested and the indifferent students."

If this could be done, it would be a god-send to all concerned; because the slow students usually set the pace for the entire class, thus holding back the brilliant ones and lowering the grade of the graduating output. Again, much money is wasted in the endeavour to train the unfit, which money could be spent to advantage on the better instruction of high-class students. Another good reason for rejecting unfit applicants for admission is that flunk-outs, during their entire lives, are apt to be overshadowed by the depressing sense of failure, and, in consequence, are discouraged from putting forth their best efforts. Some of such rejects might have proved quite successful in other lines of endeavour, or even in some of the minor lines of engineering, if they had had a good course in a trade-school or some similar institution of practical technics.

The author of paper No. 4 says:

"A suggestion is made that a psychological or intelligence test and a personal interview might be useful in determining whether or not a prospective student should take an engineering course."

The suggestion is valid; and the said test should be universally applied. Some claim that it is unfair to a young man to prevent him from trying to obtain an education for which he is willing to pay; but such a view of the matter is most decidedly wrong; because it is not the welfare of the individual that is to be considered, but that of the entire class and of the engineering profession—moreover, the young man would be paying for only a small portion of his education, the remainder being the gift of the institution. The sooner this psychology test is universally established, the better will it be for technical education, for the advancement of the engineering profession, and for the general welfare of the world, because the material progress of mankind is dependent primarily upon the engineers.

The author of paper No. 5 says:

"More attention should be given to the student during school and high-school days with departments or agencies to advise with parents and children regarding suitable careers for the young student."

This remark is directly in line with the policy of the American Association of Engineers, which, two or three years ago, started, through its "Engineering Education committee," the preparation of a book on "Vocational Guidance in Engineering Lines," to be written by a number of high technical authorities and edited by that committee. Some work was done by myself as chairman thereof, but the rest of the committee failed to function; and late in 1928 I was called to China for a year's service, hence the matter was temporarily dropped, but I am now trying to make arrangements for its resumption under better conditions. The object in view is to issue a very low-priced book on the subject for distribution among young men who contemplate entering the engineering profession, so as to show them and their parents all the pros and cons and to indicate what kinds of youths will constitute suitable material for our profession and its various specialties.

The Society for the Promotion of Engineering Education is also investigating the subject of "Vocational Guidance"; and I intend to try to co-operate with that organization in my committee work.

The last-mentioned author says also:

"After high-school graduation, a year in some industrial plant as a labourer or mechanic is suggested, with one or two evenings per week at pre-university studies."

This scheme might work well in exceptional cases; but its general adoption would require too great an expenditure of the young men's time, and, therefore, would result in an economic waste.

The same author says:

"Requirements for matriculation should be more scientific and less academic."

This statement is correct. I do not believe in the altogether-too-common practice of accepting candidates for admission to the freshman class in engineering schools solely on high-school diplomas, because the selection of the high-school studies adopted may have been entirely inappropriate. It might be practicable to recognize such diplomas, if the high-school course had been selected specially for engineering requirements; but it must be confessed that high-school education in general is sadly lacking in thoroughness and efficiency. For this reason it has been, and still is, necessary to teach elementary mathematics in engineering courses.

In my opinion, the entering freshman should be well grounded in the English language (including especially spelling), arithmetic, algebra, geometry, plane trigonometry, general world-history, the history of his country, and the history of engineering. He should also have an elementary or general knowledge of the sciences. I include plane trigonometry, so that he can at once begin to study the theory and practice of surveying.

Unless reliable evidence be offered that the applicant has received proper instruction in all of these subjects, the entrance examination should not be waived.

Rigid requirements for entrance tend to good progress in classwork, especially during the freshman year.

The author of paper No. 6 says:

"The value of an arts course before the engineering course may be over-rated, unless there is a definite programme of study and objective throughout the courses."

This statement is correct; for time and money are often wasted by taking an arts course preparatory to studying engineering. If the arts course be properly selected with a view to entrance into the sophomore class in engineering, the method would be a good one for those young men who have an ample amount of money to spend on their technical education; but, as a matter of economics, it will usually be found wanting.

The last-mentioned author says also:

"Adaptability to engineering is an inherent trait, and the college cannot create it, but only develop it.

"The intelligence or psychology or other tests should be applied to students wishing to enter college.

"There should be a point in the intelligence scale (obtained by comparison of school achievement and intelligence tests) below which students should be discouraged from entering a university."

These dicta are absolutely sound, but I would modify the last sentence by substituting for "discouraged" the word "prevented."

Scholarships and Loan-Funds

The author of paper No. 1 says:

"It is desirable to encourage by scholarships and loan-funds those who are anxious to learn but who have no one to pay their way. It is most unwise to allow students to spend more money than is actually required by the necessities of their college life."

There is no finer use for a rich person's surplus money than enabling worthy and capable young men and women to obtain the education they truly desire but are otherwise unable to secure—nor does one have to be rich in order to be of service in this manner. On several occasions during my long professional career, I have taken such an interest in certain young men as to lend them money to go through college—and in each case the loans made have eventually been repaid. The method I have adopted is simple, just to all concerned (including the lender's family and heirs), and fairly safe as an investment. It consists in having the young man insure his life for an amount somewhat in excess of the estimate of total cash required, turn the insurance certificate over to the lender as security, borrow money from him in small amounts when needed, give a note at the current rate of interest for each loan, pay the debt after graduation as soon as feasible, and receive back the insurance policy (which should then have a cash value) when the total indebtedness is removed. A debt of honour of this kind is not really a hardship for a young person, but will serve as an incentive to effective effort in his professional career. Moreover, he will not be burdened with the thought that he has been made an object of charity, as might be the case if he had taken the money as a gift.

Scholarships may rightfully be considered as public prizes for unusual ability and energy; and the recipient of one need not deem himself an object of charity because of its acceptance; nevertheless I believe that loan-funds are preferable to scholarships, in that they put the users on their mettle both to utilize economically and advantageously and to repay the money borrowed. Moreover, loan-funds need not call for competition in their award, while scholarships generally do. For that reason the former are of wider applicability and greater usefulness. Again, a much smaller sum is required for a loan-fund than for a scholarship; and the money invested therein does greater effective duty through serving more people. By careful ruling and handling, a loan-fund may be made not only perpetual but of steadily increasing value. Some twenty years ago I established one in the University of Nebraska by the deposit of one thousand dollars. It has been in constant use ever since, and its value has more than doubled, which indicates that there have been few, if any, losses; because the individual loans bear only simple interest.

Layout of the Curriculum

Concerning the actual make-up of engineering curricula, the authors represented in your compendium speak as follows:

The author of paper No. 1 says:

"It is thought that the technical student should be drilled in the use of clear, forcible English, when speaking as well as when writing."

Author No. 3 says:

"A study of the Latin and Greek languages, as languages, is not necessary for an engineer; and cannot the cultural tradition desired be obtained from translation? The ability to write and speak both English and French is necessary in Canada.

"It is not possible for the engineer to know too much of mathematics (including accounting), and of natural science.

"The dead languages, psychology, political economy, and English literature should not be included in an engineering curriculum.

"Training for executive positions is outside the scope of educational institutions."

Author No. 5 says:

"Mathematics, physics and mechanics should have first consideration in an engineering course.

"During college course, basic or elementary principles should be given throughout the course: from two-thirds to three-quarters of the entire time of college work is suggested in studying basic principles."

It is quite evident from the preceding quotations that there is a decided difference of opinion as to the content of an engineering curriculum. This must be deemed unavoidable if one recognizes the correctness of the old saw "Mony men o' mony minds, etc."; but there is still another valid reason, viz., different technical schools have different objects for attainment—for instance, high-grade engineering schools and trade-schools, the former being suited for the instruction of future engineers of importance, and the latter for the rank-and-file, the "hewers of wood and drawers of water." Again, there is a vast difference between the curricula of the usual high-grade technical institutions and of post-graduate schools of engineering. Finally, a curriculum appropriate to North America might not be at all suitable for some foreign land—for instance, the before-mentioned course in civil engineering that I laid out last year for Nanyang University in China.

As I explained in my report to the National government, the fundamental principle that guided me in my recommendations was diametrically opposite to what I have been advocating during the last three or four decades for the engineering schools of America. For the latter I have counseled the inclusion of numerous cultural courses and the reduction, to a proper minimum, of instruction in engineering practice; while for the former I recommended cutting down the cultural studies to a legitimate minimum and the inclusion of as much instruction as possible in engineering practice. My reason for this policy is that practical experience in any line of technical work is readily obtainable in America, while in China it is always difficult, and in some cases impossible, to secure.

Concerning my opinion about the curricula of vocational schools, high-grade professional schools, and post-graduate schools of engineering, I would refer those interested therein to pages 281 to 284, inclusive, of "Memoirs and Addresses of Two Decades."

In respect to the study of English by engineering students, I have been striving constantly for over four decades, both orally and in print, to inaugurate fundamental innovations in the technical schools of America; for I contend that a thorough knowledge of his native tongue is the most important asset that an engineer can have, because he can hire assistants to do his mathematical work, make his designs, and attend to his business matters, but he cannot employ anyone to do his talking for him, or even to express effectively in writing his individual ideas.

For years I have held the belief that a special kind of instruction in the English language is requisite for engineers, covering the reading, writing and speaking of correct modern English, but omitting consideration of the history of the language and ignoring all reference to antiquated writing and diction. The students, however, should not only be taught polished English; but, if it be possible, they should be compelled to use it in their daily lives.

There are certain high-class books on English for engineers; and these should be used for both text and reference. Among others, I would recommend the following:

"A Course in English for Engineers" by Naether & Richardson, published by Ginn & Company, in two volumes.

"English for Engineers" by Harbarger, published by McGraw, Hill & Company.

"English and Engineering" by Ayedelotte, published by McGraw, Hill & Company.

Besides these special books for engineers, I can recommend the following treatises that are of a more general nature:

"Workmanship in Words" by Kelley, published by Little, Brown & Company.

"Public Speaking for Business Men" by Hoffman, published by McGraw, Hill & Company.

"The King's English" by Fowler & Fowler, published by the Clarendon Press, Oxford.

"Good Engineering Literature" by Harwood Frost, published by the Chicago Book Company.

"Technical Writing" by Rickard, published by John Wiley & Sons.

"Composition of Technical Papers" by Wait & McDonald, published by McGraw, Hill & Company.

If any technical man will faithfully read, study and endeavour to apply the teachings of these various books, he will be almost sure to obtain a fine, useful knowledge of the English language, and make himself a master of its diction.

As for foreign languages, I am unalterably opposed to wasting time on the study of Latin and Greek; but I concede that for a man to be a real master of his native tongue it is necessary for him to struggle with and master the intricacies of at least one foreign language. For the United States I advocate Spanish, because of the proximity of the Latin American countries, and for Canada the French language, because it is the standard in the province of Quebec. In my opinion, either of these two modern languages will give the student as good mental and linguistic training as can any dead language; and, in addition, it has an important economic advantage.

The author of paper No. 3 asks whether the desired cultural tradition of Latin and Greek can be obtained from translations. In reply I would ask another question, "What is there in the writing of some two thousand years ago that would be really useful to modern engineers?" Our profession looks forward and not backward. It is concerned with questions of the present time and not with those of past ages. I would wipe out absolutely the compulsory study by engineering students of Latin and Greek and of translations therefrom.

The same author says: "it is not possible for the engineer to know too much of mathematics and of natural science"; but the study of pure mathematics is almost endless, and could occupy all of a student's time. In my opinion, class-room work in mathematics should end with the usual amounts of differential and integral calculus that are given in the leading American and Canadian technical schools.

At the International Mathematical Congress, held in Toronto, in the summer of 1924, which I attended as representative of the Royal Academy of Sciences and Arts of Spain, I presented a paper entitled "Mathematics from a Consulting Engineer's Viewpoint." In it I indicated that, while a thorough study of mathematics, both pure and applied, is essential for technical students and young engineers, the longer an engineer lives the less does he have to employ them in his personal work—also that mathematics is merely a useful tool and not, as many mathematicians seem to think, a god for man to fall down and worship. The article referred to is reproduced in "Memoirs and Addresses of Two Decades."

In respect to what is said in paper No. 3 concerning a thorough study of natural sciences I heartily agree, but I must take issue concerning the suggested exclusion of psychology, political economy, and English literature from engineering curricula. Any man who is not posted on the principles of psychology is very likely to be worsted in business matters; and, without some knowledge of political economy, one cannot be a man of the world, take his place among the best elements of society, or converse intelligently on many live topics of importance.

As for English literature, an engineer should be well versed in modern English book-lore, but not necessarily in that of ancient days. It is modern English that we employ in our every-day lives; and an engineer of high standing should be unusually well versed in it, a thorough master of its principles, and so conversant with its correct usage as not to have to think at all about the correctness of his speech and writing.

I disagree, also, with author No. 3 when he says "training for executive positions is outside the scope of educational institutions"—surely, he would not deny it a place in post-graduate instruction! If there were time available, it should be covered in the undergraduate curriculum.

While conceding to author No. 5 that "mathematics, physics and mechanics should have first consideration in any engineering course," a thorough training in "humanities" (using the modern acceptation of that term) is equally essential, and a certain amount of time should be devoted to practical technics. He is quite right, however, in his claim for instruction in elementary principles and the proportion of time to be devoted thereto.

It is strange that the question of including "engineering economics" in the curriculum has not been treated by any of the seven authors. It is true that author No. 1 says it is essential "to point out in all courses that successful application rests on good business methods, good ethics, and sound economics"; that author No. 4 says "English and economics are generally included in an engineering course"; and that author No. 5 states that a certain national board in answer to its questionnaire re the pulp and paper industry received replies to the effect that "subjects requiring more attention in college courses were economics, business administration, accounting, public speaking and psychology."

These three side-issue references are the only indication that economics is a proper subject for an engineering curriculum, when, in truth, it is the very acme of importance in all engineering work. For some two decades past, practising engineers have been earnestly urging the engineering teachers of North America to pay more attention in their curricula to "engineering economics," but, until quite lately, with very little effect. I have been one of the prime movers in this matter, hence I know whereof I speak. There are two probable fundamental reasons why the said engineering teachers refuse, viz., the lack of time in the present four-year courses for any additional studies, and the ignorance of many of the instructors themselves concerning even the first principles of the subject—to say nothing of the details.

It will not be well for me, however, to get started on a dissertation upon this matter, for I should not know when to stop; but I might state that I shall keep on pounding away until something worth while has been accomplished in respect to this important *desideratum*.

I might mention again, that last July, I gave to the Summer School of Engineering Teachers, held this year at Yale University, two long lectures on "Bridge Economics." The manuscript thereof contains some twenty-five thousand words; and, on account of the expense that would be involved in its publication, it may never see the light of day, which would be regrettable, as in it I endeavoured to cover, either directly or by reference to standard works, everything of any importance that is known today concerning the subject.

After finishing my discourse, I requested my audience to give me their individual opinions concerning its suitability, if put into book form, for engineering classes, and whether, if thus published, they would utilize it; and a few days thereafter I repeated the question in a circular letter. Without exception, although they are unanimous in stating that they would like to have the suggested book for reference and would put it into the school library, they state they could not use it as a text-book. This is a clear indication of the unwillingness of engineering teachers to instruct their students in practical technical economics. However, I firmly believe that the day is not far distant when the influence of practising engineers will force the professors to change their mistaken policy and teach thoroughly "engineering economics."

Teaching Methods

The author of paper No. 4 says:

"The quality of those entering our schools is probably better than formerly; our teaching is improving; industry and the schools are co-operating more closely than formerly; and the engineering profession is taking more interest than formerly in educational matters."

The author of paper No. 3 says:

"The future of education for engineering lies with engineers, whose judgment in any educational matters should prevail over that of professional educationalists."

While the statement of author No. 4 is strictly correct, there still exists much room for improvement in all lines of technical education; and, as indicated by author No. 3, it is the practising engineers, not the teachers of engineering, to whom the profession must look to effect the desired advancement. The reason for this is that the practising engineers are in a position to judge concerning the efficiency of the teachers' products, while the said teachers are not. It may be somewhat difficult to convince the latter of the correctness of this claim, and they may continue their ancient resentment against certain practising engineers for alleged interference with scholastic functioning. Some teachers used to be quite bitter in their remarks about such interference; but of late I have noticed a decided change in their general attitude towards this question.

Author No. 5 says:

"The conference method in class is advisable rather than the set-lecture method."

In this I certainly agree with him—in fact, as far as I can learn, I was the first engineering professor to inaugurate the conference method for class-room instruction. This I did in the Imperial University of Japan during the latter half of 1882. It was eminently successful—possibly because of the unusual ability, energy and ambition of my Japanese students.

As for the lecture system, I have been opposing for a full half-century its wholesale adoption. In my opinion, the only lectures suitable for any practical engineering course are one at its inception, so as to indicate the ground to be covered and how to study it, and another at its close to serve as a résumé. Of course, pertinent lectures by practising engineers of prominence are always valuable to engineering students, notwithstanding the fact that they are discouraged by the faculties of many technical schools, on the plea that they interfere too much with the routine of class-work. In my opinion, such lectures have an exceedingly beneficial influence on the young men, and should be encouraged instead of discouraged.

The author of paper No. 5 strikes a keynote when he says:

"Special provision should be made for brilliant pupils in selected classes, rather than mass instruction for students of different abilities."

One of the chief hold-backs in technical education today is that the curriculum is adjusted to the capacity of the average student and not to that of the upper half or, preferably, upper third of the class. Every inducement should be offered to brilliant students to take post-graduate studies; and it is for that purpose that the scholarships should mainly be employed. They would serve as well-earned rewards for extra effort and lofty purpose.

Author No. 4 says:

"Small classes where something approaching individual teaching is given are preferred to large classes."

This statement is axiomatic, yet the principle involved is too often violated. For instance, I knew of a case in a high school where a single teacher attended to eighty boys in eighty minutes! How much teaching of any real value could he perform under such conditions? If it were left to me to decide, there would never be more than twenty students at a time handled by one instructor. An even smaller number would be better for efficiency.

Author No. 5 says:

"The graduate who is trained how to think normally, rather than what to think, is the more useful in his profession, and the more capable of expansion and personal success."

This is eminently true; but the teaching of "how to think" should be started in the preparatory school, or, if possible, still earlier in life, rather than be left to the technical institute or university. There is a very good little book by Dr. Geo. F. Swain, published by McGraw, Hill & Company, entitled "How to Study." This should be read and re-read by school boys until its atmosphere has been absorbed. There is another book by the same gifted author entitled "The Young Man and Civil Engineering," published by the Macmillan Company, that should be read and closely studied by every young man who contemplates becoming a civil engineer. Author No. 6 quoted some good advice from the book.

Post-Graduate Study

The engineering alumnus who, soon after graduation, parts with or sets aside his school-books, with the idea that he will have no use for them in his practice, makes the grand mistake of his life; for not only will he have to refer often to his old text-books, but also he will have to buy and read many new books. To be a truly successful and prominent engineer, one has to study hard and read technical literature all his life, not merely in order to do his work properly, but so as to keep abreast of the times and posted concerning all important general technical innovations and discoveries. His reading should cover not only technics, but the sciences, current events, and good literature in general. The man who fails to read is the man who will make a failure in professional life.

Author No. 3 says:

"The education of an engineer is incomplete when he leaves college, and he is only commencing its more practical phase.

"Engineering students for continuance of their education should attend engineering society meetings, where papers on engineering subjects are read and discussed."

Author No. 5 says:

"The young graduate should take an active interest in an engineering society; and such societies should make co-operation with him a definite part of their activities.

"Post-graduate occupation should be regarded for at least five years as a part of training and education."

For nearly half a century I have been urgently advocating both *viva voce* and in print that every engineering graduate immediately after commencement day should join one of the four national founder engineering societies and take as prominent a part as practicable in its activities and functions. For instance, my elder son received his Rensselaer diploma at Troy one night; and the next forenoon at New York city I delivered in person his application for admission to the American Society of Civil Engineers, and secured quick action thereon. Without any exaggeration, I can claim to have influenced considerably more than one hundred young men to join that society.

Author No. 4 says:

"The 'settling-down' period of a graduate, extending over from perhaps one to five years, should be carefully checked up by the engineering school, and any necessary assistance given, the graduate meanwhile to keep the school informed of his whereabouts and circumstances."

This idea of extending the influence of the technical school over its alumni for at least a few years after graduation is an excellent one and ought to be adopted, notwithstanding the extra labour that it would involve for the faculty. One always can find leisure for doing some extra work of special importance, hence technical teachers should not hesitate to undertake any task that will militate for the benefit of the alumni of their school. While it is granted that professors are often overworked, nevertheless, on the whole, they do not have to labour as hard as do engineers in practice.

Recent alumni should make a point of consulting with practical engineers of eminence concerning a course of technical reading and study to be followed, so as to utilize all of their spare time to best advantage. Contact alone with such men will always prove to be a valuable asset in one's professional career; and the wider the young alumnus's technical acquaintance the better will it be for his advancement—to say nothing of the pleasure and satisfaction involved.

Concerning civic duties for engineers, author No. 6 says:

"In recent years modern society has come to realise that men with a solid foundation in science and engineering must be capable of taking a leading part in matters of policy and government."

On this subject author No. 7 says:

"With improved personnel in the engineering profession, a higher standard of appreciation from the public would be created and more remuneration obtained.

"There should be insistence of a more intensive infiltration of engineering into all positions—in parliament, on commissions, in executive positions generally, in industry, in city-manager and town-planning positions, etc."

These three remarks cannot be gainsaid; and they indicate the necessity for engineers to take a much more active part than is now customary in civic, state and national affairs, if our profession is to occupy in general society the high position to which it is entitled because of its fundamental worth and importance.

These seven competitive papers that your periodical has in part reproduced would well serve for a much wider dissertation than I have herein written; but probably, I have already occupied too much of your valuable space.

Respectfully submitted,
J. A. L. WADDELL, M.E.I.C.,
Consulting Engineer.

The Savery Engine

Editor, The Engineering Journal,
Dear Sir:

In The Engineering Journal for October 1930, I was interested to see in a paper on coal mining by T. L. McCall, M.E.I.C., a brief discussion of the history of the steam engine.

The reference to Savery's engine, however, is open to criticism. It is stated in the paper that "this pump acted on much the same principle as the present day pulsometer, with the exception that, steam pressure being absent, the pump acted as a suction pump only."

This statement is hardly true, as it is well known that although his successors, Newcomen and Watt, made no use of steam pressure, Savery was well in advance of his time and used both the pressure and suction principles. This point was well established by an eminent English engineer, David Brownlie, who wrote in "The Power House" as follows:

"The exact pressure Savery employed is not known with certainty, but it is generally estimated to have been 40-60 pounds per square inch, although it may have been much higher.

"This pump was worked for a considerable time, and in one installation water was pumped 80 feet high continuously, and Savery mentions that to pump water 60 feet high required a 3-inch pipe, and the firebox for the boiler was only 20 inches deep and 14-18 inches wide."

The fact that water was pumped to a height of 80 feet is a direct proof that a considerable amount of steam pressure was employed.

Yours faithfully,
E. A. ALLCUT, M.E.I.C.,
Associate Professor of Mechanical Engineering,
University of Toronto.

RECENT ADDITIONS TO THE LIBRARY

PRESENTED BY THE SOCIETIES:
- Liverpool Engineering Society: Transactions, Vol. 51, Fifty-sixth Session.
- Society for the Promotion of Engineering Education: Proceedings, Vol. 37.
- The New Zealand Society of Civil Engineers: Proceedings, Vol. 16, 1929-30.
- Royal Society of Canada: List of Officers and Members and Minutes of Proceedings, 1930.
- American Society for Testing Materials: Year Book, August, 1930.
- Canadian Electrical Association: Proceedings for Fortieth Annual Convention, June 11-13, 1930.
- The Society of Naval Architects and Marine Engineers: Year-Book, 1930.
- American Society of Mechanical Engineers: Record and Index, Vol. 3, 1929.

Reports, etc.

DOMINION BUREAU OF STATISTICS, CANADA:
- The Canada Year-Book, 1930.

TOPOGRAPHICAL SURVEY, CANADA:
- Map of part of Peace River District.

DEPARTMENT OF THE INTERIOR, NATIONAL DEVELOPMENT BUREAU, CANADA:
- Map of the World, showing Trade Routes and Shortest Sailing Distances between Canada and Foreign Ports.
- The Maritime Provinces, Canada, (being a short description of the developments in New Brunswick, Nova Scotia and Prince Edward Island).

DEPARTMENT OF THE INTERIOR, CANADA:
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- Labour Legislation in Canada, 1929.
- Ninth Report on Organization in Industry, Commerce and the Professions in Canada, 1930.

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- The Gypsum Industry of Canada.

DEPARTMENT OF MINES, EXPLOSIVES BRANCH, CANADA:
- Rapport Annuel de la division des explosifs du Ministère des Mines pour l'année civile, 1929.

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- Annual Report, 1929.

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- Circular No. 387: Copper Electrotyping.
- Misc. Pub'n No. 111: [Map], Standard Time Zones of the United States.

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- Bulletin No. 322: Effect of Vacuum on Oil Wells.
  - 323: Gas-Lift Method of Flowing Oil Wells, (California Practice.)
  - 324: Zinc Smelting from a Chemical and Thermodynamic Viewpoint.
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- Water-Supply Paper No. 630: Surface Water Supply of the United States, 1926: Part 10, The Great Basin.
- Bulletin No. 815: Geology and Mineral Resources of Northwestern Alaska.

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- Hydraulic Power Committee, Engineering National Section:
  - [1]. Automatic and Partial Automatic Hydro-Electric Plants.
  - [2]. Mechanical Reliability of Hydro-Electric Units, 1928.
  - [3]. Ice Problems in Hydro-Electric Plants.
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- Prime Movers Committee, Engineering National Section:
  - [1]. Turbines.
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Electrical Apparatus Committee, Engineering National Section: Electrically Driven Auxiliaries for Steam Generating Stations.
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Department of Geological Sciences: Structure of the San Gabriel Mountains, North of Los Angeles, California.

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Engineering and Science Series No. 27: Investigation of the Thermal Conductivity of the System Copper-Nickel.
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Purdue University:
Engineering Extension Department, Bulletin No. 21: College Personnel Procedures.
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Presented by McGraw-Hill Book Company:
Estimating Construction Costs, by G. Underwood.

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Manual of Engineering Practice: A Selected Bibliography on Construction Methods and Plant Applied to Bridges, Buildings, Dams, Hydro-Electric Plants, Roads, Sea-Walls, Sewers, Tunnels, etc.

Presented by Northern Electric Company, Ltd:
Bell Telephone Laboratories:
Reprints B-467: Age Hardening Lead-Calcium Alloys.
B-468: Alloys for Cable Sheathing.
B-469: An Artificial Larynx.
B-470: The Complex Nature of Dielectric Absorption and Dielectric Loss.
B-471: Radio Facilities for Aircraft Communication.
B-472: Acoustic Control of Recording for Talking Motion Pictures.
B-473: Loud Speakers for Use in Theatres.
B-474: Particle Size as a Factor in the Corrosion of Lead by Soils.
B-475: Barkhausen Effect in Iron, Nickel and Permalloy—II.
B-476: Recent Developments in Toll Telephone Service.
B-477: The Chicago Long Distance Toll Board.
B-478: Air Transport Communication.
B-479: Transmission Characteristics of a Short-Wave Telephone Circuit.
Monographs B-488: Preparation of Air of Known Humidity and Recorder Calibration.
B-489: Moisture Content of Compressed Nitrogen.
B-490: Developments in Communication Materials.
B-491: The Words and Sounds of Telephone Conversations.
B-492: The Reciprocal Energy Theorem.
B-493: The Approximate Networks of Acoustic Filters.
B-494: Some Contemporary Advances in Physics,—XX, Ionization of Gases by Light.
B-495: Motion of Telephone Wires in Wind.
B-496: Economic Quality Control of Manufactured Product.
B-498: The Chromolinoscope Revived.

Purchased:
Whither Mankind, edited by C. A. Beard.
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BRANCH NEWS

Cape Breton Branch

S. C. Mifflen, M.E.I.C., Secretary-Treasurer.
Louis Frost, Branch Affiliate, Branch News Editor.

The modernity and progressively aggressive policy of the Bethlehem Steel Company, the second largest steel operators in the world, was adequately illustrated by Geo. A. Richardson, technical lecturer of that organisation, during the course of an illustrated address to a large audience of ladies and gentlemen, at the central schools, Sydney, on Friday, October 17th, given under the auspices of the Cape Breton Branch of The Engineering Institute of Canada.

The speaker, who was introduced by acting-chairman A. P. Theuerkauf, M.E.I.C., paid tribute to the local steel plant and during the course of his lecture pointed out how the selective fabrication of a wide variety of steel products can only be achieved by highly modernized organizations, backed by adequate capital.

Motion pictures were shown, which illustrated in detail the fabrication of steel, from the landing of the ore from boats, to the different finished products. A panoramic view of the plant at Lackawanna, Pa. and of the blast furnaces at Johnstown, proved of great interest, as showing the mammoth operations of this company. Of peculiar interest to the steel men present, were the close-ups, showing the various phases of steel manufacture and the machinery used in the production of the fabricated units.

A bolt and nut making machine shown in operation, has a capacity of a million and a half pieces per day, other phases illustrated a 52-inch plate mill in operation and the manufacture of 36-inch steel girders, weighing 300 pounds per foot.

A distinctive feature of the plant at Lackawanna, were the time-saving methods employed to bring the plant up to a hundred per cent operating capacity. One of these operations showed the changing of rolls by moving the whole unit weighing 275 tons by a crane, the tremendous proportions of which will be readily recognized by the fact that the motor employed in this operation is rated at 8,500 h.p.

The films concluded with aerial views of the Delaware bridge and the new bridge across the Hudson at New Jersey, for which the Bethlehem Steel Company is supplying the steel. The latter bridge has a span of 1,750 feet with towers 600 feet in height.

At the conclusion of the meeting a vote of thanks to the speaker was moved by K. H. Marsh, M.E.I.C., chief engineer of the Dominion Steel and Coal Company, and seconded by J. H. Frazer.

Saint John Branch

A. A. Turnbull, A.M.E.I.C., Secretary-Treasurer.

Members of the Branch motored to the plant of the Canada Lock Joint Pipe Company, East Saint John, on Saturday, June 21st, and spent an interesting two hours viewing the manufacture of the large steel reinforced concrete pipe being laid for the new water main from the Marsh bridge to Little river.

Accompanying the members over the plant were R. Hugh Bruce, representative of the Canada Lock Joint Pipe Company, W. W. Trickey, superintendent of construction, and the Hon. R. W. Wigmore, commissioner of the Water and Sewerage Department, under whose direction the large programme of work is being carried out in the Water department of the city of Saint John.

The tour of inspection covered all the various stages in the manufacture and laying of the pipe. Large steel plates were cut and punched, then rolled to form one-third of the shape of a cylinder. Three of these rolled sheets were then welded to form a cylinder. Circular iron collars or ends were then welded to these cylinders after which the whole cylinder was tested for leaks in the welded joints by being subject to heavy air pressure. Upon passing the test for air-tight joints, the cylinders were next enclosed in a sort of steel cage consisting of steel bars and rings which were wired into place to form additional reinforcing when the cylinder is encased in concrete. The completed steel cylinder with steel reinforcing cage, is placed on end and the inside and outside moulds fitted to it. The concrete is then poured and worked down by means of long rods. It is allowed to set, after which the forms are removed and the pipes thus formed are allowed to stand until the concrete has sufficiently hardened. Each pipe weighs approximately 6,800 pounds. When laid in the excavated trench, the caulking of the sections of pipe is done from the inside and by means of a special lead caulk which is wedge-shaped and has a tightly compressed cotton core. This lead caulk is driven tightly for a considerable depth. About 30 of the large joints were being manufactured each day. The actual laying of the pipe was then inspected on Rothesay avenue.

Members were also treated to an additional feature in the form of a brief visit to the nearby Duntile plant of the Eastern Cement

Products and were shown through this plant by John N. Flood, A.M.E.I.C., president of the company. Mr. Flood explained the manufacture of the Duntile blocks and told of the growth in business which warranted new machinery, as the first unit could not cope with the heavy demand for the product.

Moncton Branch

V. C. Blackett, A.M.E.I.C., Secretary-Treasurer.

"The Manufacture of Structural Steel Shapes and Related Products" was the subject of an address delivered before the Branch on October 14th by G. A. Richardson, technical lecturer of the Bethlehem Steel Corporation, Bethlehem, Pa. The meeting was held in the city hall and was open to the public, upwards of two hundred being in attendance. A. S. Gunn, A.M.E.I.C., presided.

The address was illustrated throughout by motion pictures. Mr. Richardson brought with him not only the films but the entire projection equipment, and he was accompanied by a special operator. The pictures were much superior to any shown at previous Branch meetings and received very favourable comment from those present.

The speaker's remarks were not confined to the manufacture of structural shapes but covered the general field of operations of one of the largest steel corporations in the world. In connection with the handling of raw materials, the mammoth cargo unloaders excited particular interest. Each of these giant machines has a clam shell capacity of 17 cubic yards, and is controlled by one man, yet with a delicacy of movement that is amazing. A noteworthy time saving procedure has developed in the rolling mill. Formerly a change of section to be rolled meant a delay of twenty-four hours in changing the rolls. Now, the rolls are not touched, but instead the entire housing is lifted out and another substituted, an operation that may be performed in twenty minutes. The fabricating shop contains a somewhat novel machine called the piano-player punch, which does exactly what its name indicates, by punching steel plates in accordance with the perforations in a paper template fed into it. Not the least interesting was a description of the nut and bolt machines—almost human in their movements and considerably more than human in their speed and accuracy. Mr. Richardson's address brought out very forcibly the modern tendency towards time and labour saving devices and the mechanization of industry.

A hearty vote of thanks was tendered the speaker on motion of C. S. G. Rogers, A.M.E.I.C., seconded by Professor H. W. McKiel, M.E.I.C.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

On October 2nd, 1930, J. O. Bason presented a very interesting paper on "The Phenomena of Oil Circuit Breaker Interruption." Mr. Bason commenced by giving a brief description of the physical phenomena occurring during the rupture of an arc under oil. This was followed by several reels of moving pictures taken at ultra-high speeds, showing the actual operations of an oil circuit breaker. These pictures had been secured by the use of a special circuit breaker, the sides of which were constructed of plate glass and which was filled with a special transparent oil. This is the first occasion on which pictures of this kind have been shown, and the initial flash on breaking the metallic contact, the formation of the gas bubble, the rising of this bubble to the surface of the oil and the final extinction of the arc were shown with great clearness. Additional pictures showing the effects of electrode damage due to heavy arcing with various types of contacts were presented.

F. Newell, M.E.I.C., occupied the chair.

On October 9th H. R. Bartell, engineer of The General Steel Castings Corporation, Granite City, Ill, addressed the members of the Montreal Branch on the design, development and manufacture of special steel castings in locomotive and railway car construction.

Mr. Bartell attributed the major portion of present-day improvement and efficiency in railroad operation to the creation of sturdy and substantial foundations for locomotives, tenders, passenger and freight cars through steel castings. A careful study over a period of years indicated that most of the difficulties encountered either in the manufacture of steel castings or that developed later in service could be eliminated by changes in design. If not, modifications to the manufacturing processes could prevent all but a small percentage of the remainder of these difficulties.

In the opinion of some, too great an emphasis has been laid on metallurgical practices and methods but the speaker stated that in his experience, engineering design and manufacturing practice offered the greatest avenues for improvement in the quality of steel castings. Mr. Bartell further pointed out that, while the earlier designs of steel castings followed in general outline the appearance of the fabricated structures which they displaced, it was not long before designing engineers recognized that lightness and strength could be combined with good appearance, so that to-day much attention is given to producing castings that not only possess utility but that are also pleasing to the eye.

Steel castings originated with the development of the crucible furnace by Benjamin Huntsman, a clockmaker of Sheffield, England, in 1740. At this time, however, on account of the necessarily small size of the crucible, the production of large castings was very difficult. Henry Bessemer's invention in 1855 of the converter for transforming iron into steel, removed the limitation in size imposed on the crucible. Then the later development of the open-hearth furnace by the Siemens brothers of Germany and the French metallurgists, P. and E. Martin, blazed the way for much of the modern steel foundry practice of to-day.

The first steel castings used in locomotives were driving wheel centres built in 1895. At the same time when the movement towards larger and heavier locomotives began, it was found that cast steel engines were of great advantage. Mr. Bartell stressed the remarkable advancement in the art of steel casting during the past decade and predicted that even greater progress might be expected in the future.

F. Newell, M.E.I.C., occupied the chair.

Peterborough Branch

F. G. A. Tarr, S.E.I.C., Secretary-Treasurer.
B. Ottewell, A.M.E.I.C., Branch News Editor.

The Peterborough Branch of The Institute commenced the season's activities on September 13th, 1930, by a trip to the nearby village of Lakefield, where an inspection of the Canada Cement Company's plant was made. Mr. F. W. Bailey, the manager of the plant, and his staff of guides were indefatigable in making the tour interesting and educational. Several improvements in the plant had lately taken place, notably the addition of a 300-foot concrete chimney, replacing a number of steel stacks.

Following the inspection trip, the members indulged in a programme of sports, consisting mainly of vocal encouragement given to the visitors' softball team in a battle with the cement mixers, with the satisfactory result of a win for the former.

The day's events wound up with an excellent dinner served on the lawn of "Reydon Manor," Lakefield. About 70 members and friends took part in this trip.

A meeting of the Peterborough Branch of The Institute was held on October 9th, 1930, in the canteen of the Western Clock Company, under the chairmanship of A. B. Gates, A.M.E.I.C., after which a tour of the plant was undertaken, proving of keen interest, affording as it did an insight into the many intricate details of operation which contribute to the Westclox alarms and watches.

"We cannot conceive of a clock without knowing something of the thing we are dealing with—time," stated Mr. J. H. Vernor, general manager of the company, "and we cannot get down to practical things, leaving the realm of the speculative until we know what we intend to do." The speaker then dealt with the various means of time division which have been employed throughout the ages, adding, the calendar has varied considerably during the past six thousand years. The Western Clock Company was one of the first, if not the first, firms to adopt a newer and better calendar of thirteen months. "Our accounting periods" said Mr. Vernor, "are all divided into twenty-eight days, because it standardizes the entire plant and makes accurate comparisons possible. If the year itself is inaccurate, how can we make a timepiece which is accurate—and make it at a price where the public can be reached?" A mechanical device such as a clock is designed to perform certain functions accurately. The train of gears will revolve a given number of times per day. Therefore since the day itself is not evenly divisable by any set train of teeth in the gears, the timepiece cannot be perfect. The best the most accurate timepiece can do is to run at a given rate. The closer this rate, the better the timepiece. It is the practice of the Western Clock Company in the manufacture of alarm clocks which must sell to the wholesale trade for less than $1.00, to regulate them to within two minutes per day. They can be more accurately regulated, but this has to be done by the purchaser who may run them under different temperature conditions than is done at the plant.

A tour through the plant which followed the conclusion of Mr. Vernor's address, was proof that the preparation for the manufacture of a clock takes in many divisions of the engineering. Special attention was called to some double-acting draw presses on which the brass and steel shells for certain of the cases are drawn, while it was also pointed out that many of the smaller machines were designed and built in the plant, and have no counterpart elsewhere. One of the machines in particular, which performs the operation of making the bevel on the front of watch cases, was displayed with justifiable pride, having been fashioned and designed in the company's own tool room from parts taken off the junk pile. It has a special safety feed, which is a feature of all the machines in the Westclox plant, and which makes it almost impossible for the operator to get trapped.

The wheels used in all the clocks and watches are blanked, even the teeth in the watch wheels are not cut, and it is necessary that they be blanked without a burr. One of the dies was set up for the inspection of the visitors and another operation, that of piercing holes in a watch plate, was followed with interest. The operator of the piercing machine is able to produce approximately fifteen thousand parts daily, piercing a hole .021 inches in diameter through stock .054 inches in thickness. None of the holes on Westclox watch and clock plates are drilled; they are all pierced on power presses.

In the assembly department an operator was observed, deftly putting in the wheels that go between the plates of an alarm clock mechanism. One operator is capable of assembling 210 such parts per day. The wheels for the dial movement are put in by a separate operation. Nominally 2,000 clocks are assembled daily.

Mainspring casings for alarm clocks were also seen in the process of manufacture, and the machine performing the operation of punching the anchor hole in the barrel is stated to have a capacity of 2,200 per hour.

At the end of the assembly room is situated the regulating room wherein thousands of clocks, carefully guarded from dust, undergo a rigid test, running at 100 per cent for a period of three to five days. The clocks are all run in three positions before receiving the O.K. of the inspection staff. Maintaining a perfect silence, the visitors were able to hear these thousands of timepieces, their concerted action sounding like gently falling rain.

Hamilton Branch

John R. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. A. M. Galilee, Affiliate E.I.C., Branch News Editor.

Meeting in Toronto, October 10th

The members of the Hamilton Branch were invited by the Ontario section of the American Society of Mechanical Engineers to attend their opening meeting. This was arranged as a joint meeting of the Toronto section American Institute of Electrical Engineers, the Ontario section American Society of Mechanical Engineers, and the Toronto Branch of The Engineering Institute of Canada. Several members of the Hamilton Branch availed themselves of the invitation. The afternoon was given up to an inspection of the Royal York hotel mechanical and electrical equipment, the Toronto Terminal Railway steam plant, and the mechanical and electrical equipment of the new Canadian Bank of Commerce building.

At the dinner, which was held at the Royal York hotel, those present were glad to hear R. J. Durley M.E.I.C., General-Secretary, bring greetings from the Council of The Institute.

The speakers were Messrs. J. B. Andrews and L. P. Rundle, the subject being "Mechanical and Electrical Features of the Welland Ship Canal." Attendance—113 at dinner and 175 at the meeting.

Executive Committee Meeting, October 13th

A luncheon meeting of the Executive committee was held on Monday, October 13th, at the Wentworth Arms hotel.

The secretary reported that the proposed joint meeting with the Ontario section, American Society of Mechanical Engineers, could not be arranged in October but that an attempt was being made to arrange for a joint meeting in March or April.

Discussion took place regarding Council's action in requesting that the amendments to the constitution which had been submitted to Council and which had been discussed at the Branch meeting on September 11th be withdrawn. The following resolution was carried unanimously:

> "The Executive committee is still of the opinion that the original resolution as suggested by the Hamilton Branch members contains many features which if adopted would be of great assistance to The Institute at large. However, in view of the request from headquarters, they recommend to those who signed the amendments, that the resolution be withdrawn in its entirety, leaving it to the discretion of Council whether to use any of the material or not.
>
> "The Executive committee wish to express their appreciation of the courteous way in which the resolution was received by Council, and the attention which was given to it."

Discussion took place regarding the details of the Branch meeting to be held on October 21st. It was decided to extend an invitation to the ladies to attend the meeting.

Action was taken on one resignation as Branch Affiliate and on two applications for admission to The Institute.

The list of meetings as submitted by E. M. Coles, A.M.E.I.C., chairman of the Papers committee, was approved. The arrangement of the details of the meetings was left to the Papers and the Entertainment committees, together with the chairman and secretary.

Branch Meeting, Oct. 21st, 1930

(Reported by J. A. M. Galilee, Affiliate E.I.C., and J. R. Hutton, S.E.I.C.)

A meeting of the Branch was held in the grill room of the Royal Connaught hotel, at 8 o'clock p.m., Tuesday, October 21st, 1930. In the absence of the chairman and the vice-chairman, H. A. Lumsden, M.E.I.C., immediate past-chairman, occupied the chair.

Mr. Lumsden called upon G. F. Foot, assistant manager of sales, Canadian Westinghouse Company, Branch Affiliate, for his address on "Illumination of the Endless Caverns of Virginia," which was illustrated by coloured lantern slides. Mr. Foot took his hearers through the caverns and described the various formations of flow stone and drip stone, whose natural beauty is greatly enhanced by well-designed illumination.

The Illumination of the Endless Caverns of Virginia

The Endless Caverns of Virginia are located just off the famous Lee highway, 12 miles south east of New Market, Virginia. They have been called "endless" because explorers have worked for a long time seeking terminals to the winding channels and vast underground chambers.

"Skyland," for example is a combination of stalactites hanging down from the ceiling and stalagmites built up from the floor with the ceiling in many spots of virgin blue-gray limestone which lends itself almost perfectly to illumination from daylight lamps, and the production of a scene in which darker clouds seem to float in the afternoon sky. All the lights are concealed behind formations and broken rocks on the floor.

Caves are formed in two ways: by an upheaval of the earth which opens large seams and cracks within it suddenly, or by the slow unceasing action of acidulated waters seeping here and there through microscopic cracks in the original limestone. Ever so gradually these cracks widen. The acidulated waters are helped by silt and gravel-bearing waters and the process of solution is hastened by the action of erosion. Every erosion cave in its youth and early maturity is being enlarged by this action. Gradually however, as the water level of the surrounding country recedes, that is as the master streams eat their way further and further toward the level of the sea, the underground stream does likewise, and leaves behind its former channels. At the same time, or almost before this stream has begun to recede, the same acid-bearing waters which have played their part in the forming of the cave commence to fill it up again.

A section of a stalactite was shown and it was noted that there was a hole through the centre, extending from end to end. During the formation of the stalactites, mineral-bearing waters flowing through that hole gradually permeate through the formation, evaporate and build it larger and longer. Some perhaps have noticed that active stalactites almost invariably have a drop of water upon the tips. When the mineral-bearing waters are passing through the stalactite at a rate greater than the evaporation from the stalactite itself, the surplus drops from the tip of the stalactite to the floor of the cave beneath. There, more of it is evaporated, gradually building up a mound of material similar in composition to the stalactite but not similar in the mechanics of its construction because, here, the growth is in the form of successive layers formed upon the outside gradually building up a more or less conical structure. The stalagmite, therefore, is solid and consists of a number of rings of material, one encasing the other. Through the thousands of years in which one of these stalagmites is forming, the salts which the water contains in solution may change in composition over and over again. There are, therefore, layers of different materials making up the stalagmites, and these were clearly shown in the slide.

One of the interesting features brought out by the speaker was the fact that, although the visitor must retrace his steps, the illuminating engineer has so designed the illumination that the visitor is not conscious of having made the return journey by the same way as he came in.

Some of the caverns have romantic names given to them, names which their character suggests, such as "Weeping Willow Falls," "Hawaiian Village," "Gateway to Fairyland." The colours of the lantern slides brought out the attractive features of each.

Floodlighting and its Applications

The second speaker of the evening was G. F. Mudgett, manager of the Illumination Division of the Canadian Westinghouse Company. His subject was "Floodlighting and its Applications" and proved to be very interesting and much enjoyed by the members and guests. Floodlighting is a term which is becoming rapidly familiar to every one, including as it does the lighting of building façades and athletic fields.

A few applications of floodlighting are: buildings, railway yards, athletic fields, airports. These applications have entirely different conditions and requirements and the degree of illumination varies over an extremely wide range. The amount of light required depends upon the activities which are to be carried out. Due to the value of contrast effects, the colour and reflecting qualities of the surfaces to be lighted are very important factors. A dark-surfaced building in a brightly lighted district may require an intensity of 75- or 100-foot candles, whereas a light-surfaced building in dark surroundings may require but 8-foot candles.

Railway yards require a relatively low degree of illumination to produce the desired contast. A maximum intensity of .25-foot candles is used and for general yard lighting .05-foot candles or about twice full moonlight will surface. Because of the great length of most yards, lamps as large as 2,500 watts are sometimes used and to avoid glare, the projectors must be mounted as high as 100 feet.

The use of athletic fields at night is rapidly gaining in popularity. Well lighted fields have shown a great increase in attendance over daytime attendance. Baseball parks and football fields represent different conditions. The difference in size of the balls, their speed in play and height to which they rise require entirely different treatments.

Football lighting is accomplished by mounting projectors behind the stands at a height of 75 to 90 feet. The intensity may be as low as 2-foot candles and the energy required about 37 kw. Practically, however, intensities of 8- or 10-foot candles are used and it is believed that 200 kw. will be soon considered a minimum for this type of lighting.

Baseball fields should have an intensity of 15-foot candles on the infield and 8- to 10-foot candles in the outfield. Much light must be projected high in the air and as much energy as 30 kw. is expended in lighting the air. The total energy required is at least 175 kw. Glare is eliminated by mounting the projectors at a height of at least 100 feet and great care is necessary to ensure uniformity of illumination.

Airports require to be floodlighted at night to permit safe landings and take-offs. The Department of National Defence specifies that the minimum intensity of illumination must be .15-foot candles and as many fields are one-half mile or greater in length and width, the equipment must be very efficient and economical in operation.

The most efficient units use the Fresnel dioptric lens system, which is one of the oldest known and yet one of the most efficient. These lenses are in the form of half cylinders of 1,000 or 500 mm. diameter and mounted in suitable housings.

A 1,000 mm. unit with a 150-ampere, 100-volt high intensity arc as the light source, produces a beam candle power of 4,000,000 and a vertical divergence of 1¾ degrees. This will cover a field 3,800 feet by 3,800 feet with a minimum intensity of .15-foot candles.

The 500 mm. unit uses a 3,000-watt, 32-volt incandescent lamp as a light source, and produces 245,000 beam candle power. This beam has a spread of 180 degrees horizontally and 2½ degrees vertically. Four of these units, with a maximum candle power of 980,000, will completely cover a field 2,500 feet by 2,500 feet with light of minimum intensity of .15-foot candles.

These floodlight projectors are mounted with a slight downward tilt and with their small vertical beam divergence admit of little possibility of glare to a pilot and still permit uniform illumination of such large areas economically.

E. H. Darling, M.E.I.C., moved a hearty vote of thanks, which was carried with applause.

Mr. Lumsden announced the coming meetings and expressed his appreciation of the work of the chairman of the papers committee in arranging for such an excellent programme so early in the season.

After the meeting was adjourned, coffee and sandwiches were served.

Attendance 60, including 10 ladies.

Sault Ste. Marie Branch

A. A. Rose, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting of the Sault Ste. Marie Branch of The Institute was held in the Old Stone House, Sault Ste. Marie, on September 26th, 1930, at 8 o'clock p.m., following a dinner.

C. H. E. Rounthwaite, A.M.E.I.C., chairman, called the meeting to order and the minutes of the last meeting were read and adopted.

On the motion of F. H. Barnes, A.M.E.I.C., and W. S. Wilson, A.M.E.I.C., the meeting adjourned to enable those present to visit the Algoma Central Railway car shops.

The party was conducted through the store, roundhouse and machine shop of the Algoma Central Railway by I. W. Boyd, A.M.E.I.C., who pointed out the interesting points about the shops; engines 50 and 51, and especially their cabs, attracted much attention. In all, a most profitable two hours was spent in examining the railway's plant and equipment and rebuilding engines, cars and all the various things that keep a railroad fit and in good running order.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

The Lethbridge Branch got away with a flying start for the coming season when over 60 members and their wives and friends gathered in the private dining room of the Marquis hotel on October 4th.

The excellent dinner provided by Lethbridge's ambitious and successful community hotel prepared those present for the boisterous round of singing which followed. The entertainment committee under J. Haimes, A.M.E.I.C., has brought out a revised and enlarged song sheet, through the mazes of which the diners were ably led by R. S. Lawrence, A.M.E.I.C., who also rendered a vocal solo.

The speaker of the evening was B. L. Thorne, M.E.I.C. of the Department of Natural Resources, Canadian Pacific Railway Company, and his subject was "The Oilfields of Europe and Africa." Mr. Thorne outlined the various oil producing regions of these parts of the world, giving their production figures and details of the varied drilling methods employed. Following this, motion pictures were shown illustrating the life and industrial activity of the oil regions previously described.

Following the address an informal dance was enjoyed till midnight, music being supplied through the courtesy of Mr. Brown's orchestra.

Mass Production of Homes

With increasing force, there is being brought to public realization the fact that the industry of providing houses or "shelter" is lagging far behind other basic industries. From the viewpoint of modern mass production, house building is still in the dark ages. During the War perhaps this fact first became generally evident. Since then, it has been given continually increasing attention in governmental, engineering and architectural thought and action in both the professional and the popular press......

Recent years have produced many new building materials, processes and finishes, but thus far they have been built in or superimposed upon the old traditional structure. Among these products are light fibrous and aerated mineral materials for insulation and for sound deadening; also a great variety of metallic and synthetic roofings and exterior finish and numberless interior finishes in the form of plasters, wall boards, tiles paints etc. ... It is interesting to note that although there is a vast amount of experimental and research work being done on building materials and quite a little on structural elements or details, there are very few minds at work on new structural systems or methods as applied to minor buildings.

For the past five or ten years, a graduate of the Massachusetts Institute of Technology in civil engineering has studied as his avocation the problems outlined above. Through a Massachusetts corporation organized for manufacturing and building purposes, he has carried on extensive research in housing structure and materials, and tried out in actual building many new ideas, probably more novel structural methods than any one else working in the same line. As a result, several structural types have been evolved. All of them are based upon an abstract conception of building structure, the conception of a relatively small cube as a module or unit of measure by which the proportions of other parts are regulated. The final structure may be imagined as made almost entirely from such small cubes, all of one standard size and shape; practically all lengths, widths and thicknesses are exact multiples of the dimensions of this cubical module.

The cube is used first in the analytical process and then in the synthetical. It is primarily a *structural module*, and architectural standards develop from it. Usually hitherto, the modular method of design has been employed in two dimensions (surfaces) only. Modular methods like those of Ernest Flagg have been primarily architectural and the structural considerations have been subordinated to the architectural. But the new methods explained herein, though not in detail, are primarily structural, and will, it is expected, fulfil the requirements of modern industry, engineering efficiency, mass production, speedy assembly and will also open new fields to invention, design and the creation of domestic and civic beauty.

In the first place, the method makes possible the mass production of framing parts (of steel, aluminum, etc.) Relatively few cross sections are involved, few lengths, because modularized, and few connections. With similar simplicity the supplementary elements (blocks, panels and slabs) including finish "grounds" may be manufactured. In many different materials, but all modularized, these are cut and finished and shipped, all ready for swift assembly on site.

Secondly, the structure thus assembled in the field is perfectly adapted for the ready and almost automatic application of finish to its modularized surface. The use of a relatively small structural module of the order of 2, 3 or 4 inches means that all existing and prospective finishes, exterior and interior, can be conveniently designed and manufactured in form and size suitable for such application; and through general use of modularized openings, doors, windows and, perhaps, stairs could be made more economically than at present and without substantial limitation of architectural design.

Thirdly, in this new modularized structure the installation of heating, plumbing, lighting and other services can be provided without interference with either structure or finish. Eventually some of such accessories may be integrally included in the structure.

The methods thus outlined, while at first thought open to the accusation of "machine made," "standardized," do not in reality impose upon the architect harmful restrictions either in the laying out of plans or in architectural design. ... The architect can plan freely. At the same time the householder gets the benefit in the lower cost of mass production. As soon as a good number of the building materials industries recognize and adopt these modular methods, all that they now offer in the way of finish—panelling, tiling, fire-proof and sound-proof linings, and many new possible forms—can be used not only in the new structures but on those of the traditional type, with enormously greater ease, flexibility, range of effect and lower cost. Standardized modular design opens the way to the greatest possible development of materials, it takes away nothing from what we already have and it offers a more efficient structure from the viewpoints of cost, utility and beauty.

—*Industrial Bulletin of Arthur D. Little, Inc.*

Canada Wire and Cable Company, Ltd., Toronto, Ont., have recently published catalogue No. 30, on wire rope and fittings. This catalogue, which is illustrated, also contains a short article giving general information regarding wire rope.

Preliminary Notice

of Applications for Admission and for Transfer

October, 23rd, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in December 1930.

R. J. Durley, *Secretary.*

* The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BICKLE—WARNER PENTLAND, of Winnipeg, Man., Born at Gladstone, Man., Apr. 26th, 1903; Educ., B.A., 1923, B.Sc., 1924, Univ. of Man.; 1918-22 (summers, and winter of 1919-20), chainman, rodman, etc., Man. Good Roads Board; 1923-29, with Man. Good Roads Board as follows: 1923-25, instr'man., 1925-26, asst. engr., District No. 5; 1927-29, asst. dist. engr. (Civil Service Appointment), Brandon District; 1929 to date, supt., paving dept., Carter-Halls Aldinger Co. Ltd., Winnipeg, Man., i/c of bituminous treatment work for western Canada, and partial supervision paving work.

References: A. W. Fosness, C. W. Dill, E. C. Cowan, J. E. Buerk.

BINNS—RICHARD MALINSON, of Montreal, Que., Born at Toronto, Ont., July 25th, 1902; Educ., 1st year engrg., Dalhousie Univ., Halifax, 1919-20; 1922-23, 1st year, evening course (electy), Montreal Technical School; 1923-25, 2nd and 3rd year evening course (elec. engrg.), N.S. Tech. Coll., Halifax; 1920-22, and various times in 1924, Dept. of Highways of Nova Scotia—dftsman., surveying, etc., office engr. on highway constrn.; 1926, designing dftsman., C. D. Howe & Co., Port Arthur, Ont., grain elevator work, reinforced concrete design, machy. layout, etc.; 1927 to date, in office of gen. supt., Montreal Tramways Company, engrg., traffic study, statistics, etc.

References: D. E. Blair, J. W. Roland, W. McG. Gardner, H. F. Laurence, K. B. Thornton.

DREW—ARTHUR EDWARD, of Crystal Springs, Sask., Born at St. Paul, Minn., Sept. 14th, 1901; Educ., B.Sc. (Civil), Univ. of Sask., 1927; 1923 (Feb.-Sept.), tracing and blueprinting; Sept. 1923 to Aug. 1924, field dftsman.; 1925-28, with Backus Brooks Company as follows: June 1925 to Apr. 1926, dftsman.; 1926 (Apr.-Sept.), field engr. on constrn. of 100-ton addition to paper mill; June 1927 to Nov. 1928, designer and layout man on plans for new paper mill at Fort William; Nov. 1928 to April 1929, with Spruce Falls Power & Paper Co., as senior dftsman., and May to Dec. 1929, designing dftsman.; Dec. 1929 to Oct. 1930, res. engr. on constrn. of hydro-electric plant for Orbison & Orbison, Consltg. Engrs., Appleton, Wis., handled all field work and some of designing and estimating.

References: C. J. Mackenzie, H. B. Brehaut, A. R. Greig, C. W. Boast, H. A. Jones, J. E. Underwood.

FIEGEHEN—ROBERT GEORGE, of 289 Patricia Avenue, Montreal, Que., Born at Bedford, England, July 29th, 1903; Educ., 1922-25, Birmingham Technical College; 1922-25, pupil ap'tice with Messrs. Belliss & Morcom Ltd., Birmingham (1st prize for efficiency and progress in 2nd year); 1925-26, asst. to chief tester, Diesel dept., W. H. Allen Sons & Co. Ltd., Bedford, England, in full charge of tests of Diesel and semi-Diesel engines from 50-800 B.H.P., and 1926-27, on research work in experimental dept.; 1927-28, asst. tester and calibrator, Geo. Kent, Ltd., Luton, England, accurate checking and testing of meters and power house control instruments; 1928-29, dftsman., British Electrical Commission, St. Neots, England, designing pylons for overhead transmission, power stations and substations, and later i/c erection of substations and lines on section of scheme; 1929-30, dftsman., McColl Frontenac Oil Co. Ltd., Montreal, designing oil refining plant equipment, later supt'd. erection and installn. of elect'l. gear at new plants in Toronto and Montreal. At present designing dftsman., United Engineers & Constructors (Canada), Ltd., Montreal.

References: E. G. Fiegehen, R. H. Findlay, G. R. Pratt, F. A. Combe, C. O. Thomas.

FRITH—JOHN ROWLAND, of 3429 Peel St., Montreal, Que., Born at Saint John, N.B., July 14th, 1907; Educ., B.Sc. (Chem.), McGill Univ. 1927; 1925-26 (summers), lab. and engrg. work, Howard Smith Paper Mills Ltd., Cornwall, Ont.; 1928 (Mar.-Aug.), plant chem'l. work, Proctor & Gamble Co. of Canada, Ltd., Hamilton, Ont.; Aug. 1928 to Jan. 1929, foreman in charge of production, and Jan.-Aug. 1929, acting supervisor in charge of all soap factory production for above company at Hamilton; Aug. 1929 to Aug. 1930, sales engr., The Peoples Gas Light & Coke Co., Chicago, Ill.

References: E. Vinet, C. W. Stokes, C. C. Kirby, W. F. McLaren, J. A. Coote, C. M. McKergow.

GRIFFITHS—WILLIAM ERIC, of Montreal, Que., Born at Ilford, Essex, England, Mar. 1st, 1901; Educ., Now in fourth year, civil engrg., McGill Univ.; 1923-26, gen. office and field work, E. M. Proctor, M.E.I.C.; Dec. 1926 to Oct. 1927, instr'man and dftsman., Dept. of Sewers, Toronto; 1928 (May-Sept.), instr'man., survey of flooded areas, MacLaren Dam, Que., for S. E. Farley, A.M.E.I.C., Ottawa; May 1929 to Mar. 1930, instrument and layout work, MacLaren Dam, for H. S. Ferguson & Co.

References: E. Brown, R. DeL. French, E. M. Proctor, G. Phelps, O. L. Flanagan, R. E. Jamieson.

HYLLAND—EINAR NYSOM, of Beauharnois, Que., Born at Kingsvinger, Norway, June 17th, 1907; Educ., Diploma in Engrg., Technical Univ. of Norway, 1929; 1927, rodman and instr'man., 1928, dfting., Norwegian National Rlys.; July 1929 to Apr. 1930, asst. to supt., British Metal Corpn., Stirling Mine, N.S.; April 1930 to date, designer, Beauharnois Construction Company, Beauharnois, Que.

References: F. H. Cothran, M. V. Sauer, J. A. Knight, O. B. Bourne, P. G. Gauthier, R. H. Reid.

LALAND—ARNE, of 89 Madison Ave., Montreal, Que., Born at Buenos Aires, Argentina, Feb. 22nd, 1903; Educ., Grad. Civil Engr., Technical Univ. of Norway, 1926; 1926 (June-Oct.), chief of surveying party, Geod. Dept. of Norges Geografiske Opmaaling, Oslo, Norway; Dec. 1926 to Aug. 1927, struct'l. steel detailer and checker, Bethlehem Steel Co., Bethlehem, Pa.; 1927 (Aug.-Nov.), struct'l. detailer and checker, Whitehead & Kales Co., Detroit, Mich.; Nov. 1927 to Aug. 1928, struct'l. engr., with Louis Kamper Inc., Detroit, Mich.; 1928 (Aug.-Dec.), concrete engr., with Trussed Concrete Steel Co. of Canada, Ltd., Montreal; Dec. 1928-Jan. 1929, conveyor engrg., Jarvis B. Webb Co., Detroit, Mich.; Jan. 1929 to Sept. 1930, struct'l. engr. with J. W. Cummings Mfg. Co., New Glasgow, N.S.; at present, concrete engr. with Messrs. J. M. Eugene Guay, Inc., Keefer Bldg., Montreal.

References: F. R. Faulkner, W. P. Morrison, F. G. McPherson, A. G. Tapley, W. H. Noonan, S. Svenningson, A. R. Chambers.

LAURENCE—EMILE, of 1130 Fairmount Ave., Outremont, Que., Born at Montreal, Feb. 28th, 1903. Educ., B.A.Sc. and C.E., Ecole Polytechnique, Montreal, 1926; 1922-23-24 (summers), surveying and topography; June 1926 to Feb. 1927, field engr. and instr'man., Dufresne Construction Co.; 1927 (Feb.-Aug.), reinforced concrete designer, Montreal Water Board; Aug. 1927 to Sept. 1928, survey engr., American Laundry Machinery Co., Cincinnati, Ohio; Nov. 1929 to Sept. 1930, steel detailer, Dominion Bridge Company; Sept. 1928 to Nov. 1929, steel detailer, L. A. St. Pierre, Esq., consltg. engr.; at present, estimator and sales engr., George W. Reed & Co. Ltd., Montreal.

References: E. Cormier, A. Frigon, A. Peden, C. J. Desbaillets, A. Cousineau, A. Duperron, T. J. Lafreniere, F. C. Laberge, J. A. Lalonde.

LEROUX—LOUIS JOSEPH, of Outremont, Que., Born at Ste. Monique, Que., Jan. 12th, 1881; Educ., B.A.Sc., Ecole Polytech., Montreal, 1906; 1906-07, struct'l. steel detailing, McClintic & Marshall, Pittsburgh; 1907-10, struct'l. steel detailing, Structural Steel Co., Montreal; 1910-11, plan preparation, Quebec Bridge Commission; 1911-18, struct'l. checker, St. Lawrence Bridge Co.; 1918-19, checking of plans for bldg. inspection, and from 1919 to date, design and supervision of constru. of various subways, bridges, etc., for the City of Montreal.
References: H. A. Terreault, G. H. Duggan, L. R. Wilson, D. C. Tennant, G. R. MacLeod, C. J. Leblanc, E. A. Forward, J. E. Blanchard, P. L. Pratley, P. B. Motley, A. R. Ketterson.

MANNING—RALPH CLARK, of Toronto, Ont., Born at Hamilton, Ont., Aug. 15th, 1895; Educ., B.A.Sc., Univ. of Toronto, 1917; Prelim. D.L.S. cert.; 1915-16 (summers), instr'man. on constrn., Toronto-Hamilton Rly.; 1917 (summer), stadia survey in Sask. as party asst.; 1918-20, chief dftsman., Union Pacific Rld., Green River, Wy.; 1920-24, steel and concrete design, Truscon Steel Co., Youngstown, Ohio; 1924-26, chief engr., Truscon Steel Co., Chicago, Ill.; 1926-30, sales and designing engr. at Buffalo and Toronto, Jones & Laughlin Steel Corpn.; at present, district engr. for the Canadian Institute of Steel Construction, Bank of Hamilton Building, Toronto, Ont.
References: F. L. Haviland, E. V. Deverall, E. A. H. Menges, A. R. Robertson, W. W. Gunn.

MUDGETT—GUERNSEY FURMAN, of 327 James Street South, Hamilton, Ont., Born at Detroit, Mich., Feb. 4th, 1901; 1918-21, Pratt Institute, Brooklyn. 1 year, Industrial Mech'l. Engrg., 2 years, Industrial Elect'l. Engrg. Cert. of Graduation, June 1921; 1922-23, Westinghouse graduate student ap'tice course; 1923 to date, with the Westinghouse Electric & Mfg. Co., as follows: 1923-25, illuminating engr. at South Bend, Ind., 1925-26, illuminating engr., at Cincinnati, Ohio; 1926-30, mgr., illumination divn., Canadian Westinghouse Company, Ltd., Hamilton, Ont.
References: H. U. Hart, W. F. McLaren, H. A. Ricker, J. R. Dunbar, E. M. Coles, G. W. Arnold.

ROSS—DAN, of 921 St. Clair Ave., Toronto, Ont., Born at Glasgow, Scotland, May 7th, 1902; Educ., 1920-24, Royal Tech. College, Glasgow; 1919-23, workshops, 1923-26, dftsman., Barr & Stroud Ltd., Engrs., Glasgow and London; 1926-27, asst. to chief dftsman., William Beardmore & Co. Ltd., Parkhead Steelworks; 1927 to date, plant layout engr. i/c of design and install'n. of equipment and all constrn. work, Willys Overland Ltd., West Toronto, Ont.
References: C. S. L. Hertzberg, A. H. Harkness, J. J. Spence, L. A. Badgley, C. J. Madgett.

SHUTTLEWORTH—WILBUR IRVIN, of 192 James Street, Ottawa, Ont., Born at Ottawa, Ont., Oct. 4th, 1901; Educ., 1916-20, Ottawa Collegiate. Private tuition; 1917 (4 mos.), rodman and dftsman with city engr., Ottawa; 1922 (6 mos.), recorder on precise levelling party, Geod. Survey, Ottawa; 1924 to 1927 (6 mos. each year), instr'man. and asst. engr., Geod. Survey, Ottawa; Sept. 1927 to Aug. 1928, instr'man., Gatineau Power Co., Ottawa; 1929 (Apr.-Sept.), engr. on three tunnels, Foundation Company of Canada, Montreal; Sept. 1929 to Feb. 1930, engr. on pulp mill extension, etc., MacLaren Lumber Co., Buckingham, Que.; 1930 (Mar.-July), engr. on Log Lodge Hotel, and Aug. 1930 to date, engr. in water dept., Lucerne in Quebec.
References: R. DeL. French, C. B. Breed, M. D. Stewart, W. Griesbach. C. O. Whitman, F. E. Holland.

TRACY—EDGAR HERBERT, of 525 Bolivar St., Peterborough, Ont., Born at Harvey Stn., N.B., July 22nd, 1900; Educ., B.Sc. (E.E.), Univ. of N.B., 1930; 1916-25, ran a steam plant for the C.P.R. (pumping water); 3 mos., elect'l. dept., C.P.R., Union Depot, Toronto; June 1930 to date, student test course, Canadian General Electric Company, Peterborough, Ont.
References: W. M. Cruthers, W. E. Ross, L. DeW. Magie, A. B. Gates, B. L. Barns, A. F. Baird.

TURTON—EDWARD PURCELL, of Montreal, Que., Born at Leeds, Yorks., England, May 11th, 1905; Educ., 1918-23, The Central School, Leeds, Matric.; Post-Matric. course for apprentices at Leeds Polytechnic; 1923-24, engr's ap'tice, Green & Son, Leeds; 1925 to date, with the Northern Electric Co. Ltd., Montreal, 2 years, circuit dfting., 3½ years, dial system equipment engrg., and at present, engr., Technical Publications Dept.
References: N. L. Morgan, W. B. Cartmel, N. L. Dann, A. J. Lawrence, H. J. Vennes.

WRIGLEY—TOM, of 1729 Gouin Blvd. West, Cartierville, Que., Born at Oldham, Lancashire, England, Oct. 22nd, 1896; Educ., 1909-14, Oldham Technical Institute. Intensive home study on mech. design and mfg. methods; 1909-14, ap'tice, works and dfting office, Messrs. Haighs Ltd., Oldham; 1914-16, jig and tool dftsman., Rolls Royce Ltd., Derby, England; 1916-18, designer of jigs, tools, special machine tools, Crossley Motors, Manchester, England; 1918 (Feb.-Dec.), designer and checker, jigs and tools, Avro Aircraft, Manchester; Dec. 1918 to Feb. 1921, designer and checker, jigs and tools, Henry Ford & Co., Cork, Irish Free State; 1921-28, designer and consultant, Messrs. Platt Bros. & Co. Ltd., Oldham; Sept. 1928 to Mar. 1929, designer and checker, General Motors Corpn., Oshawa, Ont.; Mar. 1929 to Apr. 1930, jig designer, Curtiss Reid Aircraft, St. Laurent, Montreal; Apr. 1930 to date, dftsman., Dominion Rubber Co. Ltd., Montreal.
References: W. McG. Gardner, W. H. Cook, R. Ford, T. M. Moran, M. L. Walker.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

CIMON—HECTOR, of 87 Park Avenue, Quebec, Que., Born at Riviere du Loup, (en bas), Que., April 28th, 1893; Educ., B.A., 1912, B.A.Sc. in C.E., 1916, Ecole Polytechnique, Montreal; 1912-13-14 (summers), with Dept. P.W. of Canada; 1916 to date, with Price Bros. & Co. Ltd., as follows: 1916-19, in charge of surveys for several water power developments and storage reservoirs, meterings of stream flow, preparation of plans and estimates for dams, mills bldgs., etc., inspections and investigations; 1919-23, design and direct supervision of constrn. of various engrg. works including substructure and approaches of steel highway bridge over Saguenay River, three-mile log flume, timber and concrete dams, waterworks and filtration plant, etc.; 1923-30, in charge of engrg. works for the South Shore Divn. of the company, including design, constrn. and mtce.
References: W. G. Mitchell, A. R. Decary, O. O. Lefebvre, A. B. Normandin, A. Lariviere, A. Frigon.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

FRASER—JOHN DOUGLAS, of 29 Larch Street, Halifax, N.S., Born at Halifax, Apr. 7th, 1902; Educ., B.Sc., Dalhousie Univ., 1923. B.Sc. (M.E.), McGill Univ., 1925; 1925-26, student engr., General Electric Company, Lynn, Mass.; 1926-27, air compressor test engr., with same company; 1927 (Mar.-Aug.), asst. supt., Electric Washing Machine Divn., Lauders, Frary & Clark, New Britain, Conn., in charge of inspection, planning factory layout, research, and designing, and general operating under supt. (asst. in charge of 150 men, including 6 foremen); Sept. 1927 to Dec. 1928, asst. plant engr., and Dec. 1928 to date, plant engr., Moirs Ltd., Manufacturing Confectioners, bakery products, wood boxes and paper boxes. In charge of mtce., constrn., installn., power, etc., and service dept. consisting of 8 supts. and 65 men.
References: J. H. Winfield, C. H. Wright, W. P. Copp, H. F. Bennett, K. L. Dawson.

TISON—MAURICE, of 2619 Leclaire Avenue, Montreal, Que., Born at Montreal, Apr. 25th, 1895; Educ., 3½ years, McGill Univ., 1915-16-19-20; 1912-14 (summers), asst. on engrg. staff, City of Maisonneuve; 1916 (summer), munition inspr., Canada Cement Co.; 1917 (summer), cable elect'l. testing, Northern Electric Co. Ltd.; 1915 (summer), asst. to supt'g. engr., Paving & Constrn. Co. of Canada; 1917-19, overseas, Lieut., R.A.F.; 1919 (summer), appraisal work, Ottawa Tramway Co.; 1920-23, elect'l. engr., on design of elect'l. structures, control boards, switchboards, etc., for low level pumping station, Montreal Water Board; 1923 to date, elect'l. engr. in charge of mtce., Electrical Commission of Montreal.
References: C. V. Christie, G. E. Templeman, C. J. Desbaillets, J. F. Brett, L. L. O'Sullivan.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

BUTLER—ERNEST W. R., of Winnipeg, Man., Born at Ashton, Ont., March 16th, 1903; Educ., B.Sc. (Mech.), McGill Univ., 1924; 1924-29, sales-service engr., Bailey Meter Company, Ltd., work as supervisor and constrn. and mtce. engr. on equipment in the field which included making efficiency tests and combustion tests in boiler plants all through Canada, and at present in charge of the Western Canada office of the same company, management, sales, service, and testing of boiler plant equipment from Port Arthur to the Pacific Coast.
References: A. R. Roberts, A. R. Greig, J. W. Sanger, C. A. Robb, W. H. Stuart, N. M. Hall.

GEALE—CHARLES NORMAN, of Port Colborne, Ont., Born at Montreal, Que., March 31st, 1891; Educ., B.A.Sc., Univ. of Toronto, 1915; 1915-20, overseas, R.A.F. and R.N.A.S.; 1911, general survey work, Peterborough; 1912, township outline survey, Sudbury Dist.; 1913, colonization roads, Cochrane Dist.; 1920-21, instrument work, etc., on canal lock and dam constrn. at Bobcaygeon, Ont., Trent Canal; 1921-23, asst. to engr. in charge on constrn. of dam and power house substructure at Nassau, Trent Canal; 1923-24, gen. canal constrn., etc., head office, Trent Canal, Peterborough; 1924-27, asst. to engr. in charge on constrn. of canal, including breakwalls, bridge abutments; 1927-30, highways and general canal constrn. and office work, Welland Ship Canal.
References: A. J. Grant, E. G. Cameron, E. P. Murphy, R. L. Dobbin, G. Kydd.

HENDERSON—GORDON R., of Montreal, Que., Born at London, Ont., Mar. 6th, 1900; Educ., B.Sc., Queen's Univ. 1925; 1925-27, student ap'tice course, H.E.P.C. of Ontario; 1927-28, designer and water wheel work, Dominion Engineering Works, Ltd.; Sept. 1928 to date, constrn. and gen. engrg. with Power Corporation of Canada, Ltd., Montreal.
References: W. P. Wilgar, J. N. Stanley, H. S. Van Patter, J. S. H. Wurtele, F. R. Leadley.

JOHNS—CHARLES FREDERICK, of Sackville, N.B., Born at Portsmouth, England, Nov. 24th, 1903; Educ., B.Sc., Mount Allison Univ., 1928. 1919-24, ap'ticeship in elect'l. engrg. dept., His Majesty's Dockyard, Portsmouth, last two years in charge of party; 1926-28, attached to Royal Can. Corps of Signals for summer courses; Qualified for commission R.C.C.S., June 1928; Qualified for position as asst. prof. of aeronautics, at Univ. of Oklahoma, July 1930; instructor in physics, Mount Allison Univ., 1925-28, Mount Allison Ladies College, 1926-28; 1928 to date, in charge of engrg. dept., Enterprise Foundry Co. Ltd., Sackville, N.B., design of equipment and planning of install'ns. for domestic and industrial heating, also elect'l. equipment.
References: H. W. McKiel, F. L. West, C. S. G. Rogers, F. R. Faulkner, A. A. MacDiarmid.

LEMAIRE—WILLIAM ALFRED, of 4539 Bordeaux Street, Montreal, Que., Born at Montreal, Dec. 1st, 1902; Educ., 3-year day course, Montreal Technical School, received Prov. Govt. Diploma, May 1927; 1 year private tuition, engrg. maths.; 1 year, struct'l. engrg. course, Dominion Bridge Company; 1916-18, ap'tice on engrg. staff, Spartan Machine Co. Ltd.; 1918-20, ap'tice on mtce. staff, Crane Ltd.; 1927 to date, struct'l. steel detailer, Dominion Bridge Company, Montreal.
References: N. Cageorge, R. M. Robertson, A. Peden, D. C. Tennant, G. G. Clarke.

NOTMAN—JAMES GEOFFREY, of 771 Roslyn Avenue, Westmount, Que., Born at Westmount, May 6th, 1901; Educ., B.Sc., McGill Univ., 1922; 1919 (summer), tracing, Canada Cement Co.; 1922 to date, with Dominion Engineering Works, Ltd., as follows: 1922-23, foundry engr.; 1923-24, i/c pump design, paper dept.; 1924-26, production engr.; 1926 to date, asst. to general manager, and 1928 to date, also works manager, Chas. Walmsley & Co. (Canada), Ltd.
References: G. H. Duggan, J. C. Smith, F. P. Shearwood, D. C. Tennant, A. Peden, H. G. Welsford, H. S. Van Patter, F. Newell.

ROSS—HUGH GORDON, of Pittsburgh, Pa., Born at Ottawa, Ont., May 4th, 1903; Educ., B.Sc., McGill Univ., 1925; 1925 to date, with Westinghouse Electric & Mfg. Co., Pittsburgh, as follows: 1925-26, graduate student course; 1926 to date, design and development engr., supply engrg. dept., 1926-27, development and design work on power capacitors of oil type and on wax capacitors for various applications such as radio, ignition, lightning arresters, etc., 1927-28, responsible for design of all radio capacitors used in Radiola 16, 17 and 105, and also numerous experimental capacitors for amplifiers and talking movies; 1928-30, responsible for design of further wax capacitors for radiolas and also numerous experimental capacitors for phototone, television, etc.; Jan. 1930 to date, in charge of group responsible for development and design of all wax capacitors, radio capacitors, neon obstacle markers, airway signal devices using capacitors, etc., etc.
References: C. V. Christie, E. Brown, C. M. McKergow, A. K. Hay, H. U. Hart, W. F. McLaren.

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CIVIL ENGINEER, A.M.E.I.C., Canadian, 21 years experience, railways, highways, water-power and conservation, concrete structures, electric transmission lines, etc.; field surveys, office engineering and construction. Working knowledge of French and Spanish. Available about October 1st. Now employed in Mexico. Prefer Canada, but willing to go anywhere. Apply to Box No. 327-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E., Ont., with twenty-four years experience embracing dams, wharves, grain elevators, foundations, pile driving, highways, municipal engineering, water power surveys, road locations, inspections and estimating is open for engagement as engineer or superintendent in construction, operation or maintenance. Location immaterial. Apply to Box No. 358-W.

CIVIL ENGINEER, A.M.E.I.C., university graduate, O.L.S., married, twenty years experience city surveys, calculations for curved surveys, design, layout and supervision, sidewalks, pavements, sewers and water systems. Acted in capacity of chief engineer for large engineering and surveying firm for five years. Best of references. Available on short notice. Apply to Box No. 413-W.

ELECTRICAL AND MECHANICAL ENGINEER, S.E.I.C., educated Oundle and Manchester, age 24. Student course, Brit.-Westinghouse. Three years design, production, advertising, sales and control of sales force on mechanical and electrical goods. One year outside plant engineering leading public utility company. Desires work in sales, production or engineering capacity. Available immediately. Location immaterial. Apply to Box No. 415-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), graduate. Eighteen years experience in survey and construction, railway, hydro-electric and buildings. Experience comprises both office and outside work. Desires responsible position. Would consider position with commercial or manufacturing firm. Available immediately. Apply to Box No. 425-W.

CIVIL ENGINEER, S.E.I.C., 1930 graduate of Nova Scotia Tech. with experience as plane table topographer, instrumentman and draughtsman and particularly interested in hydro-electric power development and reinforced concrete design, desires position. Willing to go to foreign fields. Available at a few weeks notice. Apply to Box No. 431-W.

SALES ENGINEER, B.Sc. (McGill, 1914), A.M.E.I.C., 37, married, presently employed in position of responsibility, desires to communicate with a prominent railway equipment supply house, with a view to becoming its Pacific Coast representative. Has a complete knowledge of railway locomotive equipment particularly. Excellent references can be furnished. Apply to Box No. 444-W.

CONSULTING ENGINEER. A member of The Institute with many years experience in general engineering is open for an engagement in consulting, advisory or inspecting capacity. Would like to meet corporation or large contracting firm to whom such qualifications may be useful. Apply to Box No. 445-W.

ELECTRICAL ENGINEER, S.E.I.C., B.Sc. (McGill Univ., '27), age 26. Fifteen months outside plant engineering with large public utility. Twenty months sales engineering experience with electrical manufacturing company. Available on reasonable notice. Apply to Box No. 463-W.

ELECTRICAL ENGINEER, B.Sc. (McGill), Jr.E.I.C., age 28, graduate Canadian General Electric Company test course, with two years experience in the design of induction motors and direct current machines. Previous experience includes electrical installation in large paper mill, and assistant to engineer in charge of small utilities company. Married. Location immaterial. Apply to Box No. 466-W.

CIVIL ENGINEER, experienced in road construction, mine surveying, transmission line survey and construction; paper mill construction; age 27. Available on short notice. Apply to Box No. 468-W.

CIVIL ENGINEER, A.M.E.I.C., age 39, with wide experience on design and construction of reinforced concrete structures, desires position. Apply to Box No. 475-W.

PLANT ENGINEER, A.M.E.I.C., age 37. Experienced in layout and maintenance of plant equipment. Special study in plant efficiency using Bedaux system and setting of standard rates and bonus payments. Apply to Box No. 485-W.

Two-Fluid Cycles for Power Plants

If water served no other purpose, one might almost suppose that it was specially provided by nature to lead mankind to the invention of steam engines. The high latent heat of its vapour and the useful pressures obtainable at very moderate temperatures combined to make steam an almost ideal working fluid for such engines as could at first be constructed. But while the art of engine building has advanced, the properties of water have remained stationary. Its cheapness and innocuousness are as valuable as ever, but the very fact that it provides a fairly high pressure at a comparatively low temperature involves the corresponding disadvantage that the pressure becomes higher than is generally desirable before the boiler temperature can be raised to the point which the designer would like. Any steam temperature required can, of course, be obtained by superheating, but the greater the amount of superheat, the further the conditions recede from the thermodynamic ideal of putting the whole of the heat into the working fluid at the highest temperature of the cycle. The falling off of the latent heat as the pressure is increased is, for the same reason, a further disadvantage from the thermodynamic point of view. The physical properties of water therefore at the upper temperature of a modern steam cycle leave much to be desired. We are, indeed, very close now to the limits of steam engineering as regards efficiency, unless something can be done to improve the conditions of the heat-receiving portion of the cycle. As to the low-temperature portion, nothing seems likely to have greater merits than steam as a working fluid, so that the only course open for progress would appear to be in the direction of some two-fluid cycle. According to this scheme, one fluid would receive heat in the boiler, and after doing its allotted work, would reject its unused heat to a heat exchanger, in which steam would be generated for the production of further useful work.

The idea of a two-fluid cycle is by no means new. The trouble is to find some suitable substance for the high-temperature work. The only thing which nature seems to have given us more or less ready-made is mercury. This has both good and bad properties. In its favour is the fact that the pressure of mercury vapour, even at a temperature of 1,000 degress F., is only about 180 pounds per square inch, so that its use would render practicable an upper temperature for the heat cycle far higher than is possible with steam alone. The poisonous nature of mercury vapour is, however, one obvious drawback, and its very small heat capacity is another. Nevertheless, a mercury-steam cycle on a commercial scale has been in operation for some years in a power station at Hartford, Conn., though whether Mr. Emmet's enterprise in this direction will ever be largely followed is doubtful, if only for the fact that there is not enough mercury in the world to enable it to be used on any considerable scale for power production. If, then, we have to dismiss mercury as an auxiliary working fluid, the only alternative appears to be the use of some synthetic product. This possibility, moreover, opens up quite new avenues for exploration, both by chemists and engineers. The former are required to find some reasonably cheap material possessing the useful characteristics required, and as harmless as possible, both to man and metal. The greater the measure of their success, the less will be the difficulties of the engineer, though the latter in any case will have to devise means of dealing with liquids and vapours having properties very different from those of water and steam. Ammonia has long been employed as refrigerating medium, so that if it should prove the most practical substance for the high temperature part of a two-fluid cycle, the problems may be less serious. The possibilities of ammonia were discussed in considerable detail by Dr. E. Koenemann in a paper presented by him at the recent World Power Conference in Berlin.

An overall thermal efficiency from fuel to shaft horse-power of 32.4 per cent would be realized according to the calculations given, and even this figure would be improved on with a higher steam pressure for the second portion of the cycle. The chemicals, moreover, are cheap and non-corrosive, and there is no reason why the plant should be expensive in first cost. Under experimental conditions, the ammonia salts have given no trouble, the boiler pipe work and pump metal being unattacked by them. Nor has there been any difficulty with leakage at the flanges. The design of effective turbine glands to prevent the escape of ammonia vapour and stuffing-boxes on the pumps to retain hot ammoniates are obviously matters incidental to the proper functioning of a plant on the lines proposed by Dr. Koenemann, but a lot can be done with the incentive of an overall thermodynamic efficiency of well over 30 per cent. The realization of such efficiencies with turbine machinery and boilers would still further weaken the position of the internal combustion engine, hard pressed as it now is by steam, and relegate to some unknown future the day so often confidently predicted when explosion engines would be the universal source of thermal power.

—*The Engineer.*

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Wharf Extension, Father Point, P.Q.," will be received until **12 o'clock noon, Thursday, November 20, 1930,** for the construction of an extension to the wharf, at Father Point, County of Rimouski, P.Q.

Plans and form of contract can be seen and specification and forms of tender obtained at this Department, at the offices of the District Engineer, St. Lawrence Power Building, Rimouski, P.Q., L'Association des Constructeurs de Québec, 267 St. Paul Street, Quebec, P.Q., and at the Post Office, Father Point, P.Q.

Tenders will not be considered unless made on printed forms supplied by the Department and in accordance with conditions contained therein.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, equal to 10 per cent of the amount of the tender. Bonds of the Dominion of Canada or bonds of the Canadian National Railway Company will also be accepted as security, or bonds and a cheque if required to make up an odd amount.

Note.—Blue prints can be obtained at this Department by depositing an accepted cheque for the sum of $20.00, payable to the order of the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,

N. DESJARDINS,
Secretary.

Department of Public Works,
Ottawa, October 30, 1930.

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CONTENTS

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The Construction of the Steel Lock Gates of the Welland Ship Canal

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Paper to be presented before the Annual General and General Professional Meeting of The Engineering Institute of Canada at Montreal, February 4th, 5th and 6th, 1931.

SUMMARY—The fabrication and erection of the Welland ship canal gates presented several shop and field problems which were of great interest, and some of which appeared to be entirely outside of previous Canadian experience. It, therefore, seemed that a description of some of these might be of interest to the members of The Engineering Institute of Canada.

In the original design of the gates, and in the original measures adopted by the contractor and sub-contractors to ensure a good and thoroughly efficient structure, some precautions to ensure accuracy and watertightness were taken, which afterwards either proved, or appeared, to be unnecessary; while on the other hand, certain refinements might have been made which would have in the end reduced the cost of the work.

Examples of the first condition were: the punching of all field holes one-eighth inch smaller than the diameter of the rivet was found to be quite unnecessary due to the use of modern spacing tables and multiple punches. The construction of the 82-foot gate endposts in one length in the shop does not seem to have been necessary, and certainly added very greatly to the difficulty and cost of the work.

As an example of the second condition, the frames may be cited; it was specified that these be fabricated by ordinary structural practice. However the apparently unavoidable toeing in of the connection angles rendered the securing of a watertight job very expensive. It would have been much better had the ends of the frames been milled to a true plane surface.

The particularly interesting points in connection with the contract were:—

1. The method adopted to secure a uniform length for all girders, and the accurate machining of their ends, at the same time locating the holes for attaching the diaphragms.
2. The shop fabrication and erection of the endposts.
3. The adjustment of the end bearing plates to a practically true line, and the measuring for and machining of the shims to attain this end.
4. The erection of the spare leaves vertically in lock No. 2, and then the procedure of placing them in a horizontal position, and floating them to the gate yard.

The contract for the construction of the steel lock gates for the Welland ship canal was awarded in the spring of 1926 to the Steel Gates Company, Ltd., of Montreal, of which Mr. William Lyall was president and the author manager and chief engineer.

In this paper it is the author's intention to deal with some of the problems encountered in the actual construction of these gates and the means taken to solve them. It will be assumed that all are familiar with their design, as this has been thoroughly dealt with by F. E. Sterns, M.E.I.C., in his paper presented at the Annual Meeting of The Institute in 1928, and therefore only those details of design which are necessary to the understanding of this paper will be touched upon.

The frame of a leaf consists of a series of horizontal plate girders, placed at from 4- to 5-foot centres, and supported one upon the other by end diaphragms, frames, and intercostals. The end diaphragms are designed to transfer the end thrusts, due to water pressure, when the leaves are mitred together, into the girders. The frames and intercostals are designed to transfer the water pressure from the skin plates to the girders, the former also being designed to keep the girders vertically over each other. The girders are also held in their proper position by heavy continuous endposts running from top to bottom of the leaf, these posts being in effect vertical girders. The frame, when thus assembled, is covered both on the upstream and downstream side by sheathing plates running between the endposts and joined together along the centre line of the flange of each girder; and lastly, doubling plates about 48 inches wide, running vertically from top to bottom of the leaf, are placed at each end of the up and downstream faces, passing outside the sheathing plates and under the flange of the endposts.

To this steel framework were attached the various castings and forgings, which were necessary for the support and operation of the leaf, such as anchorage eyebars and pin, pintle casting, sheaves, end bearing castings and end bearing plates, the two latter items running from top to bottom of the leaf at the quoin and mitre ends, and attached to the endposts by 2-inch turned bolts, their purpose being to transfer the thrusts to the frame, and to seal the joints between the mating leaves, and between each leaf and its corresponding quoin bearing. The general arrangement described above is shown in figures Nos. 1 and 4.

The two main points to be considered in planning the shop work were: the ultimate watertightness of each leaf, and the extreme accuracy in the length of girders, so that any leaves of the same height would be interchangeable. In addition to these, the best method of ensuring a satisfactory assembly of the endposts, girders, skin plates and doubling plates at the quoin and mitre ends of each leaf had to be studied.

The endposts are of constant section, and had to be shop fabricated into one piece the total height of a leaf. The sections of the endposts of an 82-foot leaf are shown in figure No. 1.

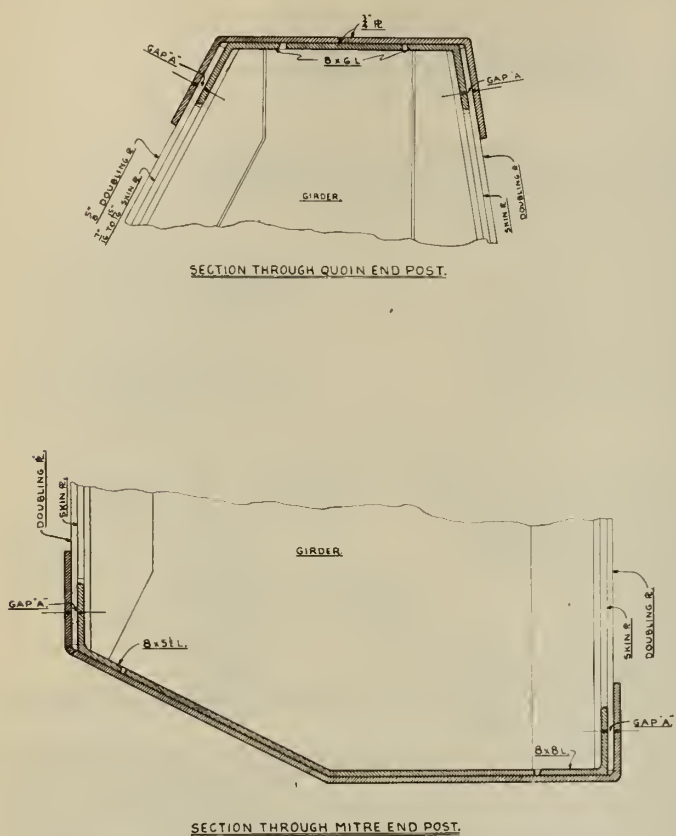

Figure No. 1.—Sections of End Posts—82-foot Leaves.

The girders enter between the 8-inch by 4-inch angles and their ends are faced to bear on the endpost web. The up and downstream doubling plates, which are of constant thickness, enter between the backs of the 8-inch angles and the flanges of the endpost plates, while the skin plates assemble between the girder flanges and the doubling plates. These skin plates vary in thickness from 15/16 to 7/16 of an inch and had the original design of constant depth girders been adhered to, the gap "A" between the 8-inch angle and the endpost flange would have had to be slightly over 15/16 of an inch, and a series of thin wedge-shaped shims used with all thinner skin plates. It was, therefore, suggested to the engineer in charge that the outside face of all skin plates be kept flush with the back of the 8-inch endpost angles, varying the depth of the girders to secure this condition. When the skin plates were under ¾ of an inch thick the ends of the girder flange angles were crimped, and when over, shims were used between the girder flanges and the skin plates.

As to clearances, the in-to-in of endpost angles was made 1/32 of an inch greater than the back-to-back of girder angles, and the space of entry of the 5/8-inch doubling plate was made 21/32 of an inch at the root and 11/16 of an inch at the outside edge. On the whole, these clearances were found satisfactory, though in some cases considerable trouble was experienced in entering the doubling plates.

The endpost plate as originally designed was in one piece, bent and flanged to the proper shape for the ends of the leaf. The practicability of flanging ¾-inch plates approximately 80 feet long to the required tolerances for clearance and straightness was taken up with several of the largest firms on the continent, and the conclusion was reached that a variation of at least ¼ of an inch must be expected, which was entirely too much. Welding was finally adopted as the solution and the endpost plate was built up by welding all longitudinal seams, and, for the 82-foot posts, making the plates in three lengths with two horizontal welds; the welds in the flanges breaking joint with those in the web.

A great deal of trouble was naturally experienced in developing an efficient shop practice for the manufacture of these posts. Heavy steel forms set in concrete pedestals and carefully lined and leveled were set up at from 4- to 5-foot centres, corresponding to the centres of the girders in the finished leaf, and to these the plates were bolted for welding. The first plates assembled were subpunched throughout. After welding, a total shrinkage in length of nearly ¾ of an inch was discovered, and it was necessary to scrap these plates. Thereafter the endposts were drilled from the solid after welding and after the inside filler plate had been assembled. The holes in the 8-inch leg of the post angles were drilled after assembling and riveting to the posts, at the same time as the holes in the flanges of the endpost plate. All drill burrs on the inside of the flanges were carefully scraped off to allow the doubling plate to be freely entered. The holes in the doubling plate were similarly scraped.

The endposts of the smaller gates were made in the same manner, but with a great deal less trouble, there being little difficulty experienced in securing accurate work on the 35-foot posts. Therefore should it be necessary to build other high gates of a similar design, it might be better to have the endposts shipped to the field in two or three lengths and connected up after assembly in the leaf, with efficient riveted or welded splices.

To ensure proper transmission of horizontal thrust into the girders and to keep the girder ends properly aligned the vertical end diaphragms were specified to be planed on the top and bottom and on the vertical face bearing on the endposts so that top and bottom faces should be truly parallel and at right angles to the vertical face. In fabrication, the web plates of the diaphragms were planed before the connection angles were assembled and riveted to them, and the outstanding legs of these angles were not punched. When assembled and riveted the angles on the three sides were planed down to the planed edges of the web plate, and the field holes were drilled in them to steel templates (all

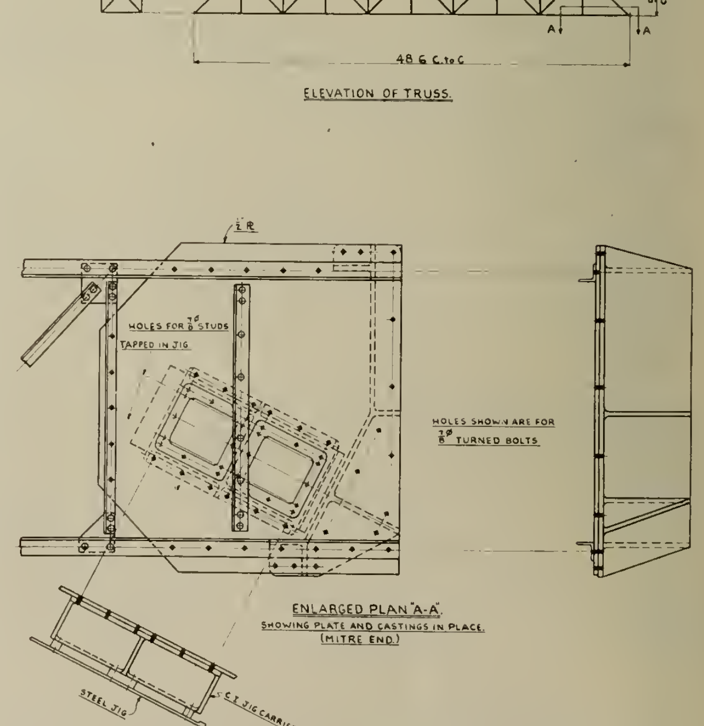

Figure No. 2.—Jigs for Girders—82-foot Leaves.

templates having case-hardened bushed holes) which had been drilled to match similar templates used for drilling the corresponding field holes in the girder webs.

The vertical frames, which with the intercostals transmit the water pressure from the skin plates to the girders, while not specified to require the same accuracy as the diaphragms, proved, with the exception of the endposts, the most troublesome pieces to deal with. To secure watertight rivets they had to be practically truly rectangular, and the outstanding legs of the flange angles practically at right angles to the web.

The former condition was taken care of at first by assembling and riveting all frames in rectangular jigs. Unfortunately these jigs were not made stiff enough, and when the fabrication was about two-thirds finished, several of the jigs became more or less distorted, and had to be abandoned. Thereafter a very careful hand squaring of the frames was resorted to.

The fact that a large proportion of the angles supplied by the mills toed in between 1/8 and 3/16 of an inch led to great trouble in the field, which will be discussed when describing the erection.

Jigs were also made and used at first for the assembly of the intercostals, but it was found that sufficient accuracy could be obtained by careful assembly, and the jigs were abandoned.

In the girder assembly care had to be taken to ensure an accurate and constant width at the ends between flange angles to ensure a neat fit between the endpost angles. To secure this, two heavy U-shaped castings were made to fit over the girder ends, and to these the girder flange angles were bolted. These castings each had two accurately located reference points marked on them, and they were carefully set for distance and square by tape measurement, which gave sufficient accuracy of assembly for everything except the end diaphragm holes and the machined length. The actual overall length of girders, within a normal tolerance, was not important, but it was most important that all girders should be the same length. To obtain this result, a lattice truss bridge was made 48½ feet long, 5 feet wide and 5 feet 4 inches deep. Castings similar to those used for squaring the girders, and having large steel plates bolted to their top flange, were attached to the first girder built. The bridge was then placed on these plates, 7/8-inch holes were drilled through the bottom chords of the bridge, and the plates were carefully bolted to it with 7/8-inch turned bolts. The castings were then detached from the girder and the bridge lifted, taking with it the plates and castings, thus forming a jig, which was used in finishing all the other girders. Cast iron jig carriers, carefully set in relation to the end castings, were also bolted to the bridge plates. The proper jigs for drilling the holes in a girder to match the diaphragm connecting to it were fastened to the carriers by stud bolts, and the bridge was then placed on each partly finished girder and connected to it through the end castings. (Figure No. 2.) A few holes were drilled in the girder web through the jigs; the jigs bolted to the girder; the studs removed and the bridge taken away, leaving the jigs attached to the girder, which was then drilled and end planed from them.

All the steel and iron castings, the forgings and bronze work were sublet to one firm, who supplied them to us finished ready for assembly in the work, and the only point to be touched on in this connection is, that 8-inch by 3½-inch and 12-inch by 3½-inch wrought steel bearing plates were supplied as slabs by the Algoma Steel Company of such excellent quality that they met the tests of the American Society of Testing Materials specifications for steel forgings, class E, without forging being necessary, and so far as is known, with no rejections after planing.

The manshafts, which are oval steel tubes, and in the case of the 82-foot leaves, 47 feet long, were shipped from the shop in one piece, and were made sufficiently accurate to be dropped down through holes in the webs of the girders, with a clearance allowance of 1/8 of an inch all around. The original plans contemplated the shafts being assembled and riveted in the field.

The 3½-inch D. E. H. steel pipe for wire rope conduits, sounding well and scuppers, in the gates, were supplied of copper bearing steel in the hope of considerably reducing corrosion.

The sub-contractors for the furnishing of material at the site ready to erect were:—

Hamilton Bridge Company Ltd.	Gate frames and sheathing plates.
Montreal Locomotive Works Ltd.	Castings, forgings, turned bolts, etc.
McGregor, McIntyre, Limited.	Walkways and movable handrails.
Foster Wheeler Company Ltd.	Manshafts and ladders.

Great credit is due all of these firms for the interest which they took in carrying out their part of the work, and for the accuracy with which it was done.

The erection of the gates was commenced in the spring of 1927 under the immediate supervision of Mr. J. O. Childers, with Mr. N. C. Rothgeb as assistant. Mr. Childers had acted as superintendent for the McClintic-Marshall Company in the erection of the Panama canal gates, and Mr. Rothgeb was a foreman on the same work and their experience was exceedingly valuable to the company. Owing to the delays in fabrication, principally of endposts, very little work was done until 1928, so that, as the last of the 64 leaves was completely riveted and placed in position by November 1929, practically the whole of this part of the work was done in two years.

In general, the erection was done with a 25-ton locomotive crane, operating on the lock walls. In some locks,

Figure No. 3.—130-foot Boom and 30-ton Crane at Lock No. 2.

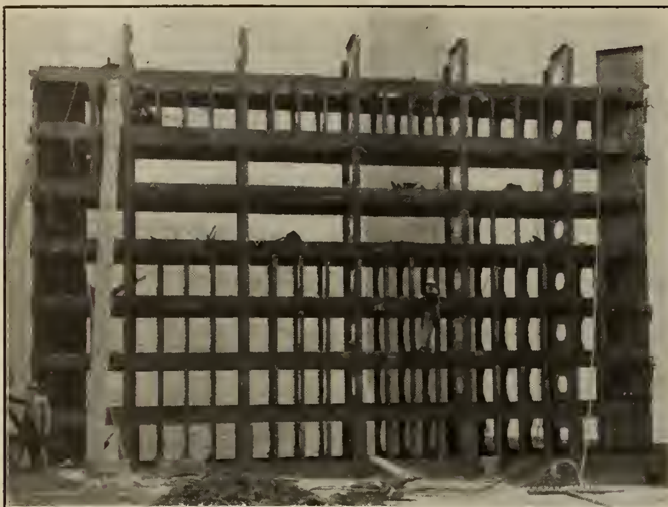

Figure No. 4.—Frame of 82-foot Leaf at Lock No. 1.

however, it was found inadvisable to run tracks on both walls of the lock, and in such cases, a Chicago boom 130 feet long was used to erect the leaf on the far side of the lock. This boom was set and pivoted on the pintle base casting of the opposite leaf and the falls passed through blocks anchored back to the eyebar pins bedded near the top of the lock wall. (Figure No. 3.) The 44-foot 6-inch gates at lock No. 8 were erected by cranes running on tracks in the bottom of the locks.

The bottom girder of each leaf was set on three concrete pedestals, which were carefully set and grouted to the lock floor, in such a position that the leaf, when finished, had to be rolled back about four feet and lowered two and one-half to three inches to its position on the pintle. The final levelling of the girder was made with steel wedges between it and the pedestals. On each girder, before lowering to position, were piled the end diaphragms and the intercostals connecting it to the one next above. The five vertical frames for each tier were strung on one long sling, the first placed, bolted and cast off, then the second, and so on. By this method, the frame of a leaf together with the sheathing plates for one side were set up in from a day to a day and a half. During this process no care was taken to secure accurate alignment, but each girder had to be carefully levelled and the proper shims inserted between the diaphragms, the frames and the girders. (Figure No. 4.)

When the frame of a leaf had been plumbed and bolted the endposts were erected. Owing to their length and flexibility they were the most difficult pieces to handle. In placing them two locomotive cranes were used, one of which was blocked. The post was laid along the lock wall parallel to the track with its upper end next to the blocked crane. Both ends of the slings were attached by angle brackets and pins to the post, each sling having first been rove through a single block, which, in turn, was hooked onto the respective crane falls. The position of the sling attachments to the post was such that about two-thirds of the load came on the blocked crane and one-third on the other.

The two cranes were now placed in position to make the falls vertical and the post was raised off the wall. The forward or blocked crane then raised its end of the post as high as possible, or about 30 feet above the wall, the rear crane advancing at the same time to keep the falls plumb. The booms of the two cranes then swung out so that the post swung clear of the lock wall; the rear crane still advancing. The limit of swing was about 19 feet from centre line of track. The bottom end of the post was then lowered away by the moving crane, which continued advancing until the post was entirely hanging from the blocked crane and within a very short distance of the end of the leaf. The rear crane was cast off and the post was quickly bolted in place. The whole operation took from a half-hour to an hour.

It was during the erection of the fourteenth mitre post that the only serious accident on the work occurred; this was at lock No. 6, one of the locks which have the 82-foot gates about 60 feet apart. In this case the post had been swung out over the lock wall and the rear crane had lowered its end of the post about half-way down, when the crane suddenly toppled over the wall, falling behind the west leaf of the upper gate (already erected) and forcing it over. When the rear crane fell the whole load of the post came suddenly on the forward one, which fortunately held fast, and neither it nor the post were damaged. In this unfortunate accident ten men lost their lives. The cause has never been determined. There is evidence that the boom did not swing out, so either the cranes came too close together, throwing the falls out of plumb and causing the post to sway, or else the rear fall was being let go too rapidly and suddenly stopped, causing impact.

When the endposts were erected the leaf was turned over to the reamers and bolters, who worked from fixed scaffolding (figure No. 5) built up from the lock floor. The specifications called for field holes to be punched or drilled 1/8 of an inch in diameter smaller than the rivet. In most cases the rivets were 7/8-inch, so that the holes were ¾-inch, and 11/16-inch assembly bolts were used.

Owing, however, to the lack of squareness of the angles in the frames it was found nearly impossible to pull the sheathing plates tight to the frames and girders of the first gate, and though the bolts were made of special steel, quite 50 per cent were valueless after their first use. As noted in the next paragraph, the punched size of field holes was increased after the first gate was assembled, and ¾-inch special steel assembly bolts were tried in order to bring the frame angles tight enough to the skin plate to ensure

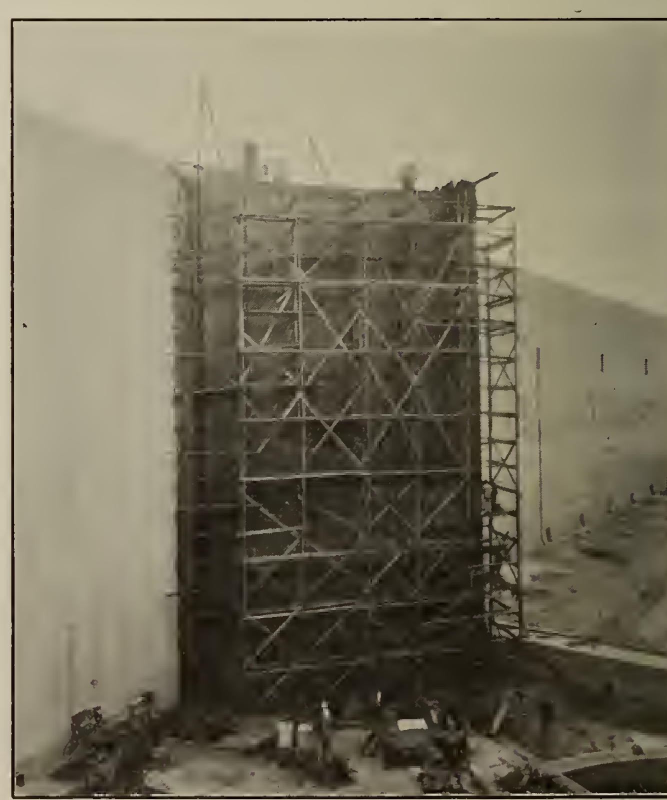

Figure No. 5.—Scaffolding, Downstream Side of Leaf.

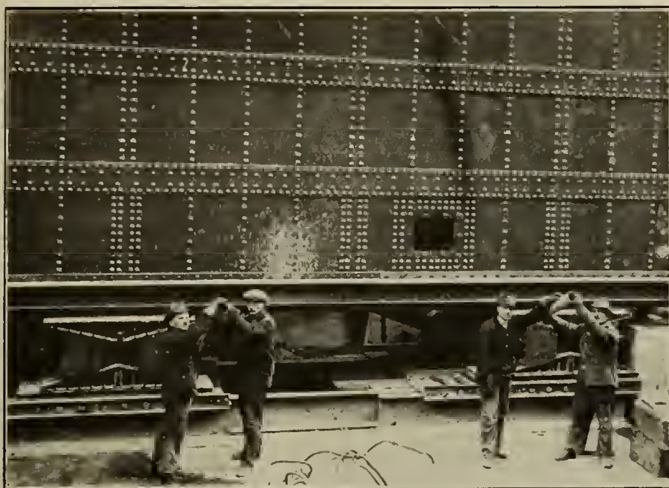

Figure No. 6.—Leaf Resting on Four 200-ton Jacks Ready to Roll Back into Quoin.

watertight riveted work. It was found, however, that so many bolts were spoiled and there were so many loose rivets, that it was better to straighten the angles in the field by hand before assembling. It would, therefore, have been considerably more economical in the end had the frame angles been milled in the shop.

At the same time it was found that the shop work was sufficiently accurate to leave little doubt of the holes cleaning up if punched larger. It was, therefore, permitted to punch 13/16-inch and use ¾-inch bolts; these had an average life of four boltings. In general, every second hole was bolted with ¾-inch bolts, the open holes reamed, and bolted with 7/8-inch bolts, the ¾-inch bolts withdrawn and those holes reamed. The leaf was then turned over to the riveters. When the frame and upstream sheathing plate were riveted the downstream plates were hung and riveted, and finally the up and downstream end doubling plates. Riveting the upstream doubling plates at the same time as the sheathing plates was first tried, but it was found to put a slight wind in the leaf, rendering it very troublesome to line up the end bearing castings.

When the riveting of a leaf was completed the quoin bearing castings were attached and the anchorage pin and quoin sheave pin assembled to the jaw plate and top girder. The holes for the 2-inch turned bolts connecting the bearing castings to the endpost were drilled full size in the castings and 1¾-inch diameter in the post, the original plan being to ream all holes in the post by a reamer operated from the outside and carrying a bronze idler to protect the holes in the castings. There are four vertical rows of these holes, the inside rows coming under the "T" flange of the castings. A special offset reamer was designed for these inside rows, but in operating it proved too slow, and they were reamed from the inside of the leaf by the use of a pilot extension.

The next step in construction covered the setting and aligning of the bearing plates on the hollow quoin, and the quoin end of a leaf. These plates were backed up by steel shims which had to be planed, to correct errors in line and warp in the wall and gate castings and secure a finished bearing surface accurate to within 0.003 inch. Measurements of the castings were taken to piano wires by micrometers equipped with ear phones, readings being taken at the centre and each edge of the bearing plate trough. On plotting these readings it was found that practically all shims required planing to a warped surface. The shims varied from 4 to 5 feet in length. To machine them, a heavy cast slab, carefully finished and having a pedestal at the centre with ball and socket joint, was bolted to a planer and adjusted to the proper angle by means of four screw jacks to allow the plane of the surface to pass through three of the corners of the shim. The shim to be planed was bolted to the slab with countersunk bolts, and where necessary, the fourth corner wedged up on a series of feelers to secure the required warp.

After the bearing plates and shims were bolted in place their alignment was carefully checked, and when necessary, adjustments were made. Temperature changes, both in the concrete of the lock wall and the leaf, were very marked, and it was found impossible to secure a true vertical line in the bearings at all temperatures, so that finally, regular curves were permitted up to about 0.010-inch.

The bearings having been adjusted, the leaf was ready to place in position. The centre concrete pedestal was removed and two rollerpaths, each of three 15-inch 60-pound I-beams were placed on the lock floor, one under each of the sheathings of the leaf, and carefully levelled and grouted. On these were placed four rollernests, and on them wedge-jacks, each operated by a screw and lever. The jacks were of about 200 tons capacity each and were the same as used in placing the Panama gates. (Figure No. 6.)

When the weight of the leaf had been transferred to the jacks, the other concrete pedestals were removed, and the pintle and pintle casting were hung in place under the heel casting. By this means, the distance which the leaves had to be lowered to position was reduced from slightly over 6 inches to 3 inches.

The top of the gate was carefully secured to the east and west lock walls with wire guys having long turnbuckles, and as the gate was rolled back, the guys were kept taut by adjusting the turnbuckles as required. The leaf was moved back by 50-ton horizontal jacks until the pintle casting was in position over the pintle bearing casting, when the wedges on the four supporting jacks were slowly released, until the pintle casting came to its bearing. The top of the leaf was then brought to its proper position

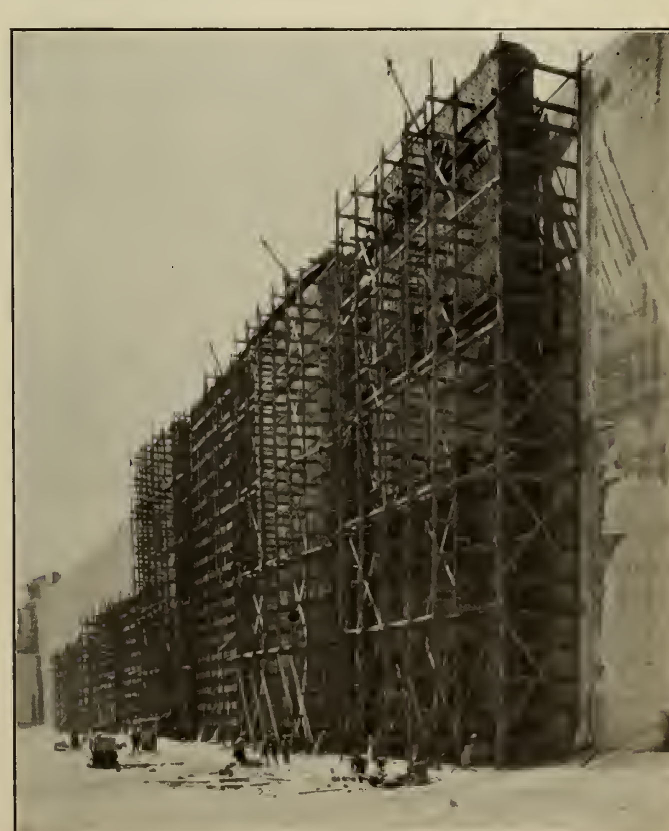

Figure No. 7.—Spare Leaves in the Process of Erection in Lock No. 2.

Figure No. 8.—35-foot 6-inch Leaf with Mitre End Rising as Air is Pumped In.

by adjustment of the four jacks; and the anchorage eyebars, which were pinned to the lock wall, were threaded on the eyebar pin passing through the jaw on the top of the leaf. This operation was the most troublesome of those required to place the leaf, the rolling back taking only a few minutes, while the connecting up of the eyebar sometimes took two hours.

Before any field coatings were applied, the leaves were tested for watertightness, the air chamber being first filled with water and the water level continued up through the manshaft to the top of the leaf. Any leaks in the sheathing, the bottom girder, or the girder between the air and water chambers, were then stopped, and the water let out of the air chamber and pumped into the water chamber, and any leaks found in it were corrected. The gates, as originally built, were tight, and very little work was required in this operation.

The exterior of the gates was specified to have two field coats of oil paint, and for this purpose, a first coat of red lead and a second coat of Gilsonite was adopted. For the interior coating, an asphalt enamel applied hot was called for, but was abandoned and a bituminous enamel applied hot was used on three gates—the 82-foot and 35-foot 6-inch at lock No. 1 and the 82-foot gate at east lock No. 5; the balance of the interior coating was put on with Hydralt, an asphalt emulsion applied cold. As the type of asphalt emulsion used will always remain tacky, all upper horizontal surfaces on which men might have

Figure No. 9.—35-foot 6-inch Leaf Canted Over and Nearly Empty.

to walk in making repairs, or inspecting the gates, were protected with a thin coating of cement sprinkled dry on the emulsion before the latter had set. The asphalt was applied so that its minimum thickness, when set, would be 1/16 of an inch. It is too early to make a definite statement as to the ultimate value of this coating, but some of it has now been on for over a year, and is showing little deterioration, except where exposed to frost or running water before it had set.

Eight spare leaves were furnished under the contract, two of 82 feet, two of 83 feet 4 inches, two of 44 feet 6 inches and two of 35 feet 6 inches, one right and one left of each. It was intended that these leaves should be erected in a gate yard near the lower end of the canal, but owing to a change in the location of this yard, contracts were not let for it until too late to have it in readiness for the building of the gates without undue delay. Permission was therefore received from the engineer in charge to erect these eight leaves vertically in lock No. 2. Concrete

Figure No. 10.—Completed 82-foot Gate.

pedestals were dowelled to the sloping floor of the lock to support the spare leaves in a line, so that the downstream face of the leaves would be about 4 feet away from the lock wall, leaving ample room for a scaffolding all around each leaf. (Figure No. 7.) The erection was carried out in precisely the same way as all the other leaves, and the gate yard being by this time ready to receive them, they were floated down to it, a distance of about 2 miles, and placed in a horizontal position on the skids prepared for them.

To accomplish this last operation, the leaves were filled with water to a sufficient depth to ensure that they would not float from their pedestals when the lock was filled to the level of the top of any leaf; the manhole covers of the manshafts were strengthened to sustain an air or water pressure equivalent to an 80-foot head, and 2-inch pipes were run through the cover down to the bottom of the leaf, one pipe then running along the bottom of the leaf to near the mitre end, and the other to near the quoin end; each pipe was fitted at the top with a shut-off valve; a third 2-inch pipe ran through the manshaft cover, and was connected with an air hose to a compressor on the lock wall. The lock was then filled to a depth of a little over 30 feet, or within a few inches of the level of girder "O" of the 35-foot 6-inch leaves. Air was then run into the first of these leaves at a pressure of approximately 40 pounds, and the water forced out through the two 2-inch pipes until the leaf floated from the pedestals. The leaf was then towed by ropes to near the centre line of the lock, and air again forced in, and the water in the leaf lowered. As the water lowered, the mitre end of the leaf, which had the greater flotation, rose considerably higher than the quoin end (figure No. 8), and as the water continued to be forced out, the waterpipe to the mitre end became dry; as soon as this occurred, its valve was closed, and the balance of the water was forced out through the quoin end pipe.

During this, the leaf gradually leaned over sideways, and by the time the water was entirely removed from the quoin end, it was floating in a horizontal position, with the downstream face towards the bottom. (Figure No. 9.) The leaf was then made fast to the lock wall, and the second 35-foot leaf was floated in the same way. The lock was then filled above the 40-foot level, and the 44-foot 6-inch leaves floated, after which the lock was entirely filled and the 82-foot and 83-foot leaves treated in the same way. This work was commenced about 10 o'clock on a Monday morning, and on the following Wednesday evening all the eight leaves were on their skids in the drydock. It may be said that all were very anxious during the floating of the first leaf, as there was a great difference of opinion both among the government engineers and the contractors as to the danger of floating the leaves in the above manner without the possibility of them being seriously damaged by plunging into one of the lock walls. The credit for evolving this method of handling the gates belongs to Mr. Childers. Another view of the leaves is shown in figure No. 10.

The author wishes to express his thanks and appreciation to A. J. Grant, M.E.I.C., and all the members of his staff with whom he came in contact, for their assistance and courtesy during the carrying out of the work.

The Design, Development and Manufacture of Special Steel Castings for Locomotive and Car Construction

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Paper read before the Montreal Branch of The Engineering Institute of Canada, October 9th, 1930.

The history of railroad development in North America is an interesting one. From the most meagre beginnings, this method of transportation has grown in less than a century into a system which covers the continent. The last few years particularly have shown remarkable improvement and efficiency in railroad operation, and the cost of maintenance has been steadily decreasing.

One of the most important factors in present day railroad development is the combination of power and speed possessed by our modern locomotives. This has been possible through the joint efforts of the railroad officers and manufacturers of railroad equipment. Among these equipment groups have been the steel founders whose contribution has been more sturdy and substantial foundations for locomotives, tenders, and passenger and freight cars. Modern railroad equipment without the use of cast steel is inconceivable.

Steel as we know it is used in many forms, but the making of steel castings can be said to have originated with the development of the crucible furnace by Benjamin Huntsman, a clock maker of Sheffield, England, in 1740, but the crucible on account of its small size offered serious obstacles to the production of large castings. Henry Bessemer's invention in 1855 of the converter, for transforming iron into steel, removed the limit on size imposed by the crucible. While the principal application of the Bessemer converter has been used in mill practice, it is interesting to know that its origin was brought about through Bessemer's discovery that the cast iron guns used in the Crimean War were not strong enough for the improved projectiles he had himself invented, and his desire was to make guns of cast steel which would be stronger. The development of the open-hearth furnace by Charles William and Frederick Siemens, of Germany, and by P. and E. Martin, French metallurgists, in the sixties made way for much of our modern steel foundry practice.

Although there are a few steel foundries in America using the Tropenas converter for making steel castings, which was a later development, and a number using electric furnaces, the open-hearth process is more generally favoured for the larger foundries.

The electric process is capable of producing an excellent grade of steel, but, due to the limited sizes of the furnaces so far developed in successful operation and to the relatively high cost per ton of this method, it has not been extensively used for large castings. The open-hearth basic process permits large heats at a low cost per ton, and further it is fundamentally a refining process.

A steel castings shop of the early days would show very little resemblance to a modern plant. A large proportion of the arduous manual work previously associated with foundry practice has been eliminated. This has been largely brought about through the use of specially designed equipment for handling material, for cleansing, milling, mixing, and distributing the sand, together with the use of moulding forms, moulding machines, sand slingers, and core-making machinery. Hydraulic washing equipment for cleaning large castings is another improvement which modern engineering skill has devised.

The large locomotives in use today, with large boilers, high steam pressures, great piston thrusts, and heavy rail loads, impose a duty on the machinery foundation and on the trucks which cannot be withstood by a bolted structure, no matter how well the connecting bolts may be initially fitted. A bolt in a built-up locomotive frame or truck is subjected to especially severe tension; and it follows that constant inspection, tightening of nuts, and periodical reaming of the holes and replacement of the bolts are essential if the equipment is to remain serviceable. It is also extremely difficult to apply a rivet in a locomotive or car structure subjected to weaving and have it remain permanent without loosening, even where the hole is reamed true and the rivet properly heated and driven.

Therefore, the ideal mechanical construction can be obtained in a single casting where the metal can be distributed in the most economical manner possible. Increased section moduli can be most efficiently developed in a casting by increasing the depth or width of the sections, or changing metal thickness to suit varying fibre stresses.

Among the earlier uses of steel castings in the construction of railroad equipment was its substitution for cast iron. As there was no precedent at that time to follow except the practice of the iron founder, the results, as in all new industries, left much to be desired. The pioneers who introduced steel castings for railroad service found it necessary not only to overcome an existing prejudice against castings but at the same time to build a foundation on which this new art could rest. They sought every opportunity for improvement and as a result of unremitting effort the steel foundry business occupies an important place today in railroad work which is remarkable considering it is only about thirty-five years since the use of steel castings in this field was begun.

Too much importance cannot be given to the part that good engineering design plays in the production of steel castings. A careful study over a period of years indicates that most of the difficulties encountered either in the manufacture of steel castings or those developed later in service could be eliminated by changes in design. It has also been found that modifications to manufacturing processes could further prevent all but a slight percentage of the remainder. It is believed that too great emphasis has been laid on metallurgical practices and methods. While there is unquestionably an opportunity for betterment along metallurgical lines, experience has definitely shown that, first engineering design, and, second, manufacturing practice, offer the greatest avenues to improvement in the quality of steel castings.

Stringent limitation of weight is often a handicap to the designer of steel castings for moving vehicles.

While the earlier designs of steel castings followed in general outlines the appearance of the fabricated structures which they displaced, it was not long before designing engineers recognized that lightness and strength could be combined with good appearance. Today much attention is given to producing castings that not only possess utility but that are also pleasing to the eye. It can be generally stated that an integral cast steel structure may be made lighter than a built-up one where equal strength is desired. Where equivalent weight is to be met the cast structure will have greater strength.

To appreciate the rapid strides made by the use of cast steel in railroad equipment, it would be interesting to review car and locomotive construction as it was in 1893, just previous to the beginning of the "cast steel era." Freight cars had built-up bar iron trucks and wooden truck bolsters; their underframes were of wood with steel plated wooden body bolsters. Passenger cars had wooden trucks and wooden underframes reinforced with steel plates. There were no steel castings on the locomotives. All railroad couplers were of malleable iron.

The need for heavier cars and locomotives was being agitated. Wood car bolsters deteriorated in service and about 1893 a St. Louis railroad official suggested that these be made of cast steel and after considerable experimentation this was accomplished. It was not long after this that several companies were making cast steel truck bolsters and their use became quite general. Early in 1899 the first cast steel double-body bolster for passenger cars was made and applied to a Pullman sleeping-car.

The first cast steel truck side frame for freight cars was made in 1900. Freight cars built today have cast steel truck side frames and bolsters. The use of built-up freight trucks now would be considered a backward step.

The first steel castings used in locomotives were driving wheel centres. When the movement toward larger and heavier locomotives began in the late nineties, cast iron wheel centres were found to be inadequate, so cast steel was tried and with such success that its use became general. The first record we can find of steel wheel centres was in the latter part of 1895.

The original form of locomotive foundation consisted of two forged wrought-iron bar frames, which carried the boiler and the cylinders, and had a few forged cross ties to keep the axles in a parallel position. Larger locomotives required more substantial frames, and finally the bar frame became the limiting factor to any increase in the size of motive power because of the difficulty and cost of forging it. In the middle nineties, railroad men and locomotive builders who had been observing the progress in steel-making began to consider the possibilities of cast steel main frames. The first made were applied to switch engines, and then began the move toward the modern locomotive as we know it today.

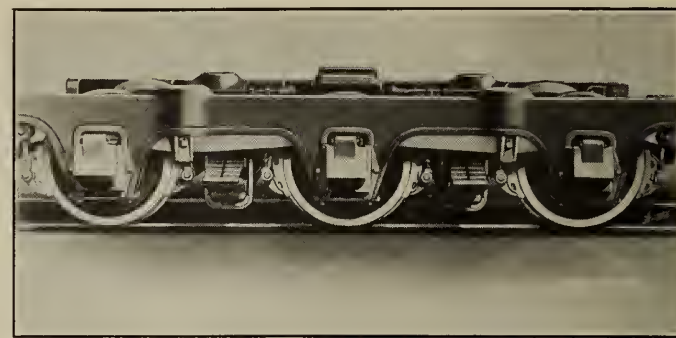

Figure No. 1.—Six-wheel Truck with Pedestals Cast Integral.

The first cast steel trucks to be made for passenger car service were placed under two Santa Fe cars in 1904. They were of the four-wheel type and the entire truck frame was in one piece. They even had integral pedestals and cast steel equalizers, and met the railroad's requirements so well that they are still in service. After this first application, no more trucks were made with integral pedestals until 1918. Previous to that time railroad mechanical officers felt that wrecks or derailments might damage the integral pedestal portion of the truck frames beyond repair, but when modern welding methods came into general use this objection was overcome. All new passenger car trucks today are made of cast steel, and the majority have integral pedestals.

The initial application of cast steel six-wheel trucks to a passenger car was made by the Pullman Company on one of their sleepers in 1905. In recent years a more improved design of truck has been developed (figure No. 1), which has pedestals cast integral, eliminating separate castings and a considerable number of bolts and giving more accurate alignment for journal or oil boxes as the faces of the pedestals are machined by our special slotters. This type of truck under a passenger car looks much better and gives greater accessibility for inspection.

After the general adoption of the integral cast steel passenger truck by steam railroads, its use was extended to electrically propelled cars. Motor and trailer trucks of cast steel have been applied to many street cars and to cars in multiple unit suburban operation as well as interurban electric service. A majority of Diesel engine and gas-electric rail cars, which have been much used in the last few years, have trucks of this type.

About 1905 a demand was made for stronger passenger car equipment and to meet the new requirements the combined double-body bolster and platform casting was designed to form a part of and to strengthen the underframe. This casting in one-piece forms the entire end of the car underframe including the foundation for car platform or vestibule and pockets for the draft gears and buffers. (Figure No. 2.)

This forms an anti-telescoping cast steel end construction which will prevent its being telescoped by an adjacent car in a collision as unfortunately has occurred too often in the past. The cast steel end frame will withstand a blow of approximately three-quarters of a million pounds struck 18 inches above the floor where the greatest strength is needed.

The first cast steel tenderframe or foundation for the locomotive tank was made early in 1907 and the main portion was in three castings. These three pieces included the centre sill, bolsters, needle beam and draft housing. Channel side sills and plate end sills were fastened to these castings, and the castings were connected together at keyed machined joints.

After it had been successfully demonstrated that a tenderframe could be made with three steel castings, the next step forward was in 1908 when the entire structure was made in one piece.

From this modest beginning there has been a gradual development in the size and design of tenderframes to meet the constantly growing demands of the railroads for greater fuel and water capacity. About 1911 water capacities of tenders had reached 7,200 Imperial gallons, but Mr. John Purcell of the Santa Fe Railway believed that operating economies could be effected with larger tenders by eliminating some water stops and thereby avoiding to some extent bad water districts.

It was necessary for some of the western roads to haul water and keep a supply at points where the tenders had to be refilled and where the water was bad. The first step to eliminate this was to use a 9,600 Imperial gallon tender carried on four-wheel trucks, but it was found that the high wheel loads produced considerable wheel wear. It was, therefore, necessary to develop a six-wheel truck with a short wheel base, and in 1912 the six-wheel cast steel tender truck was built. It was not long after this that large tenders with both rectangular and cylindrical tanks became the general practice. The desire to avoid bad water districts prompted this experiment, but it was found that larger tenders would also permit longer locomotive runs and accelerate the movement of trains.

As the length of locomotive and tender was limited by turntables and engine house stalls, the height of the tank was increased to get additional capacity and, therefore, the centre of gravity from rail of larger tenders kept gradually increasing until the limits of safety were being approached. In order to keep pace with the desire for greater capacity with minimum length, the bottom of the tank was cast integral with the bottom of the tenderframe and the space formerly occupied by the depth of the tenderframe used as water storage. This improvement added approximately 15 per cent more water capacity. The development of the water carrying frame introduced a new manufacturing problem as the entire bottom is a thin, continuous plate

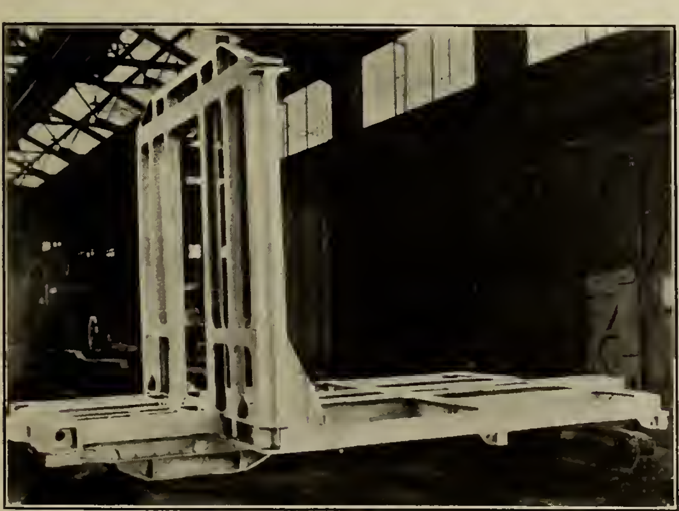

Figure No. 2.—One-piece Casting of End of Car Underframe, including Foundation for Car Platform.

Figure No. 3.—Water Bottom Tender Frame.

making it very difficult to cast. These obstacles were successfully overcome by advances made in the technique of moulding, so that the first water bottom tenderframe was produced in 1925. (Figure No. 3.) About 2,000 tenders of this type are now in service, some with water capacities as high as 18,400 Imperial gallons and with storage space for 30 tons of coal. They are built with tanks, cylindrical in form as well as rectangular. As the water bottom tank is solidly connected to the frame, it cannot shift and telescope the locomotive cab in a collision, which is a safety factor of primary importance.

Some of the latest of the larger water bottom type tenders have all the parts of the tank above the frame welded to each other and to the frame. There are no rivets in this tender other than those required by law for the application of safety appliances.

The cast steel tenderframes after years of service have proven that they will withstand corrosion. This is partly due to the elimination of joints and rivets and partly to the chemical characteristics of cast steel also from the coating of silica which is fused on the surface of the casting in the manufacturing process. This provides a protective skin.

The two- and four-wheel leading trucks of the locomotive operate under severe conditions while performing the important function of guiding the engine around sharp curves at high speeds. Due to the conditions just explained, the built-up engine trucks have always been expensive to maintain. It was, therefore, desirable to make the frames for these trucks in unitary form. At first these trucks had inside axle bearings, but during the past few years outside bearing trucks have been successfully developed and a considerable number are now in service. They have been arranged for friction journal bearings, Brooks floating bushing grease lubrication, the use of which was initiated on the Canadian National Railways, and for various types of roller bearings.

In 1912, because of the heavier loads carried, it was found necessary to greatly improve the design of the trailer truck of the locomotive and this was best accomplished by a one-piece steel casting. The latest development simplifies construction and properly carries an auxiliary engine geared to the trailer axle known as the locomotive booster. The majority of modern locomotives are now equipped with these two devices. Continual increases in the sizes of the locomotive fire-box, the use of stokers, syphons and other improvements finally caused the weight permissible on one pair of trailer wheels to be exceeded, and to eliminate this condition, an additional pair of load-carrying trailer wheels was added. Four-wheel trailer trucks are now used on the latest locomotives.

Successful results experienced in the elimination of maintenance by casting truck parts and underframes in one piece, logically suggested that even greater savings in weight and repair costs could be obtained for the locomotive proper by the application of the same principles. It was

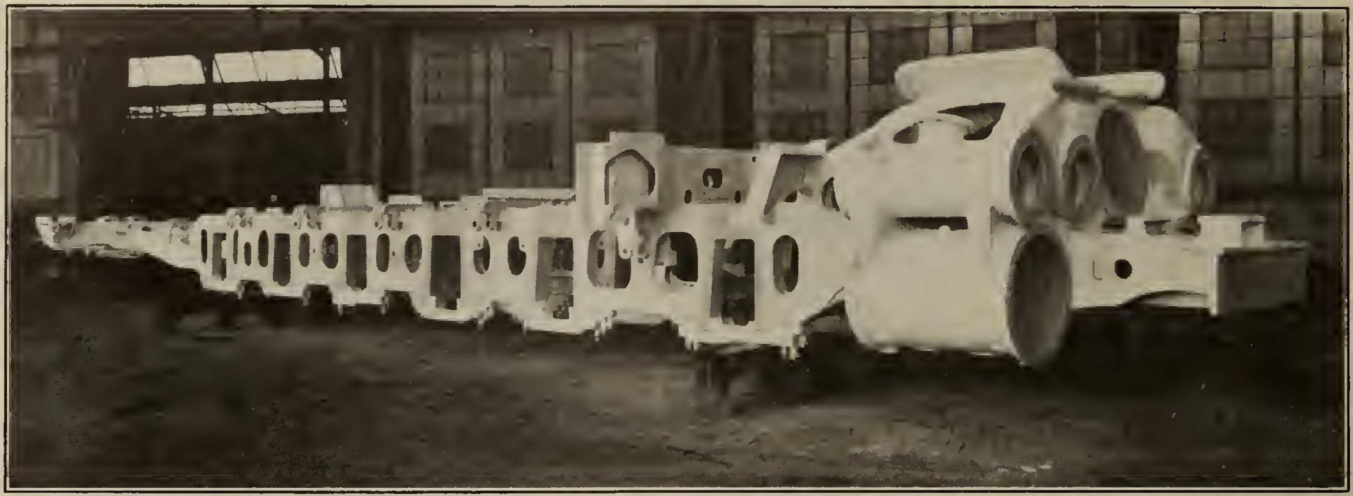

Figure No. 4.—Cast Steel Bed for Locomotive.

also realized that foundry art had progressed so rapidly that the production of larger castings was entirely feasible.

The next improvement was made in 1914 when the locomotive cradle casting was designed to include, in one unit, the parts forming the subframe back of the rear drivers on locomotives equipped with trailing trucks. As this was the buffing and pulling column, the use of the cast steel cradle provided greater strength with less weight and at the same time eliminated the difficulties experienced with loose bolts in the foot plate or draw bar pocket and other parts.

As locomotives were built larger, heavier, and more powerful it became most important to use steel castings in the construction of the foundation, but the severe strains imposed on the bolted connections resulted in high maintenance costs and breakage.

The main frame structure was, therefore, very carefully studied because it was realized that a one-piece bed casting, including all parts, would not only give much greater strength with minimum weight but would also permit improved cross bracing and much better alignment for the reciprocating parts. After a great amount of engineering work extending over a period of several years, a design was developed that embodied all the above improvements. This gave the foundry new problems to solve and special machinery had to be designed and built to take care of the difficult operations involved in machining such a huge unit.

In 1917 a railroad required additional electric passenger locomotives which would be more powerful than their previous engines but it was important that this larger engine should not exceed the weight limitations imposed by a viaduct over which these locomotives would operate. After considerable study it was decided by the locomotive builder and the railroad that the use of an integral bed casting would answer this problem. These bed castings were successfully manufactured, weighing, complete with pedestal binders, 17,100 pounds, and being 32 feet 4 inches long.

The important advantages gained from the use of the bed casting on electric locomotives gave an impetus to the production of a similar structure for steam locomotives where even greater benefits would be attained.

With the demand for high-speed locomotives having a greater horse power than any previously built, locomotive designers found that the larger boilers, increased boiler pressures and corresponding changes in running gear produced much heavier rail loads which exceeded the limits of the track and bridges. Separate cast steel cylinders had already begun to replace those made of cast iron which saved considerable wieght and gave increased strength but only partially solved the problem.

About this time a heavy eight-wheel switching locomotive was built, having the locomotive bed in one piece, and including cylinders, pilot beam, equalizer and brake attachments, and supports for the motion work.

While designs of the one-piece bed with integral cylinders were being developed, the foundry and machine departments had to work out many problems of production, it being obvious that a casting of this size and weight would have to be machined, drilled, and the cylinder barrels and valve chambers bored and hydrostatically tested before it was shipped. Therefore, to perform the many important finishing operations, new buildings were built and especially designed machine tools were installed, so that when the castings were shipped they were ready for assembly.

A bed of the latest design, 55 feet 9 inches long and weighing 66,500 pounds, with cylinders and rear cradle unit cast integral, was made for the Canadian Pacific new 5900 class 2-10-4 type locomotives which are efficiently hauling long heavy trains over the Canadian Rockies. At the time these beds were cast, they were the largest ever made.

The casting of many separate parts in one piece and the resulting benefits are not the only advantages to be obtained by the locomotive bed. Designers of modern locomotives have difficulty in finding a satisfactory place for the air reservoirs. The problem has been answered by making the backbone of the bed cylindrical in form and utilizing this as an air reservoir. This unique improve-

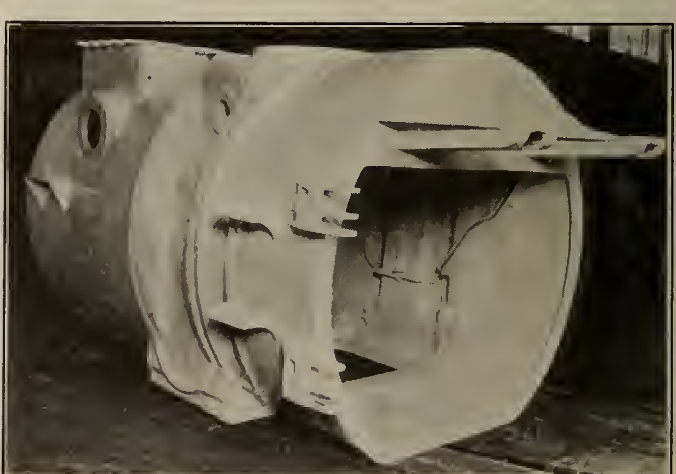

Figure No. 5.—Cast Steel Smoke Box.

Figure No. 6.—Cast Steel Bed for Canadian National Oil-Electric Locomotive.

ment is embodied in the beds furnished for the new high-speed passenger locomotives just completed for the Canadian National Railway.

The largest and heaviest cast steel bed so far manufactured was recently furnished for the Union Pacific 4-12-2 type locomotives, which engines are now in service. (Figure No. 4.) It will be noted that this design incorporates the three-cylinder arrangement with the centre cylinder on an angle, a feature that introduced another interesting machining operation. This casting weighs 82,000 pounds and is 60 feet 4 inches long.

Not only have the majority of railroads on this continent availed themselves of this construction, but likewise the two principal railroads in Australia, and to date there are over one thousand steam locomotives equipped with cast steel beds.

A cast steel smoke-box has also recently been successfully manufactured and applied to a number of Mountain-type locomotives on the New Haven Railroad. (Figure No. 5.)

One of the most complicated castings made to date forms a part of each unit of one of the Canadian National oil-electric locomotives. This casting was 46 feet 1¾ inches long, and 9 feet 11 inches wide, and 5 feet 1 inch deep weighing 40,000 pounds. (Figure No. 6.) The bed includes the entire locomotive foundation below the cab line.

The depressed centre car is a very unusual type of railroad rolling stock as it is used to transport extremely heavy loads concentrated over a small area, such as large machinery and transformers. The cast steel frame solved many practical problems inherent in the construction of a car of this type which occurred through the difficulty of fabricating the heavy rolled steel sections necessary to carry the great loads imposed and to take care of the buffing and pulling stresses magnified by the offset sills. (Figure No. 7.) A considerable saving in weight was also effected by the more economical distribution of metal. The average weight of these castings is 58,000 pounds.

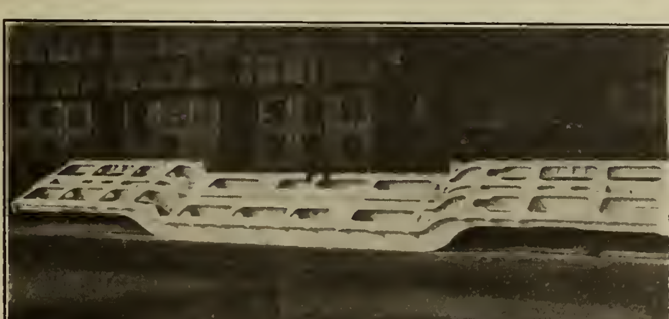

Figure No. 7.—Depressed Centre Car Casting.

A number of railroads have these one-piece underframe cars in service, and five similar cars are now being built by the Canadian Pacific at their Angus shops.

The railroads serving the sulphur deposits in the state of Texas have experienced extremely high maintenance expense on cars engaged in this traffic, as the fabricated steel underframes deteriorate rapidly from corrosion. This brought about the development by the Santa Fe Railway of the 70-ton gondola-type car with a wooden superstructure and a cast steel underframe, which casting included the entire underframe of the car and the stake pockets.

The success of the cylindrical water bottom tender suggested the possibilities which the cast steel bottom offered in tank car construction and a number of these cars have been constructed with a capacity of 12,900 Imperial gallons. About one-fourth of the circumference of the tank is a part of the underframe and forms the tank bottom, while the remainder of the tank is made of tank steel and is riveted to the underframe. In tank car construction it is very desirable to maintain a low centre of gravity to avoid excessive rolling of the loaded car and at the same time to secure the largest possible capacity without unduly increasing the length, as shorter cars are more convenient to shippers. By combining the lower portion of the tank with the underframe, making a strong, simple construction, it was possible to considerably lower the centre of gravity of the car and to reduce the length about one-third.

Figure No. 8.—One-Piece Frame for Ore Car.

Another development utilizing a large steel casting is the high capacity ore car. These cars, carrying approximately 75 tons, are loaded by steam shovels which drop about 15 tons of ore into the cars at a time, and as many as 160 of these loaded cars sometimes operate in one train. On account of these severe service conditions the ore carrying roads some years ago realized the utility and maintenance saving which would result from the use of a cast steel underframe. (Figure No. 8.) This one-piece frame while stronger was actually lighter than the fabricated construction. The weight of this casting was 8,900 pounds.

The success which the use of large steel castings has met in locomotive and car construction very clearly indicates that the freight car underframe of the future will be an integral steel casting.

Cast steel foundations for cars and locomotives while resulting in direct maintenance savings are also the basis for additional savings in repairs to other parts of the equipment. In cars the brake rigging and the superstucture will have longer life when the understructure is not subject to distortion. In locomotives, the bed casting reduces wear of reciprocating parts, maintains alignment of the driving wheels, thereby considerably reducing driver flange wear and minimizing lateral wear on driving boxes.

The advancement which has been made in the steel foundry art in the past decade has been truly remarkable but had anyone attempted to predict in 1920 that such strides as have been made were to be looked for within 10 years, he would have been regarded as an exceptional optimist. In view of this advancement, is it unreasonable to predict that the next 10 years will record a progress which will be even greater than has occurred in all of the 35 years of the industry to date?

This paper has dealt with the development of steel castings for railroad equipment, but it should not be overlooked that similar advantages can also be obtained by the use of integral steel castings in other fields. Many parts are now being assembled that could be cast profitably from molten metal directly into their final form.

A brief explanation of moulding methods may be of interest, particularly after considering that these large castings are necessarily produced by quite a different process than is usually employed in the production of small miscellaneous castings.

On account of the intricate shape and magnitude of the devices like a locomotive bed or water bottom tender-frame, a method of moulding employing essentially a metal form and dry sand cores has been developed. In this process the form consists of a heavy steel frame which roughly outlines the shape of the casting and extends downward into a prepared pit far enough to accommodate the depth of the mould. The mould is formed by hundreds of dry sand baked cores, therefore the word mould is used more descriptively than accurately, as the process does not employ a pattern or a sand mould. The cores are placed against and on top of each other to form the shape of the casting and are supported on I-beam members at the bottom of the form and at the side by the walls of the form. What would ordinarily be termed patterns in the above mentioned process become core boxes from which the cores are made.

The cores are separated where metal is to form, by metallic spools or chaplets, the melting point of which is just high enough above that of the molten steel to permit the free flowing of the metal and low enough so that there will be complete fusion between the chaplets and the parent metal after the casting has cooled.

The cores are baked to a brick-like degree of hardness, so that they will be strong enough to support each other and not crush under the tremendous weight of the casting after the pouring has been completed. Particular attention must be paid in this process to the making and hardening of the cores, as it is essential that a smooth surface be presented to the molten metal, and one which will not fuse with the steel under the terrific heat of some 3,000 degrees F. necessary to satisfactorily pour castings of this size.

Finally, after the cover cores have been placed, the entire mould is securely clamped down to resist any movement or tendency of the cores to float under the tremendous pressure of the steel as it is entering the mould.

The metal is generally poured into one gate and is distributed in a main runner at the bottom of the mould, from which it rises through the different openings between the cores to form the shape of the casting. The completion of the process finds the metal at the top of each riser.

Considering the varying sections and the length of the castings which have been discussed, it will be appreciated with what nicety the moulds, formed out of all these different cores, has to be figured in order to correctly compensate for the tremendous and variable shrinkage which occurs at different points of the casting. The location and number of risers is another part of the moulding technique, which those in charge of that part of the work have learned by long experience.

Finally it might be added, as a matter of interest, that it actually requires only about three minutes to fill the entire mould for one of the largest castings, but following the initial pouring, the metal is fed intermittently for some eight minutes to compensate for the contraction which takes place as the steel cools.

The New Smelter and Concentrator of the International Nickel Company at Copper Cliff, Ontario

L. M. Sheridan,
Chief Engineer, The International Nickel Company of Canada, Ltd., Copper Cliff, Ont.

Paper read before the Montreal Branch of The Engineering Institute of Canada, November 6th, 1930.

The ores of the Sudbury district occur in the walls of an oval basin having a length of about 36 miles and a maximum width of about 16 miles.

The mines of the International Nickel Company are located around the rim of the basin. There are four mines at present in operation, namely, the Creighton, Levack, Garson and Frood, the farthest being 30 and the nearest 5 miles away from the Copper Cliff and Coniston smelters.

The Frood mine is the principal source of ore reserves and is by far the largest. Here a shaft has been sunk to a depth of 3,000 feet. The vertical shaft is one of the largest ever sunk, being 16 feet by 28 feet in horizontal section. Ore is mined underground and hauled in dump cars, by storage battery locomotives. It is crushed underground to about 8-inch cubes, and is then hoisted in 10-ton skips at 3,000 feet per minute. On the surface at the mine, the large pieces of rock are picked out by hand, the ore is recrushed by hand and screened. It is then hauled by electric locomotives in standard gauge 70-ton side-dump cars to Copper Cliff and by steam locomotives to Coniston.

The ore is received in 10,000 ton capacity receiving bins. Here it is crushed to two hundred mesh and sent through a wet concentration to remove the rock. The ores consist of copper, nickel and iron sulphides intimately mixed.

In the concentration process the sulphides are floated, and the lighter rock material sinks to the bottom. This phenomenon is due to the introduction of a very small quantity of oil and other reagents to the pulp of ore and water, and blowing air through the mass. This causes bubbles or balloons of air to attach themselves to the heavy sulphides and float them. By selective flotation a rough separation is made of the copper from the nickel.

The succeeding smelting operations consist of the separation of the iron and silica from the copper and nickel sulphides. It comprises roasting in multiple hearth roasters, where a part of the sulphur is burned away, smelting in reverberatory furnaces, where most of the iron and silica is removed in the form of a slag, and finally blowing in basic lined Bessemer converters, where most of the remaining iron is removed.

The product of the smelter is an 80 per cent copper-nickel matte. At present this is shipped to the Port Colborne nickel refinery or to Huntington, West Virginia.

In the refinery, the copper and nickel sulphides are separated by the modified Orford process. The nickel is refined electrolytically at Port Colborne, and the copper at the Ontario Refining Company plant at Copper Cliff.

At the present time, the No. 1 process, or that of separating the copper and nickel sulphides previous to electrolytic refining, is being transferred to Copper Cliff.

The construction programme carried out during the past three years by The International Nickel Company of Canada, Ltd., includes additions to their refinery at Port Colborne, the underground development and surface plant of their Frood mine, the construction of a new smelting plant at Copper Cliff; also additions and improvements to the Coniston smelter, and a new surface plant at Levack. The smelter and concentrator have now been put in operation, and additional construction is being proceeded with in transferring part of the Port Colborne operations to Copper Cliff. The present paper deals with the smelter and concentrating units at Copper Cliff, especially in regard to the problems of engineering design.

The plant was designed by the staff of The International Nickel Company at Copper Cliff, the structural and mechanical part of the work being under the supervision of the writer. A general flow sheet and plan was submitted by A. G. MacGregor, consulting engineer, and this was, in the main, followed.

The general contractors were the Fraser-Brace Engineering Company, Ltd., Montreal, who built or erected the foundations, brickwork, lumber, piping and most of the machinery. The structural steel work was supplied and erected by the Dominion Bridge Company; the blast piping, and the gas main to the Canadian Industries plant by the Horton Steel Company; the smelter stack by the Custodis Canadian Chimney Company; the powdered coal plant by Heyl & Patterson of Pittsburgh. A number of other contractors installed individual equipmet of various kinds.

The construction work went forward with smoothness and despatch, under difficult winter weather conditions, without delay in brick and concrete construction, and with the most harmonious relations between the contractors and the company's engineering staff.

The plant is designed to crush, concentrate and smelt approximately 8,000 tons of ore per day. The accompanying plan of the works (figure No. 1) shows the general layout of the plant which includes receiving bins and trackage, crushing and screening units, conveying systems, a concentrator in which selective flotation is practised; and a smelter equipped with mechanical roasters, reverberatory furnaces and converters, with the attendant coal pulverizing plant, flue system, stack, water systems, and other auxiliary units.

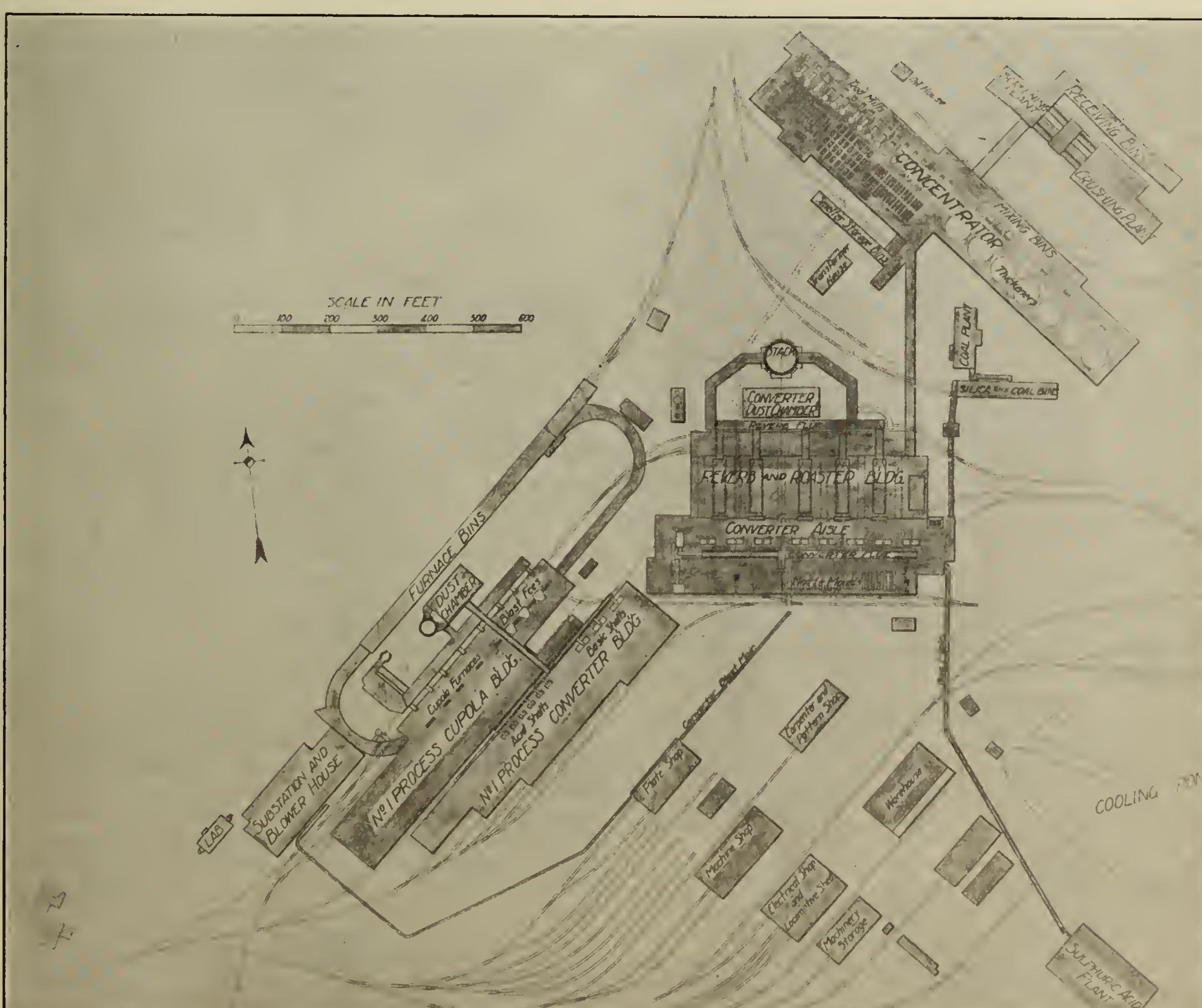

Figure No. 1.—Layout of Smelter and Concentrator.

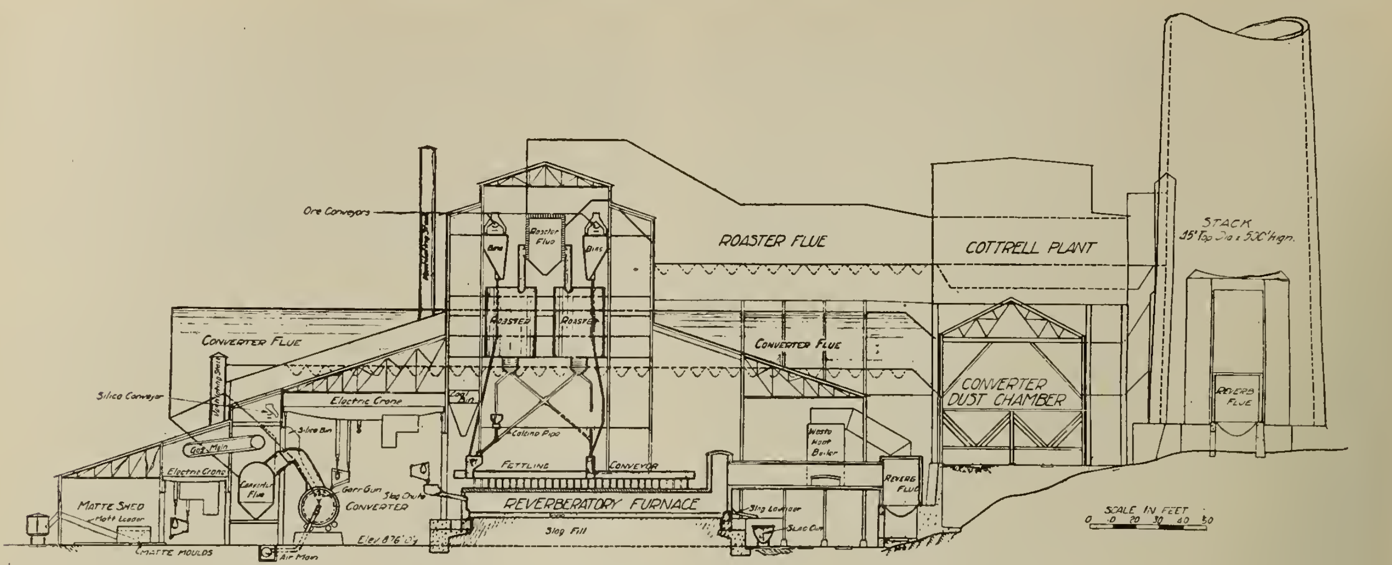

Figure No. 2.

The magnitude of the work is indicated by the following figures:

Tons of structural steel used	35,000
Brick in buildings, flues and furnaces	7,034,000
Hollow tile (interlocking in buildings and flues)	1,250,000
Concrete in foundations and floors, cubic yards	61,000
Combined ground area of all structures, square feet	510,000
" floor " " " " " "	1,000,000
Tons of brick in smelter stack exclusive of foundations	15,000

As shown in figure No. 2, the roasters are placed above the reverberatory furnace plant, which, in turn, has a floor elevation of 12 feet above the converter floor. This requires rather a high furnace building, which is 183 feet from the yard level to highest roof elevation. The main smelter stack is the largest in the British Empire, being 512 feet from the base to the top, or 554 feet above the converter building floor. It has an inside diameter of 45 feet at the top.

Most of the building foundations are carried down to bed-rock, the only exception being part of the smelter building which is built over an old cooling pond. Here the pond site was excavated to a depth of 35 feet and 166,000 tons of molten reverberatory slag were poured in to form a base. Concrete foundations were poured on this base during the coldest winter months; it took about seven months for the mass of slag to cool until there was no evident emission of heat. There was a slight settling of about four-tenths of an inch, due to cooling.

The reverberatory walls were built on the slag. These walls were lined with hollow tile to protect them from heat, and then filled to a depth of 12 feet with molten slag. No appreciable cracking of the concrete walls resulted.

The foundations for the stack are on solid rock. The stack was built near the face of a rock ledge having a slope of approximately 20 per cent. In order to be certain that there would be no slip due to seams in the rock, the stack foundation site was diamond-drilled to a depth of 60 feet and the cores examined for seams and faults.

A difficult problem resulted from the very heavy loads on the reverberatory-and-roaster building columns, in some cases as high as 1,400,000 pounds per column. Past experience in reverberatory buildings has shown that these furnaces will spread, owing to heat expansion and to the impregnation of the base with matte. Over a period of years this spread may amount to several feet, and as a result the building columns are pushed out of plumb, since the columns were close to the sides of the reverberatories. On account of the heavy superimposed loads from the roasters, this condition might endanger the structure; therefore special precautions were taken to guard against this happening (figure No. 3):

(a) The building foundations were separated from the reverberatory furnace foundations, for a depth of 6 feet, by expansion joints about 2 feet wide at the column bases. The resulting holes or spaces were then filled with "Insulex," a very porous gypsum which can be easily crushed under pressure. The top surface of the Insulex was protected by a light concrete slab.

(b) The foundations between furnaces were made in the form of long piers, and heavily reinforced with longitudinal grillages to take end thrust, each pier taking two or more column bases.

(c) The building columns were heavily braced laterally, so that even if pushed out of plumb the bracing will take care of the heavy lateral thrust resulting therefrom.

In the structural steel design the specifications of the American Bridge Company were adopted, with some modifications, using 16,000 pounds net tensile stresses per square inch and $19{,}000 - 100 \frac{L}{R}$ for compression on main members. A wind load of 30 pounds per square foot, and a snow load of 40 pounds per square foot, were assumed. No main members were made less than three-eighths of an inch in thickness, so as to allow for corrosion from the gases resulting from operations. All members were chosen with the idea of preventing the accumulation of moisture or corrosive dust on ledges of the steelwork. The above precautions caused a somewhat heavier steel construction than is met with in ordinary building construction. The structural steelwork was furnished by the Dominion Bridge Company, and the services of their engineers were freely made use of in the detail design.

Roofs on practically all structures are made of slow-burning wood construction, consisting of two by fours on edge. In buildings where furnaces are located, all wood was impregnated with a zinc chloride solution under pressure. The solution completely penetrated the wood and made it fire resistant.

The brick roaster flues are covered with a corrugated-iron roof, with an air space between the brick roof arches and the corrugated roof.

The concentrator roof is of wood with a half-inch insulation of wood fibre board.

Flat roofs are covered with Barrett specification roofing; all sloping roofs are covered with roll slate covered asphalt roofing.

The experience of the company with corrugated-iron sheathing has not been satisfactory, because it requires frequent painting to prevent corrosion, with a consequent heavy cost of upkeep, and the insulating qualities are not sufficient to meet the low winter temperatures prevailing at Copper Cliff. For these reasons a fireproof wall was sought which would meet the requirements, and interlocking tile walls were chosen for practically all structures. They are, in the main, 8 inches thick and non-bearing. The tile chosen has a vitreous burn, making it non-porous, in order to prevent disintegration by frost. In every case the lower 8 feet of the walls were made of brick to prevent damage to the tile by steel bars and heavy tools. Where blasting is apt to occur, such as at the steel ore bins, the tile walls are protected by heavy plank sheathing.

In the smelting group the roasters are above the reverberatory furnaces in a single building, and the converters in an attached structure. Since the buildings are completely enclosed, it was necessary to take extraordinary measures to ensure the escape of the fumes from the converters while turning down, in tapping matte and slag from the reverberatories, from the hot calcines, etc. To take care of this, tile partitions were placed between the roasters and converter aisles, and at other points where gases were to be excluded from working floors. In addition ventilating stacks were placed above the matte-casting aisle, the converter aisle, the roasters, and the reverberatory slag aisles. These stacks are of large diameter and of a sufficient height to cause an induced draft from the warmer air in the building. This arrangement has proved superior to the monitor type of building, and the structures to date have been very free from gas.

The ore is conveyed from the mines to the smelter in standard side bottom-dump Hart-Otis type 60- to 80-ton steel ore cars, and hauled by 500-volt direct-current electric locomotives over the company railway, or by steam over the lines of the Canadian Pacific Railway. These cars are dumped into sloping bottom steel bins having a capacity of 10,000 tons of ore, over which two standard gauge railway tracks run.

The ore is drawn out of the bins through two lines of special gates over belt feeders onto two 36-inch conveyor belts. A system of conveyors then carries the ore to the various processes and will be described later.

From the receiving bins the ore passes to the fine crushing plant bins, below which are three 7-foot Symons cone crushers which reduce the ore from 5-inch lumps to a three-quarter-inch product. This material is then conveyed by two 36-inch wide conveyor belts and passed over eight 54-inch type FB-2 Traylor vibrating screens which remove the minus 6 mesh fines. These fines are carried by belt conveyors direct to the concentrator. The oversize is conveyed to two Traylor rolls, 78 inches by 18 inches, in a closed circuit with Traylor vibrator screens and reduced to a suitable ball or rod mill product. This material is then conveyed over 24 Traylor secondary vibrator screens which are in closed circuit with three Traylor 78-inch by 18-inch secondary crushing rolls and connected thereto by 48-inch conveyor belts. There are bins over the Symons crushers, over the primary screens and over the crushing rolls.

Since the ore is handled entirely by conveyors from the time it leaves the receiving bins until it reaches the roasting furnaces in the smelter, there are, necessarily, a great many conveyors which form an important link in the process. In the smelter conveying system there are 47 belt conveyors, using a total of 24,000 feet of rubber-covered conveyor belt.

The maximum length of any inclined conveyor is 514 feet, with a rise of 98 feet, and a maximum slope of 17 degrees.

All cold material is handled on belt conveyors ranging in width from 24 inches to a maximum of 48 inches. All troughing and return idlers are Timken roller equipped, and made by the Link-Belt Company of Canada, Ltd., Conveyor trippers (made by Stephenson-Adamson Company) with slat type snub pulleys are of the motor propelled type.

The conveyor system includes some novel features. Thus in the transfer of discharge from the conveyors under the receiving bins to either one of two parallel belts at right angles to the line of flow, the head and tail pulleys only are made movable, with troughing idlers attached to spacing rods and a sufficient counterweight to keep the belt tight in all positions. The head pulley is moved forward by means of a "nigger head" on the end of the head pulley shaft. In this manner a conveyor 340 feet long can be easily and quickly moved forward or backward under the power of the conveyor motor. All take-ups are of the counterweighted type.

The drives in general are from lagged head pulleys. There are a few tandem drives on some of the longer belts.

Since the ore is slightly attracted by a magnet, it is not entirely feasible to use magnetic pulleys to remove tramp iron. Stationary magnets have been placed above the belts, adjustable as to distance, for this purpose. All snub pulleys are of the slatted type. Conveyor speeds are, in general, kept under 300 feet per minute. The drives for all conveyors are through totally enclosed gear reducers of the herringbone and worm gear types.

The principal use of fuel in the smelter is for the reverberatory furnaces. For this purpose powdered coal is used and is prepared from run-of-mine or slack coal from eastern United States fields shipped by boat to Little Current, on Georgian Bay, whence it is transported about 80 miles by rail to Copper Cliff.

The coal pulverizing plant has a capacity of 700 tons of coal per 14 hours operation. It consists of the necessary conveying apparatus, three Heyl and Patterson concurrent flow type rotary cylindrical coal dryers, each 7 feet 6 inches in diameter by 50 feet long, and four 4-foot Raymond mills, each having a rating of 15 tons per hour. The coal is conveyed to shooting tanks where it is weighed and then shot by compressed air to a 200-ton bin behind each reverberatory furnace. The filling of these bins and the control valves for switching from one to another are all operated from a central point in the pulverized coal building.

There is one central vent in the coal plant through a cyclone separator to the smelter flue system.

The coal is fed from the reverberatory storage bins by means of screw-type feeders driven by electric motors through variable speed changers. It is blown into each

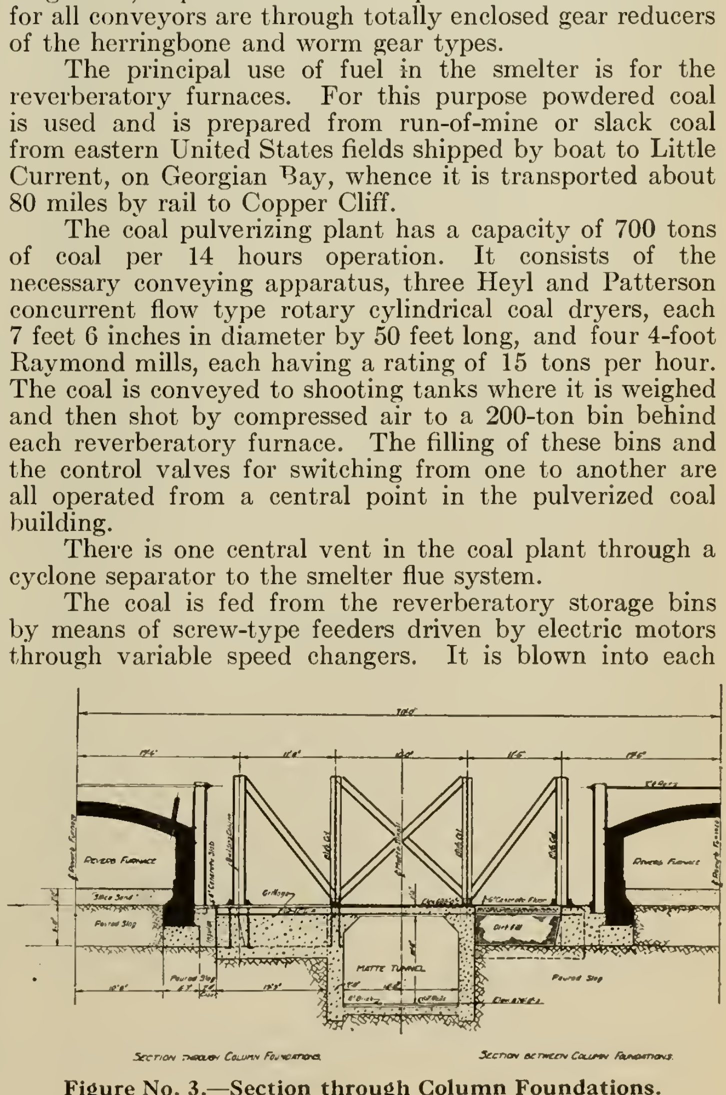

Figure No. 3.—Section through Column Foundations.

reverberatory through four fan-tail burners, by a primary air fan. Each burner has a total maximum capacity of 3,600 pounds per hour of powdered coal, or 170 tons per 24 hours per reverberatory. Secondary air is introduced direct by induced draft around the burners.

The gases from the new smelter are conveyed to a central stack from the various furnaces. The stack is 512 feet in height and 45 feet 2 inches inside diameter at the top. It is constructed of radial brick burned from shale at Cooksville, Ontario. There is a 6-inch lining of special Pennsylvania acid-resisting brick supported on corbels approximately every 35 feet in height. It was built in five months by the Custodis Canadian Chimney Company and was kept heated by steam heat during the cold weather before being put into service.

A tunnel projects under the stack with cleanout gates for removing dust. The floor of the stack is inclined, making a V-hopper, lined with paving brick.

The lightning protection consists of seven-eighths-inch copper rods 7 feet apart around the top of the stack. There are four vertical leads to the ground, which are interconnected by horizontal bands of copper every 50 feet. All are lead covered. Four grounds are connected to the stack and consist of copper plates buried in charcoal 6 feet below the surface.

There are four openings into the base of the stack to receive the three separate flue systems from the roasters, the reverberatories and the converters.

In the roaster flue system, the gases from the roasters pass through cast iron cylindrical risers to a brick and tile flue, which consists of two branches 14 feet wide and 18 feet high, with steel hopper bottoms, which combine into a flue 20 feet wide by 25 feet high. They then pass to a Cottrell treater and on to the smelter stack. The design of this flue system includes two novel features of construction. The side walls consist of 4 inches of fire-brick lining and 8 inches of interlocking tile. The tile is of vitreous burn, laid up in fire clay and cement. Owing to the fact that these flues are supported on structural steel 122 feet above the ground, brick and tile construction was adopted in place of all brick, to save weight; and a considerable saving in the steel supporting structure resulted.

The roof consists of 9-inch fire brick arches against cast iron skewbacks. The skewbacks are cast in short T-sections and bolted to the bottom flanges of structural beams above the flue. It is believed that this construction will be very resistant to corrosion, since only the cast iron and brick arch are in contact with the gas stream. The maximum velocity of gas in this flue system has been calculated to be 30 feet per second for the 30 Herreshoff roasters.

The flue dust from the roaster flues is carried by 730 feet of drag conveyors to the reverberatories.

The Cottrell plant treats the gases from the roasters only, those from the converters and reverberatories going through separate systems. It was built in accordance with plans furnished by the Western Precipitation Company of Los Angeles who also furnished the electrical equipment.

The plant consists of seven units of three sections each—each section of 18 ducts—of the rod-curtain electrode type. It has a capacity of 600,000 cubic feet per minute at a temperature of between 400 and 700 degrees F.

The floor of the precipitator is supported over the converter dust chamber at an elevation of 104 feet 6 inches above the smelter yard level. The use of vitrified interlocking tile as partitions between the treater units is a novel feature of construction.

The Cottrell plant is housed in a steel frame building with interlocking tile walls and wood roof treated with zinc chloride to make it non-inflammable.

The reverberatory flue system includes connecting flues from the reverberatories to a main header flue, and two main branch flues on each end of the smelter from the header flue to the stack, where they enter on opposite sides of the stack. All these are of brick, supported 8 feet above ground on concrete columns and beams with steel hopper bottoms, and cross brick arches supported on 18-inch H-beams at 5-foot centres. There is a track underneath each flue for dust removal.

Lift dampers of special construction are provided to regulate the draft from each reverberatory and also to divert the flow through waste heat boilers. These dampers are of brick of special shapes and are held together with steel rods enclosed in the brick so that no steelwork comes in contact with the hot gases.

The reverberatory flues have five dampers arranged so as to direct the gases of all or part of the furnaces through either branch to the stack. These dampers are lifted and lowered from a steel frame, by chain blocks, and are constructed of a steel frame covered with expanded metal. A solid slab of "Celite" was cast between and over the surfaces of expanded metal. Since the dampers are either entirely out of the gas stream, or else blocking the flow entirely, it was felt that the temperatures would not be sufficient to destroy the cement binder. This construction gave a damper of comparatively light weight with considerable heat resistance. The maximum velocity of gas in this flue system will not exceed 30 feet per second.

The converter flue system takes the gases from eight 13-feet by 35-feet Pierce Smith type converters. The flues are made of steel plate reinforced with external stiffener angles, and have a cross-section with a semi-circular top, straight sides and hopper V-bottom.

The converter dust chamber has brick side walls, steel roof and hopper V-bottom, supported on steel columns and served by tracks for drawing out dust. The gas is distributed by two internal V-flues with adjustable cast iron doors for regulating the width of the slot at the bottom.

In the construction of the concentrator building, to meet the requirements of the flow sheet at first contemplated, it was necessary to elevate the fine-ore bins very high above the ground and to provide an elevated platform free from vibration for the installation of Deister tables. The tops of the bins are therefore 72 feet above the ground on which the bins rest, and the table floor is 33 feet above the ground. A heavy concrete structure was provided, with reinforced columns, beams and floor 33 feet high, upon which the steelwork for the bins was erected.

All floors of the building are concrete except walkways around flotation machines and a few others which are of wood.

The ore from the crushing and screening departments is conveyed by inclined conveyor belts to the concentrator fine-ore storage bins. These are driven by variable speed drives and the rate of the feed can be adjusted very closely to that required by the Marcy mills. There are sixteen of these mills, half of which are at present equipped with balls and half with rods. In closed circuit with each mill is a 12-foot Dorr bowl classifier.

There are in the mill one hundred and forty McIntosh flotation cells in which, by selective flotation, both high copper and nickel concentrates are made.

Practically all the mill pulp is handled by Wilfley pumps, the only bucket elevators being for floor cleanup work. A large part of the mill pulp is transferred from one process to the next, through black iron pipe, where the usual practice is to use launders. By this means it is possible to move the pulp with a very small difference in head. The only precautions taken are to maintain a small gradient in the direction of the flow, and to use large radius bends made either from the pipe or from cast iron fittings.

For distribution to the flotation cells or to the classifiers, centrally located bowl distributors with radially placed distributor pipes are used.

The tailings are pumped by Wilfley pumps to a disposal area about 40 feet above the pumps and at a distance of about 1,500 feet. Wood stave wire-wound pipes are used, and the tailings are wasted through one-and-one quarter inch holes spaced 5 feet apart.

The dewatering equipment consists of seven 55-feet by 18-feet Dorrco tray thickeners, six Dorr classifiers and six 14 feet diameter by 16 feet Dorrco filters.

A 75-ton crane runs over the Marcy mills and the filters. The flotation machines are served by small hand cranes.

Fresh and return water are pumped from storage and settling ponds, by means of De Laval pumps, to elevated tanks in the top of the mill.

The smelter building is equipped with thirty Nichols-Herreshoff roasters, 21 feet 6 inches diameter of shell, ten hearths and a drying hearth. They were built by the Dominion Bridge Company. One special feature of this installation is that the roasters can be driven at any speed between four-tenths revolutions per minute and two revolutions per minute. Each roaster is driven by a separate 20 h.p. slip-ring motor. Cooling of the central shaft and arms is accomplished by means of six 40,000 cubic feet per minute Sturtevant fans discharging into a common header in such a manner that any group of six roasters may be served by any fan, or from the common header.

The calcined material from the roasters is discharged into a brick-lined hopper bin of 10 tons capacity, and from there, through 10-inch pipe gravity chutes, to a drag chain and flight type fettling conveyor on each side of each reverberatory. From the conveyors the material drops, at 6-foot intervals, into the reverberatory furnace, through 4-inch pipes equipped with lift valves. An intermediate floor is provided with tracks and cars, whereby the calcines from any roaster can be transferred to any reverberatory. (See figure No. 2.)

Green ore and flux can be fed to the reverberatories by means of pipe chutes which by-pass the roaster and which run from separate bins above the roasting furnaces.

The reverberatory plant consists of five furnaces, each having a hearth 24 feet wide and 110 feet long, and fired with four pulverized-coal flat-flame burners. The slag is skimmed off directly into steel pots on cars. The cars are moved by car pullers onto the main standard gauge tracks and from there to the slag dump by electric locomotives in trains of eight to ten cars.

The matte from the reverberatories is tapped into 30-ton capacity cast steel ladles. These ladles are mounted on transfer cars located in tunnels between the reverberatories. They are pulled by electric car pullers into the converter aisle, and from there carried by 50-ton cranes to the converters. The reverberatories receive the molten converter slag, which is poured through a launder directly into the furnace between the coal burners at the firing end, by the converter cranes.

The converter equipment consists of eight 13-foot by 35-foot Traylor converters operated by 60 h.p. d.c. motors. In case of power failure the converters are automatically turned off the tuyères by the energy stored in the flywheel sets.

A part of the converter gas is used by Canadian Industries for the manufacture of sulphuric acid. This requires a high concentration of SO_2 delivered from the converters, which is obtained by a special hood which fits tightly over the converter mouth when blowing. The hoods are counterweighted and operated by electric motored hoists. The hoods lift automatically when the power fails, in order to allow the converter shells to turn off the tuyères. The gas to the acid plant is drawn from the top of the hood and from the centre of the gas stream into a separate flue leading to the acid plant.

The converter aisle is served by two Dominion Bridge Company cranes each having two 50-ton main hooks and a 10-ton auxiliary.

The converter slag is poured directly back into the reverberatory furnaces as previously noted. The converter matte is pulled over transfer tracks to the casting aisle which is equipped with crane having a 50-ton main hook and a 10-ton auxiliary hook. The matte is cast into cast iron moulds on the floor of the building in slabs about 4 inches thick. These slabs, when cool, are picked up by 10-ton electric travelling cranes and broken through an elevated grizzly into two pan conveyors which, in turn, discharge the material into box cars for shipment to Port Colborne, Huntington, or the No. 1 process bins at Copper Cliff.

The converter pot skulls are broken on a MacGregor skull breaker and treated in a blast furnace.

The copper concentrates are treated in a separate reverberatory and converters.

The copper converter matte is charged into an oil-fired reverberatory type holding-furnace having a hearth of 12 feet by 32 feet inside and a capacity of approximately 200 tons. The copper is cast into pigs for shipment to the Ontario refinery at Copper Cliff on a straight line casting machine built by the Allis-Chalmers Company at Milwaukee. The copper pigs are discharged into a Bosch tank and elevated to a shipping platform by a drag conveyor.

Air for the converters is furnished by turbo-compressors driven by electric motors. There is one Rateau blower with a capacity of 42,000 cubic feet per minute of free air compressed to 14 pounds pressure, and in addition, two Brown Boveri units of 25,000 cubic feet each and one of 40,000 cubic feet have recently been installed. There are also two Allis-Chalmers piston type machines of 20,000 cubic feet capacity each, the total capacity of 14 pounds air being 172,000 cubic feet per minute for both the basic converters and the No. 1 process to be installed next year.

The water for the concentrator plant is supplied from a lake about two and a half miles from the plant. Water is pumped through 12-and 16-inch cast iron pipe lines about 12,000 feet in length each by means of De Laval two-stage pumps. A storage pond receives the water at the concentrator end, or it can be directly pumped to the head tanks in the top of the mill. Drainage water from the tailings ponds is returned to a settling pond for use in the mill, or wasted, in which case it eventually finds its way back to the lake.

In conclusion, acknowledgment should be made of the work done by the author's aids on the engineering staff in the field and the draughting office. With a comparatively small force of field engineers, draughtsmen and designers, a tremendous amount of work was accomplished in a comparatively short time. Not only were plans made and specifications written, and purchasing requisitions issued for the work described above, but at the same time plans were being worked out for various other projects of considerable magnitude.

Notes on Clay and Burned Clay Products

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Paper read before the Moncton Branch of The Engineering Institute of Canada, April 14th, 1930.

In this paper an endeavour is made to indicate some of the properties of clay as a material and to outline the methods of manufacture of such clay products as are of importance to structural engineers. It is hoped that an interest will thus be aroused which can be satisfied by further individual reading or study.

Clay is a fascinating material. Far back in geological history, before life moved on the earth, the recently cooled granite hills and mountains were washed by torrential rains, broken by alternate heat and cold, buried under seas and torn by passing ice ages. The rocks were thus subjected to chemical change, ground to powder, and carried down to the lakes and seas by streams and rivers. In quiet bays, at the mouths of rivers, or at the bottom of lakes, the eroded material was deposited. Ages later, when continents had been elevated from those ancient waters, many of these deposits are found as beds of clay.

Clay consists essentially of kaolin, usually with quartz grains in the form of sand and various other impurities derived from the weathering of rocks. Take, for instance, the weathering of granite, a notable source of clay. This rock is composed mainly of feldspar ($K_2O \cdot Al_2O_3 \cdot 6SiO_2$) quartz and mica. The rock having been opened up by disintegrative forces, water containing carbon dioxide slowly decomposes the feldspar to kaolin ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) and leaches out the alkalies, resulting finally in a mixture of kaolin, free quartz and mica together with some of the other impurities originally present in the granite. Most of the igneous rocks contain to a considerable extent either a potash, soda or lime feldspar and their decomposition proceeds along somewhat the same lines as in the case of granite. Pure kaolin, which is quite rare, is white in colour and highly refractory. In the process of being transported from their sources, the sedimentary clays may become contaminated with considerable amounts of other materials and thus be very impure. However, so long as sufficient kaolin is present to form a plastic mass when mixed with water the substance is called clay. Kaolin finds an extensive use in the manufacture of porcelain.

Fire clay must necessarily be composed largely of kaolin as the presence of impurities such as iron, lime, magnesia or alkalies, in any appreciable amounts, would greatly lower its refractoriness. True fire clays withstand temperatures of 3,000 degrees F. or more. A clay or shale that will stand up to a temperature of 2,700 degrees F. is defined as No. 2 fire clay.

Fire clays occur frequently beneath coal seams and represent the ancient soil on which the coal plants grew. The fire clays are often hard rocks. We see this in the New Brunswick and Nova Scotia coalfields, as elsewhere.

Shales are clays transformed by great pressure into a rock-like form. When pulverized and mixed with water, shale becomes essentially clay again. The shale product usually has the higher crushing strength and will withstand greater temperatures.

The outstanding properties of clay are its plasticity and imperviousness to water when moist and the ease with which it can be converted into a stone-like mass when heated to a high temperature, or as it is technically known, "fired" or "burned."

Although all clays can be moulded when properly moistened and can be converted into a hardened form by heat, they are not all suitable for burned clay products. The clay may be highly plastic or only feebly so. It may show a very high shrinkage in drying and in burning. It may actually develop a permanent expansion during the burning operations. It may be tough working and liable to produce laminations during the moulding operations. These characteristics are reflected in the quality of the finished product. The modern clayworker has come to realize that he must study the nature of the clay which he has available as raw material so that he may produce a saleable article.

It is not known at just what period in history the properties of burned clay were first taken advantage of by man. Certainly the exploitation of clay constituted one of the earliest industries. The first clay products undoubtedly were receptacles for food, dried and baked in the sun only. In all probability, the first clay ware was produced by accident rather than design. With the realization of the valuable properties of the burned clay, a great impetus was given the crude manufacture of clay products. With advancing civilization, many of the early peoples logically turned to clay as a material on which to record their laws, business transactions, exploits and history. The archaeologist today classifies his discoveries according to the evidence furnished by the pottery finds. Ancient brick, tile and pottery have come down to us unimpaired, preserved for thousands of years, testifying to the fact that burned clay is probably the most enduring of all materials. On that vitally important feature, *durability*, are based those great industries which have been literally built on clay.

The chemical changes which take place when clay is burned are very involved, but the main features, especially when applied to brick burning, are most interesting. Although the variety of colours produced in brick today is brought about largely by manipulation of the fires, nevertheless the presence or absence of the oxides of iron determines the basic colouring both in the raw clay and in the burned products.

The process of manufacturing falls essentially into moulding, drying and burning. The manufacture of two types of clay products, brick and structural tile, is outlined below.

Having found by laboratory tests that the clay or shale does not contain injurious impurities, that the desired plasticity may be developed, that it dries fairly rapidly without excessive shrinkage or cracking, perhaps alone or with the addition of sand, and that it can be burned to the desired texture, strength and colour, it will be assumed that the raw material has been brought to the plant.

If soft clay, it is passed through various grinders and rolls which crush or remove pebbles and other foreign materials and thoroughly break up the laminated texture which usually occurs in the natural clay beds. If shale, it is crushed, ground and screened to the desired fineness. With this preliminary treatment the clay is passed on to a pug mill where the necessary quantities of water, sand, etc., are added. Essentially, the pug mill is a chamber within which rotate one or two horizontal shafts with knives attached which thoroughly 'pug' or mix the materials.

With this preparation the clay may be moulded into the desired shapes by one of the two methods known as the soft mud and the stiff mud processes. If the dry press

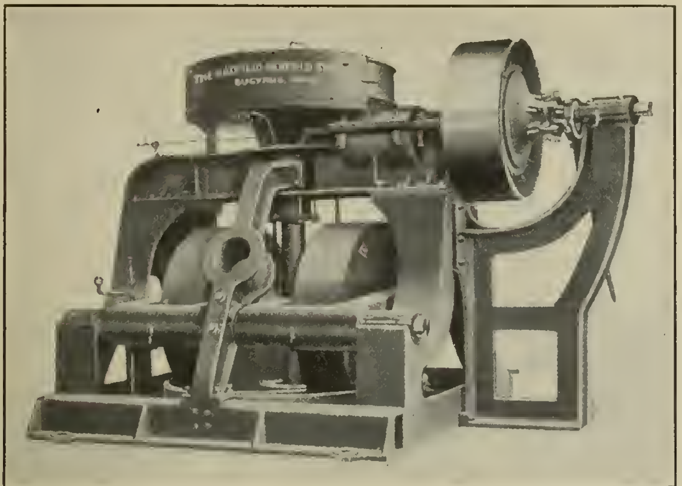


Figure No. 1.—High Speed Grinder for Fine Grinding of Hard Shale.

process is used for moulding, the clay is moistened to a slight extent during the grinding operation when it is then ready for pressing.

The soft mud process is the simplest of the three. The clay is mixed with water to the consistency of soft paste and pressed into wooden moulds. The moulds are usually sanded each time before being filled in order to deliver the brick from the mould more easily. Soft mud bricks are recognized usually by showing five sanded surfaces. Unless repressed, soft mud bricks lack sharp corners. Due to faulty preliminary preparation of the clay the interior is often more pebbly than in bricks made by other processes.

In the stiff mud process, the clay is mixed with just sufficient water to make it plastic but still quite stiff. It is then passed into an auger machine and forced through a rectangular die in the form of a bar and out upon a cutting table. This bar is cut into brick lengths by means of fine wires attached to a hand-operated or automatic cutter. Since the wire makes a somewhat tearing cut, the cut surfaces are always recognizable on the stiff mud bricks.

A characteristic of the stiff mud brick made from clay is that the process of forcing the clay through the die by means of the tapering screw or auger in the machine is apt to intensify the laminated structure of the brick. A shale brick is usually free from laminations. Stiff mud bricks will have four smooth and two roughly cut surfaces.

The soft mud and stiff mud bricks are sometimes repressed shortly after moulding; the repressing straightens the edges and removes the surface roughness.

In the dry press process, the clay is pressed in steel moulds. This process produces bricks with sharp edges and smooth surfaces. Unless the bricks are well vitrified in burning, they are apt to show a granular structure. The grains of clay cannot coalesce nearly so well as when the clay is moulded in a plastic state.

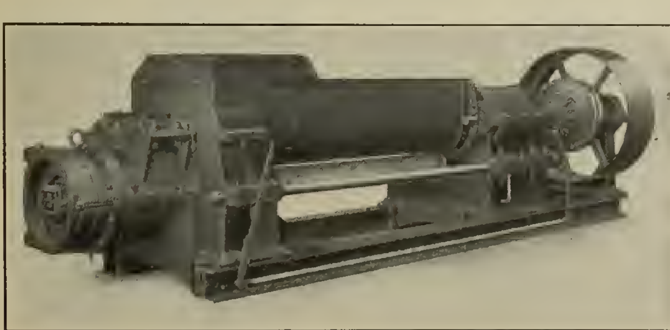


Figure No. 2.—A Brick and Tile Machine as used for moulding Stiff Mud products.

Structural tile is made by the stiff mud process. Various patterns of dies are used on the auger machine to produce the different shapes of tiles. The bar is cut usually in 12-inch lengths with cutting wires in the same manner as are the stiff mud bricks.

The product is now moulded to the finished shape. The next step is to drive off mechanically combined water. This is the drying process.

Originally, bricks were dried on outdoor racks by the action of the wind and sun. Although still prevailing in some rather primitive plants, this process is largely superseded by artificial drying.

In the structure known as the dryer, the ware may be dried either by hot steam pipes, or heat radiated from a metal tunnel in the floor through which are passed the combustion gases from the burning kilns, or from waste heat conducted to the dryer from kilns containing the finished and cooling product. The latter appeals to one as being efficient and is very largely adopted. In a kiln, for instance, containing 60,000 bricks at a white hot temperature, there are approximately three quarters of a billion B.t.u.'s., which must be removed before the brick can be handled. In drying, it is important that the ware be first subjected to a humid atmosphere so that the interior reaches a temperature close to that of the surface of the brick before evaporation is permitted to take place

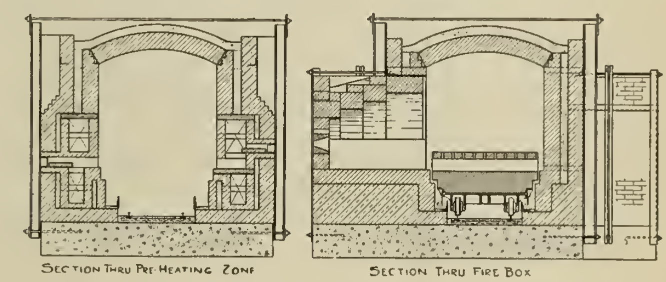


Figure No. 3.—Two Cross Sections through a single-tunnel Kiln.

on the surface. A temperature of about 150 degrees F. is reached in the dryer, although this may vary. The drying period varies from a minimum of perhaps eight hours to several days with different clays.

The ware is now ready for burning and before describing some of the different types of kilns, allusion will be made to some features of the burning process.

Leaving the dryer the clay shapes are placed in the kiln, and may to the casual observer appear dry. However, the ware still contains the chemically combined water in one or more constituents of the clay, as, for instance, the kaolin. With the application of considerable heat, the first process is that termed by the operator as 'water-smoking,' which is the driving off of the chemically combined water. This action is practically completed at about 900 degrees F., a low red heat. The passing off of this water results in a marked decrease in weight between temperatures of 800 and 900 degrees F.

If it were not for certain impurities the completion of the burning would be fairly simple. However, these are often in evidence in clays and shales and must be removed. The principal impurities are usually carbon, sulphur, and carbonate of lime. The oxidation of the impurities is unquestionably the most important part of the burning and the elimination of these substances will be referred to in some detail.

Beginning at about 800 degrees F. oxidation of the impurities commences and may extend, in the case of burning out carbon, up to 1,800 or 2,000 degrees F. At temperatures varying from 1,800 degrees F., to perhaps 2,000 degrees F. in the case of some non-refractory clays or shales, the material has reached its maximum shrinkage, and at that stage the temperature is held long enough to ensure the particles being somewhat vitrified, fused or bonded together. At higher temperatures the material becomes viscous and usually begins to increase in volume.

As previously pointed out, the iron oxides are the important colouring elements in the burned brick. Fe_2O_3, ferric oxide, is red and for red brick we naturally desire to retain the oxide finally in the ferric form. Ferrous oxide, FeO, is more of a fluxing material than the ferric and tends to combine with the silica forming a dark iron silicate. The kiln operator, by admitting an excess of oxygen to the fires, will have the red ferric oxide. On the other hand, by burning the brick with a restricted amount of oxygen, or a reducing atmosphere, the ferric oxide is reduced, and brown or black silicates tend to be formed.

In the case of red burning clays if the reduction is slight, the amount of black iron silicate developed suffices merely to darken the natural red colour to a brown, becoming darker with increased reduction and finally attains the dark gun-metal black in which the iron silicate predominates. If such impurities as sulphides and carbon are not fully burned out or oxidized before the burning of the ware is completed, they will seriously interfere with the finishing process.

Iron pyrites, or iron sulphide, FeS_2, is an objectionable impurity in clay. Gypsum, or $CaSO_4 . 2H_2O$, is also a source of sulphur. Under extreme heat both sulphates and sulphides dissociate at about the finishing temperatures of the clay. The escaping gases swell and bloat the ware and may ruin the product. Sulphur must, therefore, be carefully and deliberately oxidized in the earlier stages of the burning at temperatures of from 700 degrees F. to 1,300 degrees F.

Carbon may be present in clay or shale as coal, lignite, or vegetable matter. Carbon, of course, has a great affinity for oxygen and therefore with carbon present the iron tends to remain in the ferrous state. If the higher temperatures are reached before the carbon is burned out, the whole brick structure will be permeated with the black ferrous silicate. The aim of the kiln operator must be to oxidize the carbon before the finishing temperatures are reached, otherwise red colours will be impossible to obtain.

It is interesting to note here that the Minto shales contain about 3 per cent of coal. The author's first experience with burning this shale was disastrous. Now at one stage the fires are completely withdrawn. The coal in the shale continues to burn for some twenty-four hours. After this carbon has practically burned out the fires are again lighted.

Lime, usually occurring as $CaCO_3$, is often an objectionable impurity in clay. $CaCO_3$ calcines at temperatures of 1650 degrees F. and upwards forming quick-lime, or CaO and CO_2. Should the CaO be present in lumps in the finished brick it will of course slake when subjected to moisture and produce slaked lime or $Ca(OH)_2$. Should lime be present originally in a finely divided form, but in appreciable quantities, buff colours will be produced in clays that would otherwise burn red. In fact, lime is sometimes added to clay to produce buff colours but the product is not well regarded. Lime is a fluxing agent and the smallest percentage in fire clay reduces considerably its value as a refractory.

Fine face colours in brick are sometimes obscured by a gray or yellowish white substance termed 'scum.' This is usually $CaSO_4$ and may be formed either in the dryer or kiln. If sulphur trioxide from the combustion gases in the kiln leaks into a waste heat dryer and meets the moist atmosphere there, sulphuric acid, H_2SO_4, is formed. This acid, acting on $CaCO_3$ in the clay forms $CaSO_4$. The same substance may be formed in the kiln when SO_3 comes in contact with ware that has been improperly dried. The necessity of using fuel low in sulphur for burning brick is evident.

The white coating which often appears on brick after

Figure No. 4.—Round Kilns of Multi-stack and Single-stack type.

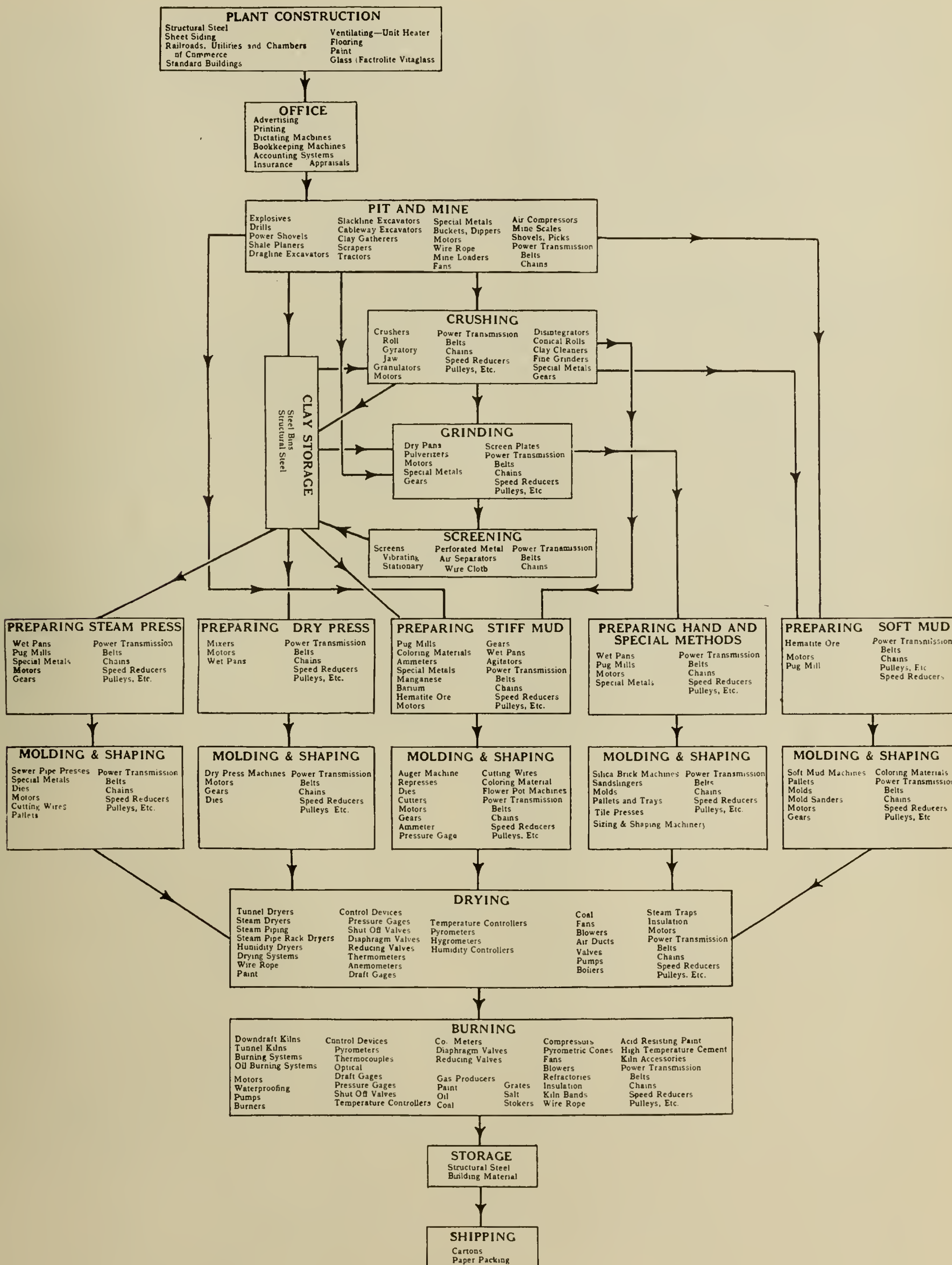


Figure No. 5.—Flow Sheet of Manufacturing Processes in the Clay Products Industry.

exposure to the weather, is known as efflorescence and is usually due to some soluble salt such as magnesium, sodium, or potassium sulphate, and sometimes calcium sulphate. The salt may be present in the brick after burning and on being wet it leaches out and dries white on the surface or it may be derived from the mortar in which the bricks are laid. It will be noted that efflorescence disappears in wet weather and re-appears when dry. Hard burning, which closes the pores, is a remedy for preventing efflorescence. Again, a barium salt, such as barium carbonate, is often added to the clay. This salt, in reaction with $CaSO_4$ produces products which are insoluble, or nearly so, as follows:

$$CaSO_4 + BaCO_3 = CaCO_3 + BaSO_4$$

The addition of barium therefore will largely prevent efflorescence and tend also to prevent scum.

For burning heavy clay products such as brick, structural tile or sewer pipe, the fuel may consist of wood, coal, oil or gas. The electric furnace is used to a considerable extent for fine products, such as porcelains, enamelling, etc. The burning operation may be carried out in a 'Scove' kiln, continuous kiln, car tunnel kiln, periodic down draft kiln or some safe type of battery kiln.

The most elementary type of kiln is the old 'Scove' or periodic up-draft kiln. This kind of kiln is of very ancient origin and is still largely used in the great common brick-making plants near New York and Chicago. It is only suitable for common brick. Low initial cost is its sole redeeming feature. In its simplest form the unburned bricks are set in rows to the desired height with openings properly arranged through the bricks for the passage of the flames. These bricks are enclosed by two parallel walls of previously burned brick, provided with fire openings. The outside is covered with soft clay which seals up the openings. The flames enter at the bottom and the waste gases escape through the top. After burning, the whole structure, including the enclosing walls, is dismantled and all saleable brick disposed of. Clamp kilns with permanent enclosing walls are an improvement over the elementary 'Scove' type. The kiln may be practically any length and its capacity is therefore almost unlimited.

In the continuous kiln the central idea is to utilize as much of the heat of the waste gases and from the cooling ware as is possible. This is accomplished by joining together a number of compartments so that the combustion gases may be carried ahead of the burning chamber through to the next compartment containing green or unburned brick, which are, therefore, preheated to a considerable extent. The air to be utilized for combustion in the firing chamber passes through the chambers containing cooling brick before reaching the burning compartment. In this manner the continuous kiln makes use of a large amount of heat otherwise lost in the combustion gases and, further, utilizes much of the heat given off by the cooling products.

The several types of continuous kilns operated are alike in their essential features. They are built either circular, oval or rectangular in shape and contain a varying number of compartments. Whatever the general shape of the kiln is, there are enough compartments to allow for the setting, preheating, firing, cooling and discharging being carried on simultaneously and continuously.

In all continuous kilns the fire is carried successively around the kiln from one compartment to the next. These compartments in the rear of the burning zone contribute their cooling heat to the entering air and the gases from the burning zone are utilized to prepare the fresh green brick for the advancing fire. Natural draft is usually adopted through the use of a large stack connected to the various compartments by a system of flues.

In the largest plants some type of car tunnel kiln is usually adopted. This is essentially a long tunnel often many hundreds of feet in length. The burning zone is fixed. Brick, or whatever is being burned, is loaded on small cars built with refractory decks and having the under carriage protected from excessive heat. The cars enter at one end and are pushed successively through the water smoking, preheating, burning and cooling sections. Divisions between the various sections are provided by building the division wall on certain of the cars so that a group of cars containing ware in one section of the tunnel will be effectually cut off from the adjoining groups of cars. A system of small auxiliary flues, fans and dampers brings the incoming air required for combustion of the fuel through the cooling ware, through the opening under the car floors, which constitutes a flue, and thence to the furnace grates.

Outstanding advantages of the car tunnel kiln are:

1. Marked fuel economy.
2. Fuel handling centralized.
3. Fixed hot zone reducing kiln absorption losses.
4. Low maintenance on kiln.
5. Two handlings of the ware, setting and drawing, eliminated.

Disadvantages are: (1) relatively large initial investment, both in kiln and car equipment, and (2) high maintenance in car equipment.

Both the round and rectangular types of periodic down-draft kiln are used. A group of these kilns is usually operated, the burning operation in any one kiln, however, being carried on independently of the others in the group.

The round down draft kiln is more widely used than any other type. The firing chambers are spaced at intervals around the kiln walls. The combustion gases pass up towards the crown of the kiln and thence down through the ware and out through openings in the floor. The gases may be conveyed away by natural draft to a stack or may be taken off by fan induced draft. Many kinds of ware may be burned in a down draft kiln. The advantages are:

1. Fairly low initial cost.
2. Simple construction.
3. Low maintenance.

Rather high fuel consumption is a drawback to this type. The kiln is very well suited to burning face brick.

In the 'Minter' system of burning, largely used, a group of down draft kilns are connected by a system of underground tunnels fitted with dampers and so arranged that the ware is water smoked by heat from the cooling kilns. After water smoking the ware is further preheated by the combustion gases from the kilns under fire.

Brief reference may be made to glazes.

Salt glazes are used on certain types of heavy clay products, such as sewer pipe, electrical conduits, and some types of brick and structural tile. Salt glaze is a soda-silica-alumina glass coating the surface of the ware. Salt is used because of its cheapness, also it fuses and volatilizes at a moderate kiln temperature, 1,400 degrees F., and further does not change chemically in fusion or volatilization. It is thrown directly on the fires at the end of the burning period. It is thought that with the sodium, aluminum and silicon oxides there is formed volatile ferric chloride which in turn reacts with hot steam producing ferric oxide and hydrochloric acid.

Glaze to be applied over a clay product body contains a variety of substances, such as feldspar, flint, kaolin, boric acid and certain metallic oxides, such as those of zinc, tin and lead. It is proportioned so that its fusing point is lower than that of the body of the ware on which it is to be applied. The glaze mixture is fused to a glass, ground in water to a creamlike consistency, and then the previously burned ware is dipped in the glaze. It is dried and fired to a temperature not so high as that to which the ware was first burned, but the glaze is brought to the fusing point, filling the pores of the ware, the body and glaze becoming practically a single mass.

Raw glazes, which have not been fused before application to the ware, are also used.

In closing, attention may be drawn to the work carried on at Ottawa in behalf of the Canadian clay products manufacturers by the Department of Mines. This department, under the capable direction of John McLeish, M.E.I.C., director, and Howells Frechette, chief of the Ceramics Division, carries on extensive research work and the time and best effort of their engineers is always at the disposal of those interested in the development of the clay resources of this country.

Discussion on "Notes on Clay and Burned Clay Products" Paper by G. S. Stairs, M.E.I.C.[1]

C. S. G. Rogers, A.M.E.I.C.[2]

In connection with Mr. Stairs' paper on the brick and tile industry, it would appear that his products might help to solve that very serious problem that faces the designers of concrete substructures of bridges, etc., in water, subject to variations in level, viz. erosion at a belt between high and low water. This trouble is particularly acute in tidal waters, partly due to the frequent change of level, partly to the salinity of the water and partly to the grinding and eroding action of ice in winter. Similar erosion, however, occurs on concrete piers in fresh waters, where variations of water level are frequent or where ice and current are the active agents.

On all important structures in tidal waters, it is the custom to protect concrete by a facing of good stone, preferably granite, but this is a very expensive procedure, averaging perhaps $40.00 a square yard of exposed surface. Can the brick and tile industry be of assistance?

Granite facing has to be of considerable thickness and the headers must run fairly far into the heart of the concrete core to ensure proper bond. Could not some form of hard brick or tile be supplied to meet the conditions described and could not the brick be shaped to create a mechanical bond without extreme length of header?

The discussor's suggestion is that the facing could be designed to permit tying back into the heart of a pier, so that the facing could be built up a few tiers at a time and serve in place of forms for pouring the concrete hearting.

G. S. Stairs, M.E.I.C.[3]

This problem is an interesting one to the brick manufacturer. A hard vitrified brick similar to a paving brick would undoubtedly stand up to the severe conditions which have been suggested. The question of getting a durable mortar might present some difficulty.

The brick facing might very well be built 8 or 12 inches thick to serve as a form for the concrete. Steel rod ties from brick to concrete would necessarily have to be provided. In this connection an interesting recent development is that of reinforced brickwork, which has been given extensive study by Japanese engineers. The bricks are designed with openings to allow steel reinforcing to be placed vertically in the brickwork. Apparently this idea is now in use in Japan for much the same purpose as that suggested by Mr. Rogers. It might be profitably followed up by the Canadian brick manufacturers, who would welcome the ideas of members of The Institute on this subject.

[1] This paper is published on page 688 of the December issue of The Journal.

[2] Bridge Engineer, Canadian National Railways, Moncton, N.B.

[3] Sales manager and engineer, L. E. Shaw, Limited, Avonport, N.S.

The FORTY-FIFTH ANNUAL MEETING

THE FORTY-FIFTH ANNUAL GENERAL *and* GENERAL PROFESSIONAL MEETING

of THE INSTITUTE *will be held*
in MONTREAL *on*

TUESDAY, WEDNESDAY and THURSDAY
FEBRUARY 4th, 5th and 6th, 1931

Headquarters—The Windsor Hotel

Outline of Programme
Subject to change

Wednesday, February 4th:

MORNING - - - -	Registration and Business Session.
NOON - - - - -	Formal Luncheon.
AFTERNOON - - -	Business Session.
EVENING - - - -	Annual Dinner. Smoker. Entertainment for Ladies.

Thursday, February 5th:

MORNING - - - -	Technical Sessions.
NOON - - - - -	Luncheon.
AFTERNOON - - -	Technical Sessions. Ladies' Tea.
EVENING - - - -	Free.

Friday, February 6th:

MORNING - - - -	Technical Sessions.
NOON - - - - -	Luncheon.
AFTERNOON - - -	Visits to engineering works of interest.
EVENING - - - -	Supper Dance.

Chairmen of Committees of Montreal Branch in Charge of Arrangements for Annual Meeting

Annual Meeting Committee

Chairman - - - - - - - -	D. C. Tennant, M.E.I.C.
Secretary - - - - - - - -	C. K. McLeod, A.M.E.I.C.

A. Duperron, M.E.I.C. - - - - -	Committees
H. Massue, A.M.E.I.C. - - - - -	Registration
P. E. Jarman, A.M.E.I.C. - - - - -	Papers and Meetings
F. Newell, M.E.I.C. - - - - - - -	Visits to Plants
Prof. C. M. McKergow, M.E.I.C. - - -	Smoker
J. A. McCrory, M.E.I.C. - - - - -	Luncheons
W. M. Gardner, A.M.E.I.C. - - - -	Ladies Committee
H. G. Thompson, A.M.E.I.C. - - - -	Publicity
J. L. Busfield, M.E.I.C. - - - - -	Hotel Committee

Montreal South Shore Bridge. *By courtesy of Gladwish and Mitchell, Montreal.*

Aerial View of City of Montreal, including a portion of Harbour.

Among the Papers to be presented at the forthcoming Annual Meeting, the following may be mentioned:—

Construction of the Steel Lock Gates of the Welland Ship Canal.

A number of papers dealing with the engineering of the Welland Ship Canal were given at the Annual Meeting of The Institute in 1928, and the lock gates were described at that time. The paper now presented deals with the difficult mechanical problems encountered during the fabrication and erection of these remarkable gates, whose design was covered in the previous paper.

Train Ferry Landings at Port Mulgrave and Point Tupper, N.S.

This paper, also dealing with structural work, describes the renewal of the train ferry landings of the Canadian National Railways at the Strait of Canso, and is of interest as it treats of the measures and precautions necessary in erecting these complicated structures in tidal waters without interruption to the ferry traffic.

Breakwater Construction in Port Arthur Harbour.

The approaching completion of the extensive programme of breakwater construction carried out in Port Arthur harbour by the Department of Public Works has made it possible to describe the arrangement and construction of this important work, which includes breakwaters of several different types, in a location where special methods of construction were required.

Head Office Building of the Sun Life Assurance Company, Montreal.

A series of papers will deal with this monumental building, treating of the structural work, and the mechanical and electrical equipment required for an office building housing ten thousand people.

Special Features of the Chute-à-Caron Project.

Engineers of the Chute-à-Caron development contribute an account of the methods adopted in dealing with construction problems encountered during the progress of this work, particularly as regards the control of the river and the placing of concrete under difficult conditions.

Automatic Block Signalling on the Canadian Pacific Railway.

This paper treats of the most important recent developments in luminous signals as applied to train control.

Water Supply Problems in Southern Saskatchewan.

Difficulties encountered in obtaining adequate water supply in the southern areas of Saskatchewan are dealt with from a geologist's point of view, and future possibilities are discussed.

Structure and Oil Prospects of the Eastern Foothills Area, Alberta.

This paper, giving the results of a study of the area between the Highwood and Bow rivers, summarizes the present knowledge of the geological structures in southern Alberta from which such important results in oil production are expected.

Power Development at Alexander Landing on the Nipigon River, Ont.

The second large power plant of the Hydro-Electric Power Commission of Ontario at Alexander Landing on the Nipigon river is the subject of an interesting paper. This plant brings the total development of the Nipigon river to 120,000 h.p.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME XIII DECEMBER 1930 No. 12

Forty-fifth Annual Ceneral Meeting

The Annual General Meeting will be convened at Headquarters, 2050 Mansfield street, Montreal, on Thursday, January 22nd, 1931, at 8 o'clock p.m. After the reading of the minutes of the last Annual General Meeting, the appointment of scrutineers to count the Officers' Ballot, and the appointment of auditors for the ensuing year, the meeting will be adjourned to reconvene at the Windsor hotel, Montreal, Que., on February 4th, 5th and 6th, 1931.

Co-operation with The Royal Aeronautical Society

It is fortunate that at a time when aeronautical engineering is coming so rapidly to the front an opportunity has presented itself to co-operate with one of the leading societies devoted to that branch of engineering, a society which is, in fact, the oldest institution of its kind in the world, having been founded in January 1866.

The Royal Aeronautical Society has a considerable and growing number of members in Canada, practically all of whom are trained aeronautical engineers. Its Secretary recently visited Canada and discussed with prominent members of The Institute the possibility of co-operation between that Society and The Engineering Institute of Canada.

The Engineering Institute of Canada is one of the few important engineering societies of the world which includes in its membership all branches of the profession. This circumstance, coupled with the wide geographical area over which our members are scattered, renders it necessary for The Institute to function on a decentralized basis. Our twenty-five branches are, therefore, in themselves the equivalent of local technical societies, and have properly been given powers to form sections devoted to the consideration of the various specialized branches of professional work. Of course it has not been possible or desirable to carry out this sectionalization in all of our branches, or in connection with all the major divisions of engineering, but the arrangement has been put in force where found possible and has been found to work satisfactorily.

On examination it was found that the organization of the Royal Aeronautical Society has many points of similarity with that of The Institute, its various branches, like our own, including in their membership not only corporate members of the society, who are fully qualified as engineers, but also a number of others interested in engineering work, who are less fully qualified and correspond to our branch affiliates. It was therefore possible to work out a scheme, which has now received the approval of the Council of the Royal Aeronautical Society as well as that of The Engineering Institute of Canada, according to which an Aeronautical section formed by a branch of The Engineering Institute in accordance with our by-laws, will also be a Canadian section of the Royal Aeronautical Society. The leading points in this agreement may be indicated as follows:

(1) An Aeronautical section of a Branch of The Engineering Institute of Canada, functioning also as a Canadian section of the Royal Aeronautical Society, will include in its membership:—
  (*a*) Corporate members and Juniors of The Engineering Institute of Canada who apply for membership therein.
  (*b*) Technical members of the Royal Aeronautical Society who apply for membership therein, and
  (*c*) Such other persons as the Executive committee of the Branch may see fit to elect.

(2) It is understood that membership in such an Aeronautical section as such shall confer no technical or professional status whatever, either in The Engineering Institute of Canada or in The Royal Aeronautical Society. Such status can only be obtained by joining one or the other of these bodies as provided in their by-laws.

(3) The officers of such Aeronautical sections shall, as far as possible, be corporate members of The Engineering Institute of Canada or technical members of the Royal Aeronautical Society, and will be appointed annually by the Executive committee of the Branch.

(4) The annual subscription to an Aeronautical section will be decided by the Executive committee of the Branch, and will be payable by all members of the section who are not corporate members or Juniors of The Engineering Institute of Canada or technical members of the Royal Aeronautical Society. Thus membership in an Aeronautical section involves no additional expenditure on those who are already members either of The Institute or the Society.

(5) The object of such Aeronautical sections being the advancement of aeronautical science and engineering, papers and communications on aeronautical subjects will be presented before the sections, and such papers will be published in a special section of The Engineering Journal so far as space permits. The Royal Aeronautical Society will supply copies of the Royal Aeronautical Society Journal for all corporate members and Juniors of The Engineering Institute of Canada who belong to Aeronautical sections, and The Engineering Institute of Canada will forward to the Royal Aeronautical Society the necessary number of copies of the

aeronautical section of The Engineering Journal for distribution to members of that Society.

(6) An Aeronautical section of a Branch of The Engineering Institute of Canada, organized in accordance with the above requirements, will be recognized as a Canadian local section of the Royal Aeronautical Society, and may be referred to either as the Aeronautical section of the Toronto (or Ottawa, etc., as the case may be) Branch of The Engineering Institute of Canada, or as the Toronto (or Ottawa, etc.) section of the Royal Aeronautical Society.

(7) It has been decided that the arrangements outlined in the foregoing clauses will become effective on January 1st, 1931, and they will be subject to annual reconsideration.

The Council of The Institute is entering into this agreement in the full expectation that it will meet with the approval and support of all aeronautical engineers in Canada, whether members of The Institute, members of the Royal Aeronautical Society, or not. With the help of the rapidly growing body of those interested in aeronautics the co-operation of the two bodies cannot fail to benefit the profession. It will enable all aeronautical engineers resident in Canada to get together and take part in the work of the leading aeronautical society of the world.

It is noteworthy that a principal feature of the affiliation proposed is the interchange of publications, a course which will not only be of direct service to The Institute members interested in aviation, but will also have the very desirable result of familiarizing aeronautical engineers in England with the progress and requirements of aeronautical science in Canada.

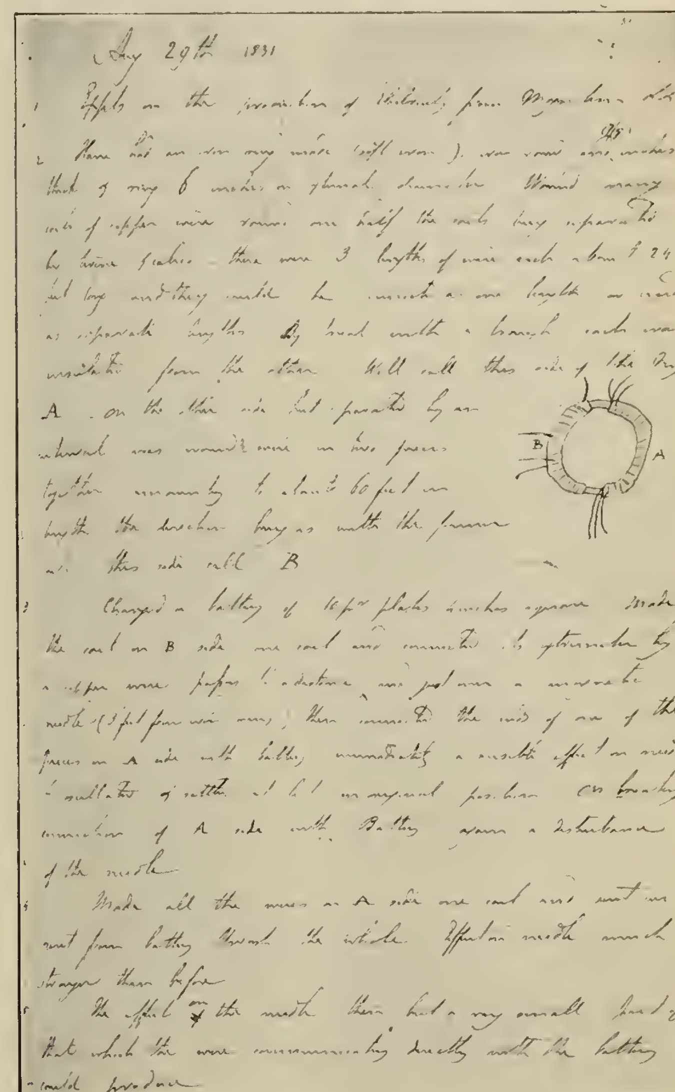
From another point of view the arrangement now outlined is equally striking. It marks an entirely new and very promising development in the policies of The Institute. There appears to be no reason why a relation similar to that between The Engineering Institute and the Royal Aeronautical Society should not be entered into with other important technical organizations dealing with specialized branches of engineering, and it is indeed the hope of the Council, in approving the course now taken, that its action in this case will be followed by equally promising arrangements with other technical societies of like standing.

The Faraday Celebrations 1931

In 1831 Michael Faraday began, or rather resumed, in his laboratory at the Royal Institution, experiments on the induction of electric currents; and on August 29th, 1831, made the discovery in which lies the origin of the dynamo and starting point of the utilization of electric power for the purposes of man. On that day, as his diary shows, he wound two coils of wire on to opposite sides of a soft iron ring, connected one coil to a battery and the other to a galvanometer, and at "make" and "break" of the battery circuit observed deflections of the galvanometer connected in the other circuit. From this simple experiment, and the variations of it made by Faraday in succeeding trials, have grown in the past hundred years the science of electrical engineering and the great electrical industry in all its phases as we know it today. No other experiment in physical science has been more fruitful in benefit for mankind. August 29th, 1931, is then the centenary of one of the great events in the history of the world.

To celebrate this occasion a series of functions will be held in London in September 1931, the lead being taken by the Royal Institution, in whose house in Albemarle street, Faraday lived and worked and gave his famous lectures, and by the Institution of Electrical Engineers, the body representing in England the profession and industry which owe their existence largely to Faraday's great discovery. Other societies and organizations will participate, and a provisional programme has been arranged for September 21st, 22nd and 23rd, 1931.

To mark the forthcoming centenary the Royal Institution is publishing the diary which Faraday wrote with



his own hand of all his experimental work. A facsimile and transcript of the page of the diary recording the discovery of electro-magnetic induction is included with these notes. and is reproduced with the kind permission of the Royal Institution.

Past-Presidents' Prize

Announcement is made by the Council of The Institute that the subject selected for papers to be submitted in competition for the Past-Presidents' Prize for the prize year July 1st, 1930, to June 30th, 1931, is:

"ENGINEERING EDUCATION IN CANADA"

Two years ago the subject of "Engineering Education" was prescribed for the prize and seven papers were submitted. At the last Annual Meeting the committee on the award of this prize reported that while several of the papers were of a high order, it was unable to recommend any one of them for the prize.

It is hoped that the papers in this competition will offer ideas and suggestions, both critical and constructive, which will be of value to Canadian universities and engineering schools, and which will also stimulate interest in the subject among practising engineers and employers of engineers. It is with this idea that the subject has again been chosen, and the following notes have been prepared by a committee of Council to suggest the treatment desired. It is not essential, however, that the arrangement of the papers should conform rigidly to that outlined below:—

(1) Curricula of Applied Science Faculties and Engineering Departments of Canadian Universities.

Pre-requisite admission standards; allocation of time between lecture and laboratory or workshop periods; tendency toward or away from specialization during regular four-year undergraduate course; recognition and guidance of special tendencies and abilities as revealed during the undergraduate course; place of cultural studies as distinguished from more strictly scientific and practical training; need and opportunities for intellectual and moral inspiration deriving from personal contacts with teaching staff; influence of organized recreation and participation in general college activities outside the class-room.

(2) The need and opportunity for organized collaboration by practising engineers and corporate or municipal bodies employing engineers, in the practical training of undergraduates during vacation periods and of young graduates in the early years following graduation.

Meeting of Council

A meeting of Council was held on Tuesday, November 18th, 1930, at 8 o'clock p.m., with President A. J. Grant, M.E.I.C., in the chair, and eight other members of Council present.

The minutes of the meeting held on September 22nd, 23rd and 24th, 1930, and of the meeting held on October 17th, 1930, were taken as read and confirmed.

Considerable discussion took place as to the possibility of so modifying the organization of the Papers committee as to increase its effectiveness as an aid to the various branches in obtaining speakers and papers for their meetings. The matter was held over for further consideration.

After routine business in connection with The Institute's representation on the Council of the International Federation for Housing and Town Planning, the agreement with the Royal Aeronautical Society, and the amendments to the By-laws to be proposed by Council, the report of the Finance committee was considered, and one reinstatement was effected.

The Council next considered the situation as regards arrears of fees, and a number of special cases of members whose illness or other adverse circumstances had led them to lay their cases before Council were also considered.

Council noted with deep regret the death on October 25th, 1930, after a brief illness, of one of The Institute's senior members, Dr. H. M. MacKay, M.E.I.C., Dean of the Faculty of Applied Science, McGill University, and the following resolution was unanimously passed; the Secretary being directed to send a copy to Mrs. MacKay and Dr. MacKay's brothers:

"The Council of The Engineering Institute of Canada has to record the death of Henry Martyn MacKay, whose loss will be keenly felt, not only by the great university in which he occupied such an important post, but also by the profession of which he was a distinguished member. All who knew him deplore the passing of an eminent engineer, a wise administrator, and an educator whose influence will long remain. The Council of The Institute desires to extend most sincere sympathy to his family in their bereavement."

The report of the examinations held on November 4th, 1930, was presented and approved.

A number of applications for admission and for transfer were considered and the following elections and transfers were effected:

Elections		*Transfers*	
Associate Members	2	Junior to Associate Member	2
Juniors	2	Student to Associate Member	4
Students admitted	31	Student to Junior	1

Attention was drawn to the hardship which sometimes exists when an applicant is called upon to take the examinations under Schedule "B" for the class of Junior, and when, after a further period, on applying for transfer he is required to take an examination under Schedule "C" for transfer to the class of Associate Member. It was suggested in such cases that it would be much simpler if applicants took the examinations under both Schedules "B" and "C" when being elected to the class of Junior, in this way avoiding the necessity of working up for an examination at a later date when their professional engagements make a much greater call upon their time. The Secretary was directed to draw such candidates' attention to this difficulty, suggesting to candidates taking Schedule "B" that they should take an early opportunity of passing the further examination under Schedule "C."

The Council rose at eleven forty-five p.m.

Amendments to By-laws

Several proposals for the amendment of By-laws are still under consideration by Council. These will be mailed to members in due course as provided in Section 75.

Membership List

New Issue of List of Members

The Membership List as of October 1st, 1930, has been issued and forwarded to all Corporate Members. It will be sent to Affiliates, Juniors and Students of The Institute on receipt of request.

Publications of Other Engineering Societies

From time to time announcements have appeared in The Engineering Journal regarding the exchange arrangements which exist between The Engineering Institute of Canada and the founder engineering societies of the United States, whereby members of The Institute may secure the publications of the American societies at the same rate as charged to members of those societies. A list of these publications, with the amounts charged, is given below and subscriptions may either be sent direct to New York or through headquarters of The Institute.

	Rate to Members	*Rate to Non-Members*
American Institute of Electrical Engineers		
Journal, single copies	$ 0.50	$ 1.00
" per year	5.50	10.50
Transactions, per year:—		
Paper	5.00	10.00
Cloth	5.00	10.00
Year Book	1.00	2.00
Pamphlets	.25	.50
American Institute of Mining and Metallurgical Engineers		
Magazine, single copies	0.50	1.00
" per year	5.00	10.00
Transactions, per volume, with pamphlets, paper	2.50	5.00
(Other publications, same rate E.I.C. members as to A.I.M.M.E. members)		
American Society of Civil Engineers		
Proceedings, single copies	0.50	1.00
" per year	4.00	8.00*
Transactions, per year	6.00	12.00†
Year Book	1.00	2.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
**If subscription is received before January 1st, otherwise price $10.00.*		
†If received before February 1st, otherwise price $16.00.		
American Society of Mechanical Engineers		
Journal, single copies	0.50	0.60
" per year	4.00	5.00
Transactions, per year	6.00	8.00
Year Book	1.00	2.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		

OBITUARIES

Robert Armour, M.E.I.C.

In the death of Robert Armour, M.E.I.C., which occurred at Toronto on September 10th, 1930, The Institute loses one of its oldest members.

Mr. Armour was born at Montreal on March 6th, 1850. At the age of sixteen, having moved in the meantime to Windsor, Ont., with his family, he enlisted in the Windsor Garrison Artillery in service against the Fenian raiders. Mr. Armour entered the service of the Great Western Railway (later Canadian National Railways) as draughtsman at Hamilton, in 1870, and was made assistant engineer in 1875. In 1881 he was appointed principal assistant engineer to the late Joseph Hobson, chief engineer, being transferred to Montreal in 1896 as assistant engineer with the Grand Trunk Railway. In 1917 he was masonry engineer, and in 1923 Mr. Armour was located at Toronto

ROBERT ARMOUR, M.E.I.C.

as masonry engineer, central region, Canadian National Railways. On February 1st, 1924, he retired from active service, but was retained in the capacity of consulting masonry engineer until his death.

As a railway man Mr. Armour's chief concern was the substructure of bridges and he had a part in the rebuilding of many for the double track between Chicago and Portland, Me. Some of the more outstanding bridges in which he was interested are those at St. Anne de Bellevue and Vaudreuil, Que., the arch at Niagara Falls and the Victoria bridge at Montreal. He was also interested in the masonry approaches to the St. Clair tunnel.

Mr. Armour joined The Institute as a Member on January 20th, 1887.

Francis Henry Balfour, M.E.I.C.

It is with regret that the death of Francis Henry Balfour, M.E.I.C., which occurred on September 17th, 1930, at St. John's, Nfld., is recorded.

Mr. Balfour was born at St. John's, Nfld., on August 12th, 1860, and was educated in England. Returning to St. John's he became assistant on a geological survey of Newfoundland, in 1882, and in 1883 was transitman and lineman on the Harbour Grace railway. For several years Mr. Balfour was on the engineering staff of the old municipal council of St. John's, being acting engineer for a time. About 1895 he was appointed chief engineer to the Department of Agriculture and Mines, which position he occupied until his death. Mr. Balfour was an unquestioned authority on the natural resources of Newfoundland.

Mr. Balfour joined the Canadian Society of Civil Engineers as a Member on October 24th, 1907, and was placed on the Life Membership List in 1930.

Stratton Harry Osler, M.E.I.C.

It is with deep regret that the death of Colonel Stratton Harry Osler, C.M.G., D.S.O., M.E.I.C., is recorded.

Colonel Osler was born at Cobourg, Ont., on October 18th, 1882, and received his education at the Royal Military College, from which he graduated with honours in 1903, and McGill University, receiving his degree of B.Sc. from that institution in 1904.

From 1904 to 1910, Colonel Osler was with the Survey division of the Department of Militia and Defence, engaged on map work in all its branches, and in 1911 he was occupied with engineering work in connection with the construction and maintenance of the defences at Halifax, N.S., and in 1912-1913 he was in charge of this work. In 1913-1914 Colonel Osler was assistant director, Engineer Services, Headquarters, Department of Militia and Defence, being engaged on administrative and technical work in connection with the construction and maintenance of military buildings and works throughout Canada. From 1915 to 1919, Colonel Osler was on military service, commanding the 6th Field Company, Canadian Engineers (latterly 5th Field Company) in 1915-1916, the Divisional Engineers 2nd Canadian Division in 1917-1918, and the 2nd Engineer Brigade in 1918-1919. Returning to Canada, Colonel Osler resumed the position which he had held in 1914 as assistant director, Engineer Services, and held it until his untimely death.

Colonel Osler joined The Institute as a Member on May 26th, 1925.

Frank Cyril McClory, A.M.E.I.C.

It is with much regret that the untimely death of Frank Cyril McClory, A.M.E.I.C., which occurred on November 9th, 1930, is recorded.

Mr. McClory was born at Lindsay, Ont., on June 20th, 1899, and received the degree of B.Sc. from Queen's University in 1926. Following his graduation, Mr. McClory was for six months assistant district engineer with the Department of Northern Development at North Bay, Ont., and from September 1926 to May 1928 he was acting town engineer at Lindsay, Ont. From May to September, 1928, Mr. McClory was instrumentman with the Department of Public Highways, Toronto Residency, and was then appointed town engineer of Brampton, Ont., which position he held at the time of his death.

Mr. McClory joined The Institute as an Associate Member on April 2nd, 1929.

George Arnold McCarthy, M.E.I.C.

Members of The Institute will learn with regret of the death of George Arnold McCarthy, M.E.I.C., which occurred at Toronto on November 13th, 1930.

Mr. McCarthy was born at Moncton, N.B., on December 19th, 1871, and received his early education in that city, finally graduating from McGill University with the degree of B.Sc., in 1898.

From 1887 Mr. McCarthy was for a number of years junior engineer in the office of the chief engineer of the Intercolonial Railway at Moncton. Following his graduation from the university, he obtained an appointment first with the Canadian Pacific Railway Company in the Lake Superior district, and later with the Algoma Central Railway. From 1901 to 1905 Mr. McCarthy was principal assistant engineer for the Canadian Niagara Power Company, at Niagara Falls, Ont., and from 1905 to 1909 he was chief engineer of the Temiskaming and Northern Ontario Railway commission. From 1909 to 1914 Mr. McCarthy was with Messrs. Smith, Kerry and Chace, first as western manager at Calgary, Alta., and later as resident engineer on the Feather river development for the Oro Development Company, San Francisco. In 1914 he became attached to the Department of Works of the city of Toronto, in which service he remained until his death.

Mr. McCarthy was always active in general engineering matters, and spent much time in the service of his profession in the various societies with which he was connected. He was a member of the American Railway Engineering Association, the American Society of Civil Engineers, the American Institute of Electrical Engineers and also of the Association of Professional Engineers of the province of Ontario.

GEORGE ARNOLD McCARTHY, M.E.I.C.

Mr. McCarthy joined the Canadian Society of Civil Engineers as a Student on May 6th, 1897, becoming an Associate Member on March 16th, 1899, and a Member on October 12th, 1905.

He represented the Toronto Branch of The Institute on the Council during the years 1917, 1918 and 1919, and was for one year chairman of the Toronto Branch.

PERSONALS

W. Schoeni, Jr.E.I.C., has accepted the position of electrical engineer with the Cansfield Electrical Works, Ltd., Toronto.

J. Harvey Westren, Jr.E.I.C., is at present superintendent of the mechanical goods division of the Dunlop Tire and Rubber Goods Company, Ltd., Toronto.

H. W. B. Swabey, M.E.I.C., inspecting engineer with J. T. Donald and Company, Ltd., Montreal, sailed on October 17th for Great Britain, and will be absent for about six weeks on a trip combining business and pleasure.

F. D. Taylor, S.E.I.C., has joined the staff of the Brompton Pulp and Paper Company at East Angus, Que. Mr. Taylor, who is a graduate of McGill University of the year 1928, was formerly with the Canadian International Paper Company at Hawkesbury, Ont.

D. G. Robertson, Jr.E.I.C., is now connected with the Production department of the Coca-Cola Company at Toronto. Mr. Robertson, who is a graduate of Queen's University of the year 1924, was formerly in the office of the city engineer, Hamilton, Ont.

R. H. Reid, A.M.E.I.C., is now on the engineering staff of the Beauharnois Construction Company at Beauharnois, Que. Mr. Reid, who is a graduate of McGill University of the year 1910, was previously with the Gatineau Power Company, at Ottawa, Ont.

P. C. Kirkpatrick, A.M.E.I.C., has joined the staff of the Ontario Power Service Corporation, Ltd., and is located at Fraserdale, Ont. Mr. Kirkpatrick was formerly with the Fraser-Brace Engineering Company, Ltd., at Copper Cliff, Ont.

Martin F. O'Day, S.E.I.C., has joined the staff of the Ontario Refining Company, Ltd., at Copper Cliff, Ont. Mr. O'Day, who graduated from the University of Manitoba in 1926 with the degree of B.Sc., was formerly with the Fraser-Brace Engineering Company at Island Falls, Sask.

J. E. Blanchard, M.E.I.C., has been appointed Director of Public Works of the city of Montreal, Que. Mr. Blanchard graduated from Laval University in 1902 with the degree of C.E. and since 1906 has been in the service of the city of Montreal, having been engineer superintendent of roads prior to receiving his present appointment.

J. Hvilivitzky, A.M.E.I C., formerly structural engineer with the Truscon Steel Company of Canada, Montreal, has been appointed instructor of engineering drawing with the Faculty of Engineering of the University of Toronto, Toronto. Mr. Hvilivitzky graduated from the University of Toronto in 1928 with the degree of B.A.Sc.

T. L. Watt, A.M.E.I.C., is now in the service of the Department of Northern Development, Ontario, and is located at Matheson, Ont. Mr. Watt was formerly locating engineer with the Canadian National Railways, Sudbury district, and in 1929 was with the Trent Valley Lumber Company on the construction of a railway.

H. A. Terreault, M.E.I.C., formerly chief engineer and director of Public Works of the city of Montreal, has resigned from that office, which he has held since 1922. Mr. Terreault, who is a graduate of the Ecole Polytechnique of the year 1899, was at one time superintendent of the municipal aqueduct department, prior to that he was stationed at Sorel, Que., where he was engaged on government work.

A. G. Grant, Jr.E.I.C., has entered the employ of the Ontario Power Service Corporation, Ltd. as draughtsman, and is located at Fraserdale, via Cochrane, Ont. Prior to accepting his present position, Mr. Grant, who is a graduate of the University of Toronto of the year 1927, was field engineer with the construction department of the Canadian International Paper Company, at Temiskaming, Que.

Lieut.-Commander Charles Stephen, A.M.E.I.C., who has, for a number of years, been superintendent engineer at Macdonald College, Ste. Anne de Bellevue, Que , in charge of water works, electric light and power, heating, roads and general construction, has recently been appointed to a newly created office of the Federal government, known as chief engineer and technical adviser, Department of Inland Revenue, Ottawa.

A. G. Tapley, A.M.E.I.C., who since 1928 has been chief engineer of the Halifax Harbour Commission, has returned to the Department of Public Works of Canada as senior assistant engineer, and is attached to the Halifax office. Mr. Tapley's early engineering work was with the Intercolonial Railway, with which he became connected in 1898, and between that date and August 1905, he occupied the positions of draughtsman, transitman and engineer in charge of construction. During the following two years he was with the National Transcontinental Railway as leveller, draughtsman, instrumentman and resident engineer. During 1908 Mr. Tapley again became connected with the Intercolonial Railway. From 1909 until 1928 he was with the Department of Public Works of Canada as assistant engineer. It will be recalled that Mr. Tapley was awarded the Gzowski Medal for his paper on "Concrete in Sea Water" which was published in the November, 1924, issue of The Journal. Mr. Tapley has been most active in the affairs of The Institute.

J. J. Macdonald, M.E.I.C., has been appointed chief engineer of the Halifax Harbour Commission. Mr. Macdonald was formerly associated with Major J. R. Grant, M.E.I.C., consulting engineer for the Burrard street bridge, Vancouver, B.C.

Mr. Macdonald is a graduate of McGill University of the year 1911, when he received his degree of B.Sc. Following graduation he took a post graduate course at McGill in the advanced theory of structures. After graduation Mr. Macdonald entered the employ of Messrs. Waddell and Harrington, consulting bridge engineers, Kansas City, Mo. and specialized in structural design and construction, covering the work in all departments of bridge engineering. He was next appointed office engineer on the staff of The Halifax Ocean Terminals project, and later served as resident engineer on the construction of sections of the above work, and spent some time at the head offices of the Canadian Government Railways at Moncton, N.B., in charge of the preparation of plans and specifications for work going to tender. Early in 1919 Mr. Macdonald accepted an offer to join a firm of engineers and contractors with a view to introducing Canadian or American methods of design and construction in connection with reconstruction work in Great Britain and France, and in 1923 he accepted the position of construction engineer with J. G. White and Company, Ltd., of London, England. In 1925 Mr. Macdonald prepared construction layouts and estimates for the foundation work for the great new bridge across the Tyne river at Newcastle, under Sir Douglas Fox and Partners, for Dorman Long and Company, Ltd., who secured the contract for the work. In 1926 Mr. Macdonald returned to Canada as chief engineer of The Foundation Company of Canada, Ltd., with headquarters in Montreal.

ELECTIONS AND TRANSFERS

At the meeting of Council held on November 18th, 1930, the following elections and transfers were effected:

Assoeiate Members

HUMBLE, Archibald Marshall, (Royal Tech. Coll.), asst. designing engr., Toronto Harbour Commissioners, Toronto, Ont.

MILLER, Harry, B.A.Sc., (Univ. of Toronto), factory planning engr., Northern Electric Co. Ltd., Montreal, Que.

Juniors

FILION, Louis Gerard, B.Sc., C.E., (Ecole Polytech.), asst. engr. for the City of Lachine, Que.

RICHARDSON, William Gordon, B.Sc., (Queen's Univ.), development branch, Northern Electric Co. Ltd., Montreal, Que.

Transferred from the elass of Junior to that of Assoeiate Member

COYNE, Clarance Stanley, asst. divn. engr., London Divn., C.N.R., of 54 Boustead Ave., Toronto, Ont.

ELLIOT, Gerald B., B.Sc., (McGill Univ.), district sales engr. for Canadian territory, Carrier Engineering Corporation, Cleveland, Ohio.

Transferred from the elass of Student to that of Associate Member

BRACKEN, William Donald, B.Sc., (Queen's Univ.), asst. supt., Canadian Niagara Power Company, Niagara Falls, Ont.

LAWRENCE, Frederick S., B.Sc., (McGill Univ.), engr. of constrn., gas distribution dept., Montreal Light, Heat and Power Cons., Montreal, Que.

MacPHAIL, Gordon Miller, B.Sc., (Univ. of N.B.), town manager, Woodstock, N.B.

SWIFT, Earle Raymond, B.Sc., (Queen's Univ.), junior engr., Welland Ship Canal, Welland, Ont.

Transferred from the class of Student to that of Junior

MATSON, Bruce Cook, B.A.Sc., (Univ. of Toronto), engr., Innerkip Lime and Stone Company, Woodstock, Ont., and sales engr., Maloney Supply Company, Toronto, Ont.

Students Admitted

ADAMS, John DeWitt, (Univ. of Alta.), 11115-85th Avenue, Edmonton, Alta.

BAILEY, James, (McGill Univ.), 301 Ballantyne Avenue, Montreal West, Que.

BENNETT, Robert Douglas, (McGill Univ.), 4643 Park Ave., Montreal, Que.

BROOKES, Norman Frederic, (Univ. of B.C.), 2646 Yukon St., Vancouver, B.C.

BRUMELL, Orby Richard, (McGill Univ.), 902 Burnside Place, Montreal, Que.

BUCKLAND, Alfred Channing, (Univ. of B.C.), 1063 Balfour Ave., Vancouver, B.C.

CARSWELL, Ernest Richmond, (Univ. of B.C.), 2812-12th Ave. West, Vancouver, B.C.

DALE, John Clapham, (Univ. of Alta.), Kitscoty, Alta.

DUNLOP, Robert J. F., (McGill Univ.), 3739 Hutchison St., Montreal, Que.

JUE, Gordon J., (McGill Univ.), 670 Lagauchetiere St. West, Montreal, Que.

KENNEY, Cleveland Lovitt, B.Sc., (N.S. Tech. Coll.), student engr., Otis-Fensom Elevator Co. Ltd., Montreal, Que.

MacDONALD, William Arthur, B.Sc., (N.S. Tech. Coll.), telephone engr., Northern Electric Co. Ltd., Montreal, Que.

MASSE, Gaston W., (McGill Univ.), 3740 St. Hubert St., Montreal, Que.

MERRETT, Edward James, (Univ. of B.C.), Mount Tolmie P.O., Victoria, B.C.

MOORE, Robert Hugh, (Univ. of Man.), 240 Balfour Avenue, Winnipeg, Man.

MUNN, Thomas Hanna, (Univ. of B.C.), 3793-23rd Ave. West, Vancouver, B.C.

McINTYRE, Douglas Vallance, (Univ. of Alta.), 11048-82nd Ave., Edmonton, Alta.

McKEEVER, James Lawrence, B.A.Sc., (Univ. of B.C.), students' test course, Canadian General Electric Company, Peterborough, Ont.

NEUFELD, James Cornelius, (Univ. of Man.), 579 Elgin Ave., Winnipeg, Man.

OLESKEVICH, Veni, (McGill Univ.), 2056 Jeanne Mance St., Montreal, Que.

PATTERSON, Gordon Neil, (Univ. of Alta.), 8638-108th St., Edmonton, Alta.

PEFFERS, William Oswald, (Univ. of Alta.), University of Alberta, Edmonton, Alta.

PINCHBECK, George Reginald, (Univ. of Alta.), University of Alberta, Edmonton, Alta.

REEVE, David Douglas, (Univ. of B.C.), 3137-42nd Ave. West, Vancouver, B.C.

ROBILLARD, Richard Francois, junior in dfting office, Truscon Steel Company of Canada, Montreal, Que.

ROSS, Arthur LeBreton, (McGill Univ.), 3592 University St., Montreal, Que.

SAUER, George Douglas, (McGill Univ.), Beauharnois, Que.

SILLITOE, Sydney, (Univ. of Alta.), 10663-107th St., Edmonton, Alta.

STIRLING, Andrew Grote, (Univ. of B.C.), P.O. Box 127, Kelowna, B.C.

STORY, George Lumgair, (Univ. of Alta.), 11134-90th Ave., Edmonton, Alta.

VOGIN, Maurice Alfred, (McGill Univ.), 4076 Lafontaire Park, Montreal, Que.

St. Lawrence Waterway Project:

Report on International Rapids Section

(Abridged from an article in "The Engineer," Sept. 19th, 1930)

In February, 1929, the Canadian Government, acting on a suggestion made in a report of the National Advisory Committee dealing with the St. Lawrence Waterway project, that a conference should be held between representatives of the Province of Ontario and the Canadian members of the Joint Board of Engineers, nominated, for that purpose, Dr. Frederick A. Gaby, M.E.I.C., chief engineer, and Dr. Thomas H. Hogg, M.E.I.C., chief hydraulic engineer, of the Hydro-Electric Power Commission. The necessity for holding the conference arose from the fact that the Canadian and United States Engineers of the Joint Board had not been able to come to an agreement as to the best method of development of the International Rapids section of the St. Lawrence River. The conference was therefore asked specifically to report respecting the most effective and economical method of developing this section, while at the same time fully safeguarding Canadian territorial and all other Canadian interests in the purely national—that is to say, the Canadian—section of the river.

The members of the Canadian Section of the Joint Board of Engineers, who formed the other party at the Conference, were Messrs. D. W. McLachlan, M.E.I.C., O. Lefebvre, M.E.I.C., and C. H. Mitchell, M.E.I.C.

After numerous investigations, including the making of a large number of borings to rock at critical points in the International Rapids section—which borings were found to supplement and generally confirm the information previously collected by the Joint Board of Engineers—and after recomputing the costs of all the projects which had been put forward, the Conference came to conclusions which may be summarized as follows:—

(*a*) That the International Rapids section of the St. Lawrence river should be improved by means of what is commonly known as a two-stage or double-stage project.

(*b*) That the upper dam and power-houses of such two-stage project should be placed at Crysler island.

(*c*) That the lower dam should be placed at the head of Barnhart island.

(*d*) That the power-houses of the lower development should be placed across the channel between Barnhart island and the Canadian mainland, with Bergen lake, situated north of Sheek island, constituting part of the headrace leading to these power-houses.

The report of the Conference proceeds to state that studies of the various schemes for the improvement of this stretch of the river show that the removal of the natural control at Galops rapids is an economic necessity. The removal of this rock sill, which forms this natural control, would—

(1) Permit of a higher elevation of the water surface at the upper dam, with a consequent increase in head at that point;

(2) Enable an ice-covered river channel, necessary for winter operation, to be secured between Galops rapids and Morrisburg at moderate cost; and

(3) Place the control of the flow at the Crysler island dam. The control of the flow would be secured by the operation of gates and turbines in such a manner as would pass the discharge determined by an approved regulation of Lake Ontario's outflow.

Several projects for improving the Rapids section by means of dams had been put forward from time to time, but most of them, it was found on analysis, would raise the levels in the intervening reaches to such a small extent that ice covers would not be secured. "The frazil ice formation in such projects would," remarks the report, "be very large in winter, and the resulting ice gorging below Barnhart island would cause a reduction in head and much loss of power. Such forms of improvement are therefore not desirable." The problem, it was decided, must be solved on broader lines, and eventually the question was reduced down to a consideration of the relative merits of two-stage or single-stage projects.

The advocates of the single-stage method proposed the construction of a single dam or barrage at Barnhart island low down-river. With regard to it, the report explains that some 2,000,000 h.p. would be developed in a single power-house. "This," it continues, "is not regarded favourably by the down-river interests, since this single plant would serve a large and populous territory, both in Canada and the United States, and operation restrictions would be difficult to impose, in view of the fact that it would be a dominant interest in the territory served. Again, the additional flooding of land and the extent of the embankments, along with some adverse effects at the end of the navigation season, make the single-stage project undesirable."

The relative merits of effecting the desired improvements with a two-stage project with (*a*) Ogden island and (*b*) Crysler island as the upper point of control were then fully considered, and it was decided that the second position offered the greater advantages. "The efficiency of the power plant and the necessity of securing an ice cover in the intervening reaches largely governed the selection of the Crysler island project."

If, it is explained, the water levels below an upper dam were raised to a point where an ice cover would form without general channel enlargement, then the Ogden island-Long Sault reach, would require to be raised to about elevation 224—the present elevation varying from about 215 to 204. A large number of power units would be required at Ogden island to generate the proposed amount of electrical energy, and the total length of the power-house would have to be about a mile. "As the river at Ogden island is relatively narrow and the banks are steep, the cost of improvement by such a project is increased. Moreover, operating characteristics are uncertain because of the very low head available. If, on the other hand, the head on such a project be increased either by placing the power-houses further downstream, or by adopting a programme of extensive channel enlargement, the estimated costs rise to figures materially above those associated with a Crysler island project."

The foregoing considerations, among others, led the members of the Conference to come to the conclusion, referred to above, that the development of the International Rapids section of the river should proceed by the adoption of a two-stage project, one development being at Crysler island and the other at Barnhart island. The following are the general features of the recommended project:—

(*a*) A free open channel south of Galops island for use for navigation, along with a diversion channel, capable of control, through Galops island.

(*b*) Channel enlargement between Lotus island and Morrisburg, designed to give 95,000 square feet of river section at ordinary operating levels.

(*c*) A dam with two power-houses at Crysler island, one power-house on either side of the International boundary.

(*d*) A dam at the head of Barnhart island with two power-houses at the foot of that island, one power-house on either side of the International boundary.

(*e*) A lock for passing 14-foot navigation through the dam at Crysler island, and also a similar structure to give access to the Cornwall canal at the Barnhart island plant.

(*f*) A short side canal with lock on the Canadian side at Crysler island, and a side canal with two locks on the United States side opposite Barnhart island. These works are designed to carry deep-water navigation past the proposed power-houses and dams.

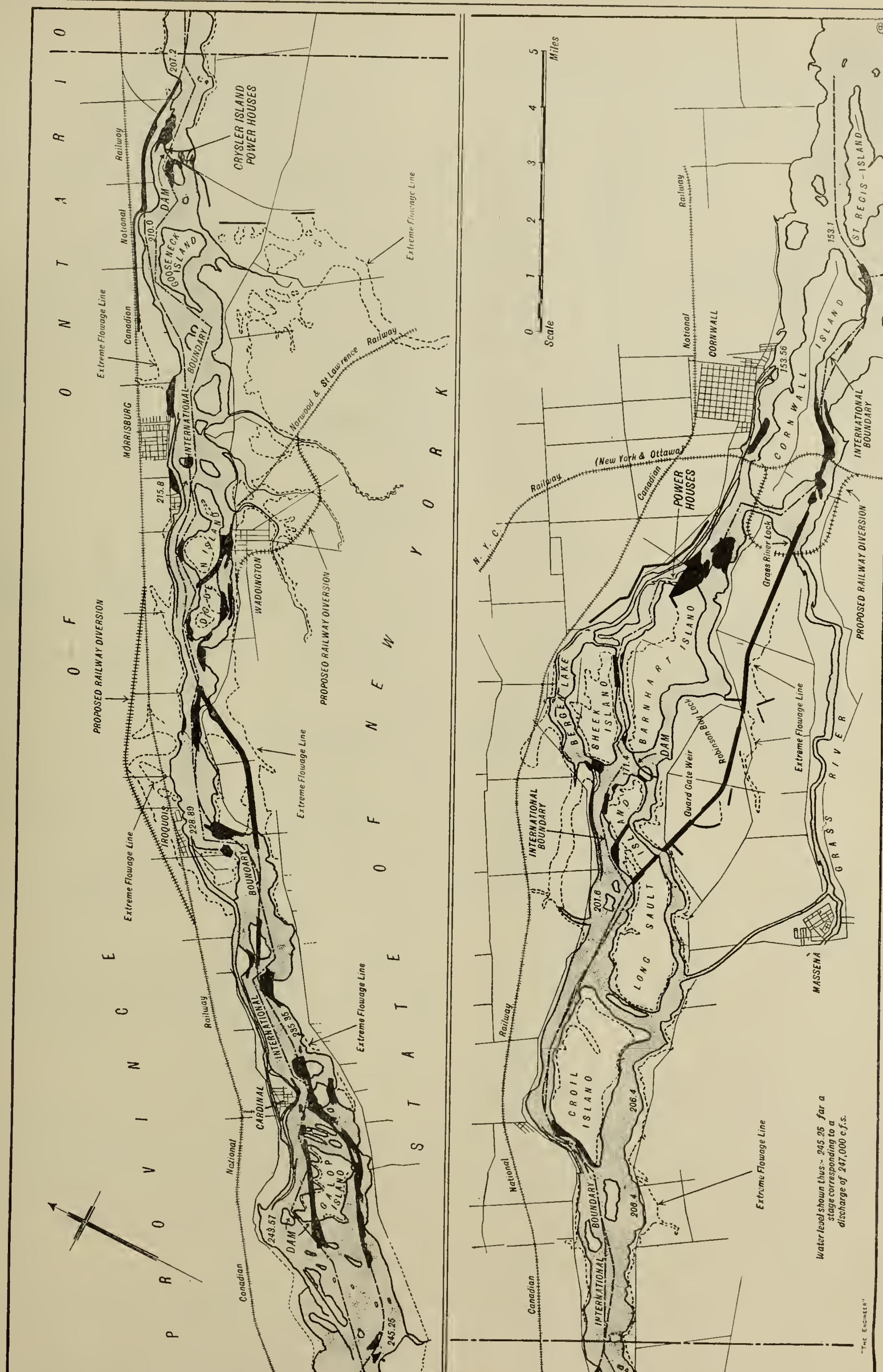
(*g*) Various works designed to protect the interests of the towns and villages affected.

With regard to the works referred to in paragraph (*g*), the report explains that the construction of the work proposed at Crysler island would raise the top water levels opposite the village of Iroquois and the town of Morrisburg to elevations 241 and 245 respectively, which would inundate almost all the village, and the easterly part of the town. Iroquois would, however, be affected in the same manner by any of the forms of improvement discussed, but the country immediately north and west of it is high, and two areas are available as sites for its reconstruction.

"At Morrisburg," the report continues, "a somewhat different treatment of the situation seems advisable with the Crysler project, as only part of the town will be affected by the raised level of the adjacent river. Investigations have led to the conclusion that the area of the town adversely affected should be raised by filling to a suitable elevation, and the reconstruction of the buildings now occupying that part of the town should be brought about by a co-operative plan in which the citizens of the area affected, and the town as a whole, would be inconvenienced as little as possible."

Provision is made in the estimated costs, to which we shall refer immediately, for the reconstruction of the village of Iroquois and, in the case of Morrisburg the estimates provide for the raising of the ground surface, the reconstruction of the buildings, the grading and paving of the streets, as well as the reconstruction of sewers, waterworks. and other facilities, along with provisions for the rehabilitation of the area affected. The excavation of an area in front of the town, so as to give deep water access, is also provided for. The Conference remarks that it "presents the foregoing as a reasonable solution of the problem of caring for these communities, though some variations in detail treatment may be permitted. The estimates are believed to be sufficient to take care of contingencies."

With regard to paragraph (*f*), the report states that the question as to the desirability of placing all the side canals with their locks wholly on the Canadian side was considered, and plans showing what could be done in that direction accompany the report. It is pointed out, however, that the situation of the town of Cornwall and the Cornwall canal, together with the industries along it, make it impossible to provide as economical a route on the Canadian side as is available on the United States side. Moreover, all available routes on the Canadian side would do injury to important local interests. If the canal were to be run at the back of the town of Cornwall, it would, in a measure, separate the town from the surrounding country, as highway and railway bridges would cause delays. If, on the other hand, it were to be constructed between the town and the river, a number of important industries might have to be moved elsewhere, and the usefulness of the 14-foot system of canals would be at an end. The arranging of the canal and locks on the United States side would leave the present Cornwall canal still available on the Canadian side and would retain undisturbed certain industries of Cornwall.



By courtesy of "The Engineer"

Map showing proposed works in International Rapids Section—St. Lawrence Waterway.

The estimated cost of the works proposed together with an estimate of the cost of a single-stage project are set out in two tables, the first of which is reproduced below. The figures given refer to the two-stage project with the upper development at Crysler island and with the navigation canal and lock on the Canadian side at that point, as shown in the accompanying map.

Table No. I.—*Estimates of Costs: Crysler island Two-Stage Project.*

	Canal on U.S. side at Long Sault, dollars.	Canal on Can. side at Long Sault, dollars.
Upper Pool—		
Works solely for navigation, 25 ft.	8,096,000	8,096,000
" common to navigation and power	75,836,000	75,836,000
" primarily for power, sub-structures, head and tail-race excavation	24,893,000	24,893,000
Machinery and superstructure	30,612,000	30,612,000
Lower Pool—		
Works solely for navigation, 25 ft.	25,370,000	*34,122,000
" common to navigation and power	32,266,000	31,334,000
" primarily for power, sub-structures, head and tail-race excavation	33,698,000	33,821,000
Machinery and superstructure	43,249,000	43,249,000
Total	274,020,000	281,963,000
Additional for 27-ft. depth	722,000	859,000
Average operating heads—		
Winter (215,000 cusecs)	19.6 + 56.4 = 76.0 ft.	
Summer (245,000 cusecs)	24.2 + 60.4 = 84.6 ft.	
Installed capacity—		
Upper plant	592,960 h.p.	
Lower plant	1,607,000 h.p.	
Total	2,199,960 h.p.	
Power available—		
Based on flow available 50 per cent of time (210,000 cusecs for 3 months) (235,000 cusecs for 9 months)	1,890,100 h.p.	

*This amount would be decreased by 2,310,000 dollars if the route between the C.N. Railway and the town of Cornwall were to be adopted. The maintenance cost would, however, be increased to the extent of about 50,000 dollars per year.

We do not give the full details of the estimates for the single-stage projects because their adoption is not recommended in the report, but for the purpose of comparison we have collected certain of the figures in table No. II:—

Table No. II.—*Estimates of Costs: Single-Stage Projects.*

	Canals and locks on U.S. side, dollars.	Canals and locks on Can. side, dollars.
Total cost, 25-ft. navigation	235,824,000	248,753,000
Additional for 27-ft. depth	594,000	603,000
Average operating head—		
Winter (215,000 cusecs)	76.4 ft.	
Summer (245,000 cusecs)	86.1 ft.	
Installed capacity	2,287,700 h.p.	
Power available—		
Based on flow available 50 per cent of time (210,000 cusecs for 3 months) (235,000 cusecs for 9 months)	1,918,600 h.p.	

There are several points in these tables which are noteworthy. The first is that for the project which is recommended for adoption, the initial cost is no less than 274,020,000 dollars. The next point is the comparatively small extra cost entailed by the provision of 2-foot additional navigation depth. Further points are that in the single stage project (*a*) the first cost is 38,196,000 dollars less than that of the two-stage project; (*b*) the 2-foot additional depth is obtainable for 594,000 dollars as compared with 722,000 dollars; (*c*) the average operating heads are greater both in summer and winter, 76.4 feet against 76.0 feet, and 86.1 feet against 84.6 feet; and the energy available is 1,918,600 h.p., as compared with 1,890,100 h.p.

Two further advantages which are possessed by the two-stage project are referred to at the end of the report. They are that (*a*) it would make available a large block of power about three years earlier than would be possible with a single-stage project; and (*b*) it can be proceeded with in two independent stages, the upper being completed, if desired, before work was begun on the lower. Power could also be secured from the upper development to help in the carrying out of the lower development without involving the prosecution of works for deep navigation. It is estimated that power could be made available from Crysler island within five years after the construction of the works there was begun.

The Sugar Refining Industry

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Paper read before the Halifax Branch of The Engineering Institute of Canada, February 20th, 1930.

For several years sugar has had the distinction of being one of the cheapest food products in the world. While other commodities have advanced to twice or three times pre-war cost, sugar is available to-day at a price very little higher than that paid for it some twenty years ago.

It is an interesting fact too, that refined granulated cane sugar is almost chemically pure, due to the nature of the refining process, and the re-crystallization and washing it undergoes.

It is estimated that during the current year (1930) the total amount of sugar produced will be slightly under 28,000,000 metric tons. Of this amount, it is estimated that 18,500,000 metric tons will be produced from sugar cane, and 9,500,000 metric tons from sugar beets. The island of Cuba is the greatest sugar producing country in the world, producing from four and a half to five million metric tons of cane sugar annually. This is equal to nearly 20 per cent of the world's total output.

The other cane sugar producing countries rank as follows:—

British India	12	per cent of the world's total production
Java	9.5	" " " " " "
South America	6	" " " " " "
Africa and Europe	3	" " " " " "
Australia	2.5	" " " " " "
Hawaii	3	" " " " " "
Porto Rico	2.75	" " " " " "
Philippines	1.75	" " " " " "
Formosa and Japan	2	" " " " " "
Central America and Mexico	1.2	" " " " " "
West India Islands	2.7	" " " " " "

The British West India Islands produce annually about 360,000 metric tons or about 2 per cent of the world's cane sugar production.

The beet sugar countries rank as follows in percentage of the world's production:—

Czecho Slovakia and Austria Hungary	7.2	per cent of the world's total production
Russia and Poland	6.7	" " " " " "
Germany	6.55	" " " " " "
France	3	" " " " " "
United States	3.5	" " " " " "
Other European countries	7	" " " " " "

Canada produces about 35,000 tons of beet sugar annually, or about $\frac{4}{10}$ of 1 per cent of the total amount of beet sugar produced in the world.

Cane sugar is of course grown in countries that are tropical or semi-tropical, while beet sugar is grown in countries of temperate climate.

In Canada the sugar beet meets with more success in southern Ontario and southern Alberta than elsewhere.

The consumption per capita in Canada for the year 1929 was 96.46 pounds. The United States consumption was slightly higher.

With the exception of the 35,000 tons of sugar produced from Canadian grown beets, the raw sugar imported refined and consumed in Canada is all cane sugar.

Due to the preferential tariff which Canada allows Empire raw sugar growers, our own domestic supply of raw sugar is obtained principally from the British West India Islands including Jamaica, with occasional cargoes from Australia and South Africa. Raw sugars imported, other than Empire sugar, after being refined, are mostly exported to other countries, when the duty is refunded by the Canadian government.

The raw sugar is delivered to the refineries in jute bags, each containing from 225 to 325 pounds.

When a cargo arrives, it is sampled and weighed by a customs official for duty purposes and these items are checked by representatives of the seller of the sugar, as well as by representatives of the refinery concerned. While all the Canadian refineries are about the same capacity, viz., from 1,000,000 to 1,250,000 pounds per day, and their equipment and methods of refining are practically the same, the notes in this paper refer more particularly to the Woodside plant of the Acadia Sugar Refining Company, Ltd., and will deal first with the boiler and power plant of this refinery, treating later, when speaking of the process of refining sugar, of the different machines and apparatus used in that work.

The original installation of boilers at the old Woodside refinery consisted of ten horizontal return tube boilers of 100 h.p. each. Hand firing was first employed, and later under-feed stokers were installed.

In course of time these boilers were scrapped, and five Babcock and Wilcox boilers of 325 h.p. fitted with chain grate stokers were substituted. When the chain grates were put in, Port Hood coal was used at first and proved to be an ideal fuel for this type of stoker. When the old Port Hood mine flooded, coal was brought from different mines in Nova Scotia and some of it proved difficult to use on the travelling grates, illustrating the fact that a coal that is suitable for one type of stoker may be entirely unfit for another type.

After the fire in 1912 the capacity of the refinery was increased from 60 tons to 500 tons per day, and three more Babcock and Wilcox boilers, each of 325 h.p., were installed over chain grates.

In 1922 one 640 h.p. and one 430 h.p. Babcock and Wilcox boiler were purchased, and oil fuel was adopted.

Fuel oil is pumped from the Imperial Oil Company's plant at Imperoyal directly into two fuel supply tanks each of a capacity of 3,000 barrels. The daily supply for the furnaces flows by gravity from the storage tanks to two underground concrete supply tanks, which have a combined capacity of 600 barrels of oil.

Thus at the present time there are available for use eight 325 h.p. boilers, each having 3,240 square feet of heating surface, and 25 square feet of superheater surface. Five or six of these boilers are in commission, and supply steam to the turbines at 160 pounds pressure with 100 degrees superheat (total temperature 466 degrees F.). Either the 640 or the 430 h.p. boiler (both of which supply saturated steam at 90 pounds pressure) is connected to the low pressure steam main, for the purpose of making up the deficiency of steam extracted from the impulse element of the turbine, in order to meet the requirements of the vacuum pans. At the point where the low pressure main is connected to the turbine extraction pipe, this steam passes through a reducing valve and is reduced in pressure to 25 pounds. All the boilers are equipped with automatic boiler stop check valves and feed water regulators. Fuel oil for the furnaces is pumped under a pressure of 40 pounds through back shot burners. The atomization of the oil is done by steam pressure of 160 pounds. The oil is heated to about 190 degrees before it is forced through the burners.

The feed water pumps are of the turbine type, two of which are motor driven, and the other two by steam turbines. The motor driven pumps have four stages and the turbine driven three stages. The feed water is metered through the discharge main of the pumps. All steam driven auxiliaries exhaust into either the 25-pound or 8-pound steam mains. The use of these mains will be explained later.

Steam flow meters of the recording and integrating type are installed on the steam distribution lines, and air-flow meters are being installed on the boiler fronts. The plant operates on an average CO_2 content of about 12.5 per cent. This could be increased, but since the furnace volume is somewhat on the small side, the cost of renewing the brick work would more than offset the saving in oil.

The power house equipment consists of two extraction type steam turbines each directly connected to a 940 kv.a. generator. The exciters are directly connected to the shafts. These units run at 3,600 r.p.m. and supply three-phase current at 550 volts and 60 cycles. There is an auxiliary lighting set of 50 kw. driven by a compound engine. The stream pressure at the turbine throttle is 160 pounds with 100 degrees superheat. The steam consumption at full load (800 kw.) is about 60,000 pounds of steam per hour, and of this amount 35,000 pounds is bled or extracted at 25 pounds pressure after the steam passes through the impulse stages of the turbine, and the remainder (25,000 pounds) passes through the reaction blading and is exhausted against a pressure of 8 pounds per square inch.

The question often arises: Why not pass the turbine exhaust into a condenser? The answer is this:—in the sugar refining industry there is so much evaporating of sugar solutions to be done, and water to be heated, that this steam is put to good use; whereas, if the units were operated as condensing units, the heat carried off in the condensing water would be wasted.

The 35,000 pounds of steam per hour at 25 pounds pressure, bled from the turbines, is conveyed through the 25 pounds pressure main to the vacuum pans and is used for boiling the sugar. If sufficient steam is not available from the turbines, the necessary quantity is made up from the low pressure boilers; their steam being reduced from 90 pounds pressure to 25 pounds.

The average analysis of the raw sugar as received shows that it contains 96 per cent sucrose or sugar, roughly about one per cent of water, and the remainder impurities. Enveloping the crystals there is a film of molasses, very dark in colour, which contains about 70 per cent of pure sugar.

At a place in the refinery termed the "cutting in station" the bags are opened, and the sugar is chuted to the crushers for the purpose of breaking the hard lumps. It is then conveyed, elevated and discharged into a receptacle called a "mingler," and is here mixed with the molasses which had been washed off a previous run of raw sugar, so as to form a plastic mass. After being thoroughly mixed, it is discharged from the mingler into a mixer placed directly below it. The mingler is fitted with agitating arms on a revolving shaft, so as to keep the mass in circulation.

The centrifugal machines for washing the raw sugar are mounted about two feet below the mixer, and receive their charges of sugar from the bottom of the mixer through large pipes fitted with cut-off valves. The centrifugals are about 40 inches diameter and 24 inches high with tapered or conical bottoms and have discharge openings about 20 inches diameter. The revolving elements of these machines have brass or copper perforated liners, the perforations being of such a size as to allow the molasses from this plastic mass (due to centrifugal force) to pass through, but not the grains of sugar. The centrifugals are electrically driven, by motors mounted on the tops of the vertical spindles, and connected to the spindles by a friction device. The automatic timing devices can be regulated so as to produce an operating cycle of from one to five minutes, during which time the wash water mechanism is started and stopped and at the time set for the finish of the cycle the motor switch is thrown out and the brake applied. The installation of these devices changed this station from a six-man station to a one-man station. When starting the machines the motors draw 105 amps. and at the end of the cycle (say of three minutes duration) the current drops to 5 amps.

At the beginning of the cycle the operator throws in the switch, opens the mixer valve and charges the machine. Due to centrifugal force the plastic mass of sugar "walls up" the entire depth of the basket. By this time the machine has attained a peripheral speed of about 11,000 feet per minute. The molasses is forced through the perforated liner against the monitor casing, and flows through a pipeline to the storage tanks.

A predetermined quantity of water is then applied to the sugar for the purpose of washing the remainder of the molasses off the grains, and as a consequence of this affination process, the purity of the sugar is increased from 96 to 98.8 per cent. Thus about 80 per cent of the impurities have been driven off by this mechanical process.

When the cycle is completed, the charge of washed sugar drops into a conveyor and passes to a continuous melter, where it is dissolved. The solution is known as "liquor." The melter consists of a round tank fitted with a revolving screen, with agitators mounted on a vertical shaft.

When the washed sugar drops into the continuous melter sufficient hot water is added to make a 60 Brix solution (i.e. a solution containing 60 per cent sugar by weight) and steam of 8 pounds pressure is admitted through a perforated copper coil so as to heat the liquor to 190 degrees.

The unfiltered liquor is next pumped into defecators, which are round steel vats with open tops and are equipped with steam coils and compressed air pipes. The compressed air is used for agitating the liquor. Additional hot water is used in the defecators to reduce the liquor from 60 to 58 Brix or density. Milk of lime is then added for the purpose of neutralizing traces of organic acid present, or to prevent its formation. A certain amount of diatomaceous earth (kieselguhr) is also added which acts as a filtering aid to the liquor as it passes through the filter presses.

Bullocks' blood was at one time the most popular defecant, and was remarkably efficient, but phosphoric acid and its soluble salts are now exclusively used as the agents for producing a defecating precipitate in liquors and syrups for refining purposes where bag filters are used. To-day nearly every refinery is equipped with filter presses, and kieselguhr is the filtering aid mostly used for trapping the suspended matter.

Each filter press consists of 90 circular leaves covered with cotton. The diatoms in the kieselguhr adhere to the cotton and the liquor is filtered as it passes through to the centre of the leaf, from whence it is conducted to storage tanks.

The filtered liquor is then pumped to pressure tanks in the char house. The successful flow of liquor through the char is the most mportant process in sugar refining, because its purpose is to remove the colouring matter and all impurities from the liquor, thus making the production of white sugar possible.

In this department there are a number of char cisterns. They are 9 feet in diameter, and 30 feet high and have a capacity of 30 tons of char. Char is composed of animal bones which have been crushed, carbonized, and sized to different grists. This material has the power of extracting the colouring matter and impurities from sugar solution. At the beginning of this operation, the cisterns are filled with char almost to the top. The man-hole cover is bolted down, the outlet valve from the pressure tank is opened, and the reddish coloured liquor flows to the bottom of the char cistern, then rises through the pores of the grains of char and around its surfaces, until the cistern is filled. The outlet pipe at the bottom of the cistern extends vertically to about 13 feet before it terminates at the receiving tanks. The idea of this vertical pipe is that 13 feet of liquor shall remain all over the char surface, otherwise channeling would take place.

When the process is complete, the outlet valve on the discharge pipe from the char cistern is opened, and the decolourized liquor flows to the receiving tanks. By this operation the char has absorbed the colouring matter and impurities from the liquor and the result is a water-white liquor now increased in purity to 99.2 per cent.

The used char is then washed with about 30,000 gallons of boiling water in order to wash out the colouring matters and impurities absorbed from the liquor. Compressed air at 15 pounds pressure is then admitted to the top of the cistern for the purpose of driving off the water. When this operation is completed the char is discharged into the dryers in order to reduce the moisture content, thence to the char kilns to be revivified. It is then elevated and conveyed back to the char cistern, and is then in condition to extract the colouring matter and impurities from incoming liquors.

The char kilns consist of vertical air tight retorts, through which the char passes while being revivified. The char kilns are fired by fuel oil, and the waste gases used as the heating medium at the driers.

The water-white liquor is next drawn from the receiving tanks into the vacuum pans, where it is boiled under low pressure and evaporated so that crystallization occurs.

A skilled pan-man or sugar boiler can produce grains of sugar of the desired size by manipulating the steam pressure and vacuum carried on the pan as well as regulating the time to draw more liquor into the pan.

Each of the vacuum pans holds about 45 tons of wet crystals or "massecuite." The time required for boiling a pan of sugar is from one and a half to two and a half hours, depending on the purity of the liquor used.

The vacuum pumps are driven by 70 h.p. motors, and the condensing water is supplied by centrifugal pumps of 5,000 gallons per minute capacity, directly connected to 185 h.p. motors. The condensers are of the barometric jet type.

The boiled massecuite is then spun in centrifugal machines where the sugar grains are separated from the syrup, and as a final treatment, the granulated sugar is washed with water. A pan of sugar when boiled will produce about 50 per cent grain and 50 per cent syrup.

The syrup extracted from a boiling or strike of sugar is either mixed with new liquor from the char and boiled into grains, or is boiled by itself into grains. When the purity of the syrup falls too low to make good saleable sugar it is boiled into remelts and these pass through the different processes in the refinery just as the original raw sugar did.

The granulated sugar discharged from the centrifugal machines contains 2 per cent of moisture. In order to extract this moisture the sugar is dried in revolving dryers, termed granulators. The drying medium is either heat supplied by a revolving heaters, or a current of heated air striking the sugar at right angles as the granulators revolve.

The sugar is then sized over vibrating screens and placed into storage hoppers. From the hoppers it flows to automatic weighing machines and thence it drops into bags.

Barrelled sugar is of course filled directly from the storage hoppers into the barrels. Fancy or tablet sugar is the product of special boiling of liquors in the vacuum pan. It is finished in the same way as the granulated sugar, with the exception that it is not dried in the revolving dryers; and after leaving the centrifugal machines is conveyed to a small mixer where it is mixed with a saturated sugar solution. It then passes through a press and is moulded into shape, after which it is finished by being placed in ovens where the moisture is driven off and the sugar baked by coming in contact with heated air.

Pulverized and powdered sugars are obtained by grinding granulated sugar to the required degrees of fineness. Granulated sugar is put up in barrels, half-barrels, 100-pound kegs, 100-pound bags, 50-pound bags, and 20-pound and 10-pound gunnies. Granulated sugar is also put up in 5-pound and 2-pound cartons. The cartons are formed, filled with sugar, weighed and sealed by automatic machines.

Soft sugars are packed in barrels and bags. Bright yellow sugar is also packed in wax-lined cartons. The waxed lining prevents the moisture in the sugar from escaping and as a consequence the sugar will not harden.

Icing, powdered, and tablet sugars are packed in barrels, boxes and cartons. In the case of icing sugar, it is put up in wax-lined cartons filled, weighed, and sealed automatically by machines of a capacity of 30 packages per minute.

The refinery is equipped with barrel and box making machinery to meet its requirements.

The end product in sugar refining is known as "blackstrap" and contains about 90 per cent of the colouring matter found in raw sugar, together with about 20 per cent of water and 30 per cent of sucrose. It is used principally for making cattle feed and industrial alcohol.

When the affination syrup (before it reaches the blackstrap state) is refined by filtering and passing it through char, thereby extracting impurities and colouring matter, it makes an excellent table syrup.

A refinery may be operated in two ways, one of which is to make all granulated sugar and blackstrap. The other is to make granulated and soft sugars, and a certain percentage of blackstrap, depending on the percentage of soft sugar refined.

It is quite possible by press and char filtering all the liquors and making from them about 29 per cent of soft sugar to practically eliminate the "blackstrap" or end product.

One of the great essentials of sugar refining is adequate chemical control. Every refinery has a well equipped laboratory, where chemists are constantly employed making analyses of the raw sugar from the time it enters the refinery until it is packaged.

Link-Belt Limited, 910 South Michigan avenue, Chicago, Ill., have just issued Book No. 1253 describing their new 1930 model travelling water screen. The book contains 24 pages and is copiously illustrated by large wash drawings which make the operation and construction of the water screen unusually clear. Copies will be gladly sent upon request.

Armstrong Cork Company, Lancaster, Pa., have recently published a 48-page booklet entitled "Industrial Applications of Cork," which describes the hundreds of uses for cork in the industrial application field. Copies will be furnished to interested parties upon request to the company.

New Switchboard Building at Peterborough Works is Arc Welded

The new addition to the Peterborough plant of the Canadian General Electric Company should be interesting to all users of structural steel, in that it is the first building in Canada of any appreciable size to be completely fabricated and erected by the electric arc welding method.

For a number of years much experimental work has been done and tests made in the General Electric laboratories to obtain data for use in the design of arc welded structures and this data was available for reference when designing the addition at Peterborough.

The new building has a floor area of 72,000 square feet and all bays are 80 feet wide, the columns being spaced at 25-foot centres. The permanent walls are of brick construction with large window areas, while the temporary walls are metal-covered wood sheathing on steel framework with large areas of window. All temporary side steelwork is bolt-connected to facilitate the removal of these walls when further expansion takes place. When completed, the building will be used for the manufacture and testing of all types of electrical switching apparatus.

The steel frame has a total weight of approximately 960 tons and consists of steel columns of Carnegie beam sections which carry crane girders, welded steel trusses, roof purlins, sway bracing, etc. All trusses have a span of 80 feet centre to centre of columns and have depths of 7 feet and 8 feet 8 inches at the columns and centre panel points respectively. A special truss having top and bottom chords each consisting of one-half of 27 inches at 160 pounds C.B. carries the additional weight of the brickwork of the north wall of the test section. The other thirty-five trusses in the building have top and bottom chords consisting of one-half of 18 inches at 67 pounds C.B. and one-half of 18 inches at 52 pounds C.B. respectively. The flange of the top chord is continuous throughout while the web was notched at the centre to permit the necessary bending to give the required pitch to the roof. This was then butt-welded and further reinforced by a steel plate. Panel points in all trusses are 6-foot 8-inch centres.

Each crane column has a cap plate welded directly to its web and flanges and all columns have a base plate also welded directly to the column sections. Anchor bolts were connected to the column by passing between the column web and a short angle standing vertically with outer edges welded to the column web. In the centre row of columns the column to carry the roof truss is welded between two 18-inch channels which are in turn welded to the two columns carrying the crane girders. In the other rows of columns which support but one crane girder the roof truss column is also carried direct on the foundations.

Horizontal bracing is provided in the plane of the lower truss chords and consists of rows of angles and Carnegie beam sections running the entire length of the building. Diagonal rods are also provided in four bays in the planes of both bottom and top truss chords. These same four bays also have vertical plane longitudinal bracing to resist crane stresses. Longitudinal struts are also provided in the plane of the truss top chords in all skylight bays. Gusset plates are welded to the truss chord flanges and longitudinal struts are bolt-connected to the gussets.

The fillet welds of triangular cross-section with base and altitude generally from one-quarter inch to three-eighths inch each are subjected to longitudinal shear only, the unit shearing stresses used in design being as follows:

$\frac{3}{8}$ inch by $\frac{3}{8}$ inch triangular fillet—3,000 pounds per linear inch.

$\frac{5}{16}$ inch by $\frac{5}{16}$ inch triangular fillet—2,500 pounds per linear inch.

$\frac{1}{4}$ inch by $\frac{1}{4}$ inch triangular fillet—2,000 pounds per linear inch.

From a great number of tests which have been made, it has been determined that the use of the above unit stresses provides a factor of safety of at least four.

A roof load of 56 pounds per square foot was used in the design divided into 40 pounds live load and 16 pounds dead load. This load was considered as applied to the sloping surfaces of the skylights as well as to the flat portions of the roof. A unit stress of 18,000 pounds per square inch was used in the design of the steel.

Provisions are made for two 5-ton 77-foot span bridge cranes and one 25-ton 77-foot span bridge crane with a 5-ton auxiliary hoist.

In the skylight framing, 88 small trusses were required. The lower chords of these trusses are supported on short pedestals at sub-panel points on the main trusses. Top and bottom chords of skylight trusses are of the tee sections with the vertical post of channel section and all other members composed of angles. These skylight trusses are erected at 20-foot centres and are cross-braced with diagonal rods. All purlins both on the inclined and flat portions of the roof are strengthened by two rows of tie rods.

Excellent progress was made in the erection of the steel work, as only three weeks were required from the erection of the first column till the completion of the work. No great difficulties were experienced during erection, though it would appear that erection would be expedited by the more liberal use of bolted connections instead of clamps. While this is especially true on members which would require punching in any case, it would also appear that the time saved in erecting with bolt connections properly designed solely for erecting purposes, would more than justify the punching of the necessary holes even though this work were done by the field forces just prior to the erection of the members

A Holorib steel deck electrically welded to the purlins was used on this building. This deck is made in sheets 18 inches wide and long enough to lap 3 inches over the purlins. These sheets telescope together this 3 inches at the end to provide for expansion while at the other end two ribs per sheet are welded to the building purlin. The erection of approximately 800 squares of this deck required about four weeks' time. The roof deck is covered by two one-half inch layers of insulation on which is laid a 15-year Johns-Manville asbestos felt roof.

The use of welding on this building resulted in a considerable saving in steel, in a steel frame of unusually good appearance due to the almost entire absence of gussets. Due to the final adoption of a lighter roof deck than originally designed for and the early decision to adopt welding methods, no exact costs are available. The welded structure is, theoretically at least, undoubtedly the cheaper, and practically should become so when the fabricating companies have obtained some experience in this type of work. Another outstanding feature of welding and one which, in many locations, will be given more and more consideration in the future, is the absence of the noise usually associated with steel erection.

On the 600 tons of steel which passed through fabricating shops, as many as seven welders were used, each employing a single operator motor-generator welding set. The field work was done on the steel work by two welders while a third welder was employed on the roof deck. All field welding was done with portable welding sets.

In the fabricating shop the trusses were assembled on timber skids, the diagonal and vertical members clamped to the chords in their proper location and all the joints welded. All trusses were assembled and welded lying flat on their sides.

The 88 skylight trusses were assembled by clamping the members together on timber jigs in the field and all welded complete before erection started. These trusses were all nearly alike so that once the jigs were laid out no changes were needed till the completion of the work. No overhead welding was permitted either in shop or field work.

No Canadian General Electric inspector was placed in the fabricating shops during the progress of the work, though all welds were inspected on the arrival of the steelwork on the site. Welds on both the shop and field work were uniformly good and in all cases erred on the side of larger sections and longer welds than called for on the drawings.

Some 360 tons of steel were shipped directly from the rolling mills to the site. This steel was delivered cut to proper lengths and the necessary punching was done by the field forces before starting erection operations. This steel was generally for use as crane girders, purlins, skylight trusses or longitudinal struts. Field forces were engaged on this work about one month before starting erection. The shop fabrication required about six weeks' time.

Great care was taken to have only competent welders both on shop and field work. Each welder before starting work was required to weld test pieces, the breaking strength of which was required to be at least four times the unit stresses used in design. These test pieces were also welded periodically as the work progressed and in addition the welding was subjected to continual inspection. It is interesting to note that the lowest breaking stress obtained by any welder working on this building was 12,250 pounds per linear inch for three-eighths-inch by three-eighths-inch fillets. Other results up to over 14,000 pounds per linear inch were obtained. It is also interesting to note that on the periodical field tests, which were made on tension test pieces only, an average ultimate strength of between 53,000 and 54,000 pounds per square inch was obtained while in several cases the break occurred in the parent metal rather than in the weld.

All work was done under the direct supervision of the Canadian General Electric Company's engineers. To the keen interest taken in the welding work and the close co-operation between the various contractors and the owners' engineers, is due in a large measure the successful completion of this welded structure.

New Underfeed Stoker Catalogue

Combustion Engineering Corporation, 200 Madison avenue, New York, N.Y., has just issued a new 28-page catalogue, describing the type E Underfeed Stoker. It is recommended for burning either coking or non-coking bituminous coals and for various refuse fuels. The type E Stoker is applicable to boilers ranging from 150 h.p. up to 600 h.p. It may be installed in a battery of two or more boilers. It is mechanically simple and easy to operate. Included in the catalogue is a list of representative installations.

The Meetings of the Second World Power Conference and of the International Electrotechnical Commission in Europe in 1930

From Notes By John Murphy, M.E.I.C.,
Vice-Chairman Canadian National Committee.

The meetings of the Second Plenary World Power Conference took place in Berlin from June 16th to 25th, 1930. The first plenary conference was held at Wembley in 1924. The Berlin conference was preceded by a week of meetings of the International Executive Council which embodies representatives of forty-seven countries.

The International Electrotechnical Commission was projected at St. Louis in 1904, and has held many meetings in various parts of the world. The last plenary meeting, prior to the recent Scandinavian meeting, was held in Italy in 1927. Its meetings this year in the capitals of Denmark, Sweden and Norway began on June 27th, immediately after the close of the Berlin Power Conference, and ended on July 9th.

The *World Power Conference* was formed in 1923 for the purpose of considering how the industrial and scientific sources of power may be adjusted nationally and internationally:—

1. By considering the potential resources of each country in hydro-electric power, oil and minerals.
2. By comparing experiences in the development of scientific agriculture, irrigation, and transportation by land, air and water.
3. By conferences of civil, electrical, mechanical, marine and mining engineers, technical experts, and authorities on scientific and industrial research.
4. By conferences on technical education to review the educational methods in different countries, and to consider means by which the existing facilities may be improved.
5. By discussions on the financial and economic aspects of industry, nationally and internationally.
6. By conferences on the possibility of establishing a permanent world bureau for the collection of data, the preparation of inventories of the world's resources, and the exchange of industrial and scientific information through appointed representatives in the various countries.

The *International Electrotechnical Commission* has national committees in twenty-five countries. Its *aims* and *objects* are as follows:—

1. The principal aim of the International Electrotechnical Commission is to bring about a plain and intelligible medium of communication between those who purchase and those who produce electrical machinery and apparatus, so as to enable them to understand each other without long and complicated explanations and to establish an equitable basis for the comparison of tenders from whatever country they emanate.
2. Whilst the scientific foundation of the electrical industry is common to the whole world, the general technical terminology used has unfortunately different meanings according to the practice of the different nations, and the commission is endeavouring to bring about international agreement as to the meaning of electrical terms, particularly those employed in industry. The commission is also engaged in the international unification of electrical symbols, and in the preparation of various recommendations with the object of facilitating international commerce.
3. The commission does not in any way bring pressure to bear on anybody, its recommendations being arrived at by general consent. Moreover, by accepting these recommendations for international purposes, no national committee is under obligation to modify its own national rules except with the general consent of its own industry. The increasing number of International Electrotechnical Commission's recommendations which are being incorporated into the national rules of the various countries is the best proof of the growing recognition of the value of this international work.

In preparing for the Berlin World Power Conference it was decided on the four following "*classes*" of papers:—

A. Sources of Power.
B. Power, Production, Transmission and Storage.
C. Utilization of Power.
D. General.

Three of the above classes were divided into five "divisions" and the fourth was divided into four. The "divisions" were further subdivided into "sections"—one division, relating to steam power plants and fuels, had thirteen sections.

Three hundred and eighty papers were printed in their original texts two months prior to the conference. These papers were analyzed or digested by "general reporters" in Berlin, and, for the purpose of presentation and discussion, the synopses of them were grouped under thirty-four "sections," namely:—

1. Electricity in the Household and in Agriculture.
2. Electricity in Crafts and Industry.
3. Three-Dimensional Load Models and Current Tariffs.
4. Economic Problems of High Temperature Distillation.
5. Gas Markets.

6. Costs and Comparative Efficiency of Different Forms of Energy from the Consumer's Point of View.
7. Construction and Operation of Large Power Plants.
8. Combined Heat and Power Supply Plants.
9. Fuel, Power and Heat Economics in Individual Countries.
10. Steam Turbines, Gas Turbines and Reciprocating Steam Engines.
11. Boilers and Furnaces.
12. Solid Fuels; Production, Trade and Treatment.
13. Rationalization and Technical and Economic Problems of Water Power Utilization.
14. Dams.
15. Economic Problems Relative to Power Storage on a Large Scale.
16. The Water Power Industry in Individual Countries.
17. Co-operation of Different Power Producing Plants.
18. Construction of Large Generators and Transformers and other Electrical Machines.
19. Switchgear including Automatic Control Apparatus for Power Stations, and Remote Metering and Signalling apparatus.
20. Power Transmission and Flow of Energy in Single and Multiple-Connected Networks.
21. Earthing, Lightning Protection and the Effects of Power Lines on Telephone and Telegraph Lines.
22. Individual Problems of Power Supply in Different Countries.
23. World Problems of Power Economics.
24. Problems Relating to Water Rights.
25. The Effect of Legislation and Control by Public Bodies on Gas and Electricity Supply.
26. Steam and Electrically-Operated Railways.
27. Power Supply on Ships.
28. Production of Natural and Synthetic Oils, their Treatment and the Properties of Motor Fuels.
29. Stationary Internal Combustion Engines and Research Work in this connection.
30. Air-Craft and Automobile Engines.
31. Mechanical Transmission of Power on Vehicles and in Workshops.
32. Research Work.
33. Standardization Problems and the Rationalization of Statistics.
34. Education.

Four thousand members and eight hundred guests registered at the Berlin Conference and the committee of Berlin engineers in charge of the conference had an organization which functioned perfectly. Among the innovations at the conference gatherings the "speech transmitting apparatus" deserves special mention. Three halls with 1,500 seats each were equipped with head telephones and by means of selector switches, English, French or German translations of the speakers' statements could be heard as they were being made. When the speakers supplied typewritten copies of their contributions the translating was excellently done and even when the translators were compelled to work without such aid they did very well.

Canadian participation in the World Power Conference was of a fairly representative character. Canadian papers were prepared and presented as follows*:—

1. Water Resources of Canada and Their Development. By J. T. Johnston, M.E.I.C., Director, Dominion Water Power and Reclamation Service, Department of the Interior.
2. Fuel Investigations and Research in Canada. By B. F. Haanel, M.E.I.C., Chief Engineer, Division of Fuels and Fuel Testing, Department of Mines, Ottawa.
3. Recent Trends in Water Power Development in Canada. By T. H. Hogg, M.E.I.C., Chief Hydraulic Engineer, Ontario Hydro-Electric Power Commission.
4. Generation, Transmission and Distribution of Electricity—Recent Practice in Canada. By Julian C. Smith, M.E.I.C., Vice-President and General Manager, Shawinigan Water and Power Company, Limited, and C. V. Christie, M.E.I.C., Professor of Electrical Engineering, McGill University.
5. Storage Reservoirs in Canada. By O. Lefebvre, M.E.I.C., Chief Engineer, Quebec Streams Commission.
6. Economic Aspects of Electrical Supply in the House and on the Farm. By F. A. Gaby, M.E.I.C., Chief Engineer, Ontario Hydro-Electric Power Commission.
7. Some Economic Aspects of the Hydro-Electric Industry in Canada. By G. Gordon Gale, M.E.I.C., Vice-President and General Manager, Gatineau Power Company, Limited.

The following Canadians attended the Conference:—

Charles Camsell, M.E.I.C., Deputy Minister, Department of Mines, Chairman Canadian National Committee.

John Murphy, M.E.I.C., Electrical Engineer, Department of Railways and Canals and Board of Railway Commissioners. Vice-Chairman Canadian National Committee.

F. A. Gaby, M.E.I.C., Chief Engineer, Hydro-Electric Power Commission of Ontario, Toronto.

O. Lefebvre, M.E.I.C., Chief Engineer, Quebec Streams Commission, Montreal.

T. H. Hogg, M.E.I.C., Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario, Toronto.

G. Gordon Gale, M.E.I.C., Vice-President and General Manager, Gatineau Power Company, Ottawa.

A. B. Normandin, A.M.E.I.C., Hydraulic Service, Department of Lands and Forests, Quebec.

Hon. F. P. Burden, Minister of Lands, Victoria, B.C.

R. G. Gage, M.E.I.C., Chief Electrical Engineer, Canadian National Railways, Montreal.

G. A. Gaherty, A.M.E.I.C., President, Calgary Power Company, Calgary.

deGaspe Beaubien, M.E.I.C., Consulting Engineer, Montreal.

John Morse, M.E.I.C., Shawinigan Water and Power Company, Montreal.

J. B. McCarthy, Consulting Engineer, Montreal.

J. G. Glassco, General Manager, Winnipeg Hydro System, Winnipeg, Man.

When each of the thirty-four sectional meetings was called to order a "general reporter" presented his synopsis of all the papers belonging to the section in question. The synopsis of the groups of papers embodied, in each case, statements showing the "trend of development" in various countries; they also contained the "concluding observations" of the reporter—his conclusions being based upon the facts and opinions presented in the papers; the reporter's statements finally contained a list of "points for discussion." The authors of papers, as it may be seen from the above remarks, took no part in the actual meetings unless they wished to discuss other author's papers, to add some new material to their own, or to correct or take issue with the contributions of some of the speakers. Nearly every one of the Canadians took a hand in making contributions to the discussions and they were greatly aided in their work through the good services of Mr. L. D. Wilgress, the Canadian Trade Commissioner from Hamburg, who came to Berlin, under directions from his department at Ottawa, and helped to establish a Canadian headquarters at the Adlon hotel. The British delegation was the largest, the United States came next, and then came Japan with 100 delegates. These three countries had large suites of offices and a staff of permanent officials at the Adlon hotel prior to and during the progress of the conference. Lord Derby, Honorary President of the World Power Conference, came to Berlin to open the conference. President Hindenburg, Honorary Patron, sent the German Chancellor to welcome us; the president's message contained the following words:—"By developing the transport of power across the political frontiers engineering is about to exercise greater influence than ever upon the economic life of the peoples and to establish a closer connection than ever before between their economic systems." It may be of interest to note here that statesmen, financiers and engineers in Europe unanimously favour the export of power to other countries during the time when it is not needed at home.

One of the features of the conference was the presentation of an address at noon, daily, in the Kroll opera house by world-famed scientists or important personages. The speakers and their topics were as follows:—

1. The Physical Space and Ether Problem by Dr. Einstein. (German.)
2. The New Forms of Rationalization by Dr. D. Surreys. (French.)
3. Place of Minerals in a Power Sustained World by H. Foster Bain. (English.)
4. Address by United States Ambassador Sackett.
5. European Power Systems by Dr. Ing. Oskar Oliven. (German.)
6. Electricity and Power by Prof. Ing. G. Vallauri, Italy. (German, French and English.)
7. Machine Power as a Factor of Culture by Dr. A. F. Enstrom. (German and English.)

The proceedings and deliberations of the council of the World Power Conference, as well as a number of "resolutions" which were passed, have been turned over to a sub-committee or "commission" of eight members who will digest them and report through the London headquarters to the national committees. The national committees are never asked to subscribe to any proposal regarding the running of the headquarters' office, the operations of future world conferences, the publication of proceedings, etc., before all details are submitted in writing; ample time for consideration is always given.

It is generally agreed that the "transactions" of the World Power Conference, when printed for distribution, are too voluminous. The above mentioned "commission" is to investigate and report upon ways and means to cure that situation.

A striking outcome of the conference, perhaps in direct opposition to popular belief, is the contention that the wider development and use of power must eventually reduce unemployment. Officials of the conference issued the following statement:—"Power, from year to year, multiplies the methods by which raw materials are transformed into finished products. New methods create new possibilities of work. New methods require new products for carrying them out, and the markets for the products of labour are thus increased. During the last one hundred and fifty years, 'the machine age,' the increase in the

These papers were reproduced in full in the July issue of the Engineering Journal.

possibilities of work has been much greater than the reduction of the demand for physical labour—if it were otherwise the population of the civilized world could not have increased as it has."

In regard to the conference itself, conference officials issued the following pronouncement: "The most important result of the conference lies in the fact that so many experienced specialists from all over the world have come into personal contact. Quite apart from the value which this has for the individuals and for the organizations to which they belong, it has served to bring the nations into closer touch."

From Berlin, on June 26th, a train-load of delegates proceeded to Scandinavia for the plenary meetings of the International Electrotechnical Commission. Three hundred and fifty delegates from twenty-five countries took part in these meetings. As it was only electrical and closely allied problems which were to be dealt with in Scandinavia, the number of delegates in attendance there was of course very much less than in Berlin.

At Copenhagen, Stockholm and Oslo, municipal and government buildings were placed at the disposal of the local committees and the state railways of Denmark, Sweden and Norway provided special complimentary trains between the capitals of those countries, and made detours to and stops at several power plants en route.

The bulk of the convention work was done in Stockholm.

The business programme of the International Electrotechnical Commission consisted of an attempt at securing unanimous decisions in regard to the standardization of the following matters, which have been in the hands of the various national committees for many years, namely:—

1.	Nomenclature – – – – – –	United States Committee.
2.	Rating of Machinery – – – –	British "
3.	Symbols – – – – – – – –	Swiss "
5.	Steam Turbines – – – – –	United States "
6.	Lamp Caps and Holders – – –	Central Office.
7.	Aluminum – – – – – – –	Central Office.
8.	Voltages and Insulators – – –	Italian Committee.
9.	Electric Traction Equipment –	French "
10.	Insulating Oils – – – – – –	Central Office.
11.	Overhead Lines – – – – –	Belgian Committee.
12.	Radio-communications – – –	Dutch "
13.	Measuring Instruments – – –	German "
14.	Rating of Rivers – – – – –	United States "
15.	Shellac – – – – – – – – –	British "
16.	Terminal Markings – – – –	Dutch "
17.	Oil Switches – – – – – –	Swedish "
19.	Internal Combustion Engines –	United States "

The work of the Committee on Overhead Lines is of special interest. A comparison of practices throughout the world, which was made at Stockholm, showed that in no country was more being done to further the cause of safety than in Canada. Twenty-five years ago many railwaymen, in Canada, favoured the erection of nets or hammocks between power wires and other wires—the assumption being that the power wires would fall and the nets would catch them and keep them away from the railways' wires. Many other countries have had regulations which insisted upon the employment of nets at crossings, but at Stockholm, in July 1930, there was not left a single advocate, from any country, of the practice which the Canadian railway commission abolished twenty-five years ago.

In the discussions on aluminum, now generally used in Canada for electric power transmission lines, the point was brought out that none of the European manufacturers of aluminum wanted to agree upon as high a "standard" for the conductivity of aluminum as is said to obtain in the aluminum which is regularly produced in Canada.

In the Rating of Rivers committee some proposed amendments forwarded through the Canadian National Committee by the Water Powers Branch of the Department of the Interior were readily accepted.

No traveller in Europe can fail to be impressed with the large number of passenger trains in Scandinavia, Germany, Switzerland, France and Italy which are now being operated electrically. The cleanliness and comfort of them leaves little to be desired. The large initial capital outlay for the electrification of steam railways has been the deterring factor in regard to many proposed changes from one system to the other and, at times, it would appear as though sufficient consideration had perhaps not been given to the saving in operating expenses, to the increased comfort to passengers, to the elimination of smoke nuisances in municipalities as well as on the trains, and to the increased capacity of tracks, terminals and equipment, as well as to the reliability of the latter—all of which are secured by electrification. Italy and Switzerland are the leaders in Europe now, in connection with railway electrification.

Canada has never taken as much interest in the International Electrotechnical Commission, in its work and its meetings, as her position in the power world warrants. Specialists in the many branches enumerated above should take an active part in the commission's meetings, and aid in the work of the Canadian National Committee.

The James Morrison Brass Mfg. Company, Limited, 93-97 Adelaide street, west, Toronto, Ont., have issued bulletins Nos. 120, 121 and 122, illustrating and describing their new three series "Streamline" bronze valves for 125, 200 and 300 pounds working steam pressure, Free copies may be had upon application to the company.

BOOK REVIEWS

The Skyscraper

A Study in the Economic Height of Modern Office Buildings

By W. C. Clark and J. L. Kingston. American Institute of Steel Construction, Inc., New York, 1930, board 6 x 9 in., 164 pp., front., plans, tables, $2.00.

Development of the tall building during the past forty years has given rise to many questions of great interest to the public as well as to the architects and engineers who are responsible for the design and to the owners who are responsible for the promotion of such projects. The public is interested in such questions as the effect of this development on traffic congestion, public health, real estate values, and also, largely as a matter of curiosity, the possible height of such buildings. The owner's interest is primarily that of the financial return to be derived from his investment. The gradual increase in the height of the skyscraper, culminating in the recent completion of two buildings of about seventy-five storeys, and recent talk of other buildings of still greater height, naturally leads to the question of what height will give the maximum financial return on the money invested. This question has been investigated by the authors, with the assistance of several architects, consulting engineers and contractors, all of whom are well qualified to do the portion of work assigned to them.

For the purpose of arriving at a solution of this problem, a specific site was selected in a region of high land values in the city of New York. The lot selected, 200 feet by 405 feet, was such as to permit a building, conforming to the set-back provisions of the New York Building By-laws, with a tower portion of the most economical size. On this site eight different buildings were designed varying from eight to seventy-five storeys in height, each building being an upward extension of the one below. An estimate of the cost of each, including all mechanical equipment, was made. The conclusions arrived at are graphically shown in table No. 1, which gives a summary of investment cost, gross and net income and return upon investment, and by chart No. 2 which shows a curve of costs for buildings of different heights from eight to one hundred and thirty storeys. The height of building giving the maximum return, with the assumed value of land at $200.00 per square foot, is sixty-five storeys. Table No. 3 gives net return on investment for various land values.

The methods of making the estimates with the detailed analyses of the results, the charts and diagrams showing the relationship of cost to height of building for the different component factors, and the many other charts and diagrams are of much interest and can made of great use by any one wishing to make an estimate of the cost of a building.

While the book is supposed to be a study of the economic height of buildings, the authors, who are writing as advocates for the skyscraper, devote the last half of the book to a discussion of the place of the tall building in the economic life of the city, and to a refutation of the various arguments advanced by the opponents of the skyscraper. They maintain that the skyscraper instead of being detrimental to a city from the public standpoint, gives a valuable public service, that there are great advantages in the concentration of the business area of a city in facilitating intercommunication and that traffic congestion is not necessarily the result of the construction of skyscrapers, that their tendency is to reduce rather than increase congestion. They also maintain that transportation facilities and public utilities can be supplied and maintained at a lower cost in the more centralized communities and remedies for the relief of congestion are suggested.

A. H. Harkness, M.E.I.C.,
Harkness & Hertzberg, Toronto.

General Reports—Second World Power Conference

VDI-Verlag, G.m.b.H., Berlin, 1930, three editions (German, English and French), 150 x 238 mm., 271 pp. each ed., price, bound in linen, R. M. 26.

The book can be obtained either in English, French or German, bound in linen, price, R. M. 26.

The great number and variety of the communications dealt with at the Second World Power Conference—376 papers were contributed from 34 countries—made it desirable to provide a condensed account describing the papers which have been classed under some thirty-four headings, and this has been done in the book now issued.

Each division has been treated by a "reporter" specially familiar with that particular phase of engineering work, who has prepared a short notice of each paper in his section, and has added notes on the trend of development and recent progress, with suggestions as to points for discussion. The volume thus forms a valuable résumé of the work of the conference in all its sections.

The complete series of World Power Conference publications comprises, in addition to the General Reports, eighteen technical volumes, each containing the papers relating to one of the conference sections; a volume of the principal addresses and lectures delivered during the conference, and an index volume. The published price of the whole series of twenty volumes, exclusive of the General Reports, is R. M. 350, or in English money, £17-10-0. The English publishers are Percy Lund, Humphries & Co. Ltd., Amen Corner, London, E.C. 4.

RECENT ADDITIONS TO THE LIBRARY

Proceedings, Transactions, etc.

Presented by the Societies:

Punjab Engineering Congress, Lahore: Minutes of Proceedings, Vol. 18, 1930.
American Society of Civil Engineers: Transactions, Vol. 94, 1930.
Association of Asphalt Paving Technologists: Proceedings of the Technical Session, Held at West Baden, Wednesday, Oct. 30th, 1929.
The British Engineers' Association: Classified Handbook of Members and their Manufactures, 1930 edition.
The Association of Professional Engineers of Nova Scotia: Minutes of 1929 Annual Meeting; Financial Statement; List of Members and Officers for the Year 1930.
Nova Scotia Engineering Profession Act and By-Laws.
American Welding Society: Year Book, August, 1930.
Queen's University: Proceedings of the Engineering Society, 1930.
Directory of Graduates, January, 1930.
The Institution of Civil Engineers: Subject-Index to:
[1] Minutes of Proceedings, Vols. 205-224.
[2] Selected Engineering Papers, Nos. 1-56, Sessions 1917-18 to 1926-27.

Reports, etc.

Ministère des Mines, Musée National du Canada:
Rapport annuel, 1927, 1928: Travaux généraux du Musée.

Department of Labour, Canada:
Investigation into the Electrical Estimators' Association: Report of Commissioner, October 4, 1930.

Natural Resources Intelligence Service, Canada:
[1] Map of Prince Edward Island, 1927.
[2] Road Map of Prince Edward Island, 1929.
[3] Map of Nova Scotia, 1929.
[4] " " New Brunswick, 1928.
[5] " " Quebec and the Maritime Provinces.
[6] " " Ontario, 1928.
[7] " " Southern Manitoba [n.d.]
[8] " " Northern Manitoba, 1929.
[9] " " Southern Saskatchewan [n.d.]
[10] " " Northern Saskatchewan, 1929.
[11] " " British Columbia, 1928.

Department of the Interior, Topographical Survey, Canada:
Map of Petawaga, Quebec.

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The Smart-Turner Machine Company, Ltd., Hamilton, Ont., who have been welding steel barrels and steel tanks for fifteen years, have recently met the demand for special pipe connections.

These special pipe connections are made of standard steel pipe throughout with heavy steel flanges welded to the ends, this being done by a very careful process. After the welding is completed, they are faced off and drilled in a similar manner to that employed in the case of cast iron pipe.

The plant of this firm is exceptionally well equipped to deal with this class of work.

Practically any pipe connection can be made by this welding process; and it should be noted that any size, from the smallest to the largest, can be produced by the company.

Members of Peterborough Branch at Lakefield, Ont.
Photograph by H. R. Sills, Jr.E.I.C.

BRANCH NEWS

Cape Breton Branch

S. C. Mifflen, M.E.I.C., Secretary-Treasurer.
Louis Frost, Branch Affiliate, Branch News Editor.

A joint meeting was held in the official club rooms of the Dominion Coal Company at Glace Bay on Tuesday, October 21st, under the auspices of the Branch and the Mining Society of Nova Scotia. The speaker of the evening was Mr. E. Godfrey, technical representative, explosives division, Canadian Industries Limited, the subject of his address being "The Care and Use of Explosives." A. L. Hay, M.E.I.C., Branch Chairman, presided.

Introducing the speaker, the chairman briefly reviewed the status held by explosives in the pursuit of peaceful occupation and the necessary procreation of measures that would effectively render the use of explosives safe. The chairman declared that the dominating principle in the industrial use of explosives was "Safety, Effectiveness, and again Safety."

During the course of the address, which lasted well over an hour, the speaker pointed out that the development of practically every industrial process has been made possible by the use of explosives. Explosives were almost as indispensable as capital and labour to world productivity and development. Explosives had not only found a place in mining and quarrying operations, but had also been established as a prime factor in pursuit of other industries, among which were notably those of railroad construction, reclamation of farm lands, hydro-electric development, and demolition.

Every year millions of pounds of explosives were used for a great variety of purposes and the number of accidents were surprisingly few in comparison with the real hazard of their use. This was especially noticeable to one who, like the speaker, had a daily opportunity to see the manner in which explosives were used or misused.

Commercial explosives, the speaker indicated, would not explode of their own accord. In the course of manufacture the ingredients were carefully tested and incorporated only in the proper proportions to produce, when exploded, certain predetermined gases of such volume and speed as to produce a tremendous concentrated power.

Therefore the speaker felt that if it was necessary for the manufacturer to exercise such a great degree of care in the manufacture, then it was equally incumbent upon the consumer to handle and store the explosive in a manner to prevent change in the ingredients and thereby affect the characteristic of the explosive. Addition of moisture will affect all explosives, especially the ammonia brands—practically all coal mining explosives are in this class—causing them to become insensitive. Age has a similar effect.

Explosives should therefore be stored in well ventilated and dry magazines and where possible stocks should be regulated to ensure that no explosive more than six months old would be used.

Human direction or mis-direction was fundamentally the cause of most of the blasting accidents, even though such accidents have in a few instances been traced to ground currents, storms and lightning. All these could be guarded against. The greatest cause of blasting accidents was the result of carelessness. The chief causes were:—

1. Not taking proper cover.
2. Playing with blasting caps.
3. Premature blasts.
4. Hang fires.
5. Boring in unexploded charges.
6. Striking explosives in blasted material.
7. Preparing charges.

Accidents from all of these could be prevented by the exercise of ordinary care.

The author dwelt at length on the special requirements of the explosives used in the mining industry, especially in connection with coal mining. Permitted explosives, he declared, must be used in a permitted manner or the fundamental principle is destroyed. An explosive is not used in a permitted manner if any of the following conditions prevail:

1. If a greater weight than specified is used in any one hole.
2. If stored under improper conditions until it undergoes a change in character.
3. If used in a frozen or partially frozen condition.
4. If more than one class, grade, or quality is used in one hole.
5. If fired without stemming.
6. If fired with combustible stemming.
7. If fired in the presence of a dangerous percentage of combustible gas.
8. If fired in a place that is dry and dusty, without first neutralizing this condition by the application of rockdust or water.
9. If shot in a depending hole or the hole is bored in the solid or has a burden so heavy that the shot is liable to blow out.
10. If more than one shot is fired at any one time in any one place other than in tunnels, shafts and slopes driven in rock.
11. If an electric blasting cap of a lesser strength than that specified for use with the particular explosive is used.

In concluding, the author expressed the opinion that workmen should receive special instruction in the use and handling of explosives. This would, he thought, result in a better product and effect a material economy in the consumption of explosives.

Following a spirited discussion of the points raised by the speaker in which a large number of those present took part, a vote of thanks was moved by J. R. Dinn and seconded by J. Moffat.

Hamilton Branch

John R. Dunbar, A.M.E.I.C., Secretary-Treasurer.
J. A. M. Galilee, Affiliate E.I.C., Branch News Editor.

Meeting at Galt with Babcock-Wilcox and Goldie-McCulloch Engineering Society

On Tuesday, November 4th, the members of the Hamilton Branch were invited to Galt by the Engineering Society of the Babcock-Wilcox and Goldie-McCulloch, to hear E. G. Bailey, president of the Fuller Lehigh Company, Fullerton, Pa., speak on "Combustion of Pulverized Fuel."

Mr. Bailey's talk was illustrated by lantern slides and showed different types of coal pulverizers and of the various furnaces in which pulverized coal can be burned. He described in particular the new type "B" pulverizer.

Although embodying the spherical ball and grinding ring principle of pulverizing used in the standard Lehigh mill, type "B" has two rows of balls instead of one, and one rotating and two stationary grinding rings. The two rows of balls, one row mounted above the other, are separated and propelled by the rotating ring which is driven by and floats on the main driving shaft in such a manner that no loading is transmitted to the thrust bearing. The pressure between the balls and the rings, which is an important factor in obtaining fineness and capacity, is obtained independently of the mill speed. This pressure is applied and kept uniform by externally controlled steel springs mounted in the top section.

The main driving shaft runs in two roller bearings and is supported at the lower end by a self-aligning, heavy duty thrust bearing. Bearings are lubricated by an automatic force-feed oiling system, the pump being mounted inside the housing and driven off the horizontal shaft. The bearings and complete driving gear are effectively protected against dust by an air-pressure (2 to 3 pounds) seal and a throw ring mounted on the shaft above the upper shaft bearing. Any leakage of dust at this point is readily observed upon inspection of the annular space between the air inlet chamber and the bearing housing. Raw coal crushed to the required size drops from the feeder, through the spout on to the rotating core inside the upper row of balls, whence it is thrown outward into the path of the balls by centrifugal action. After being ground in the upper row of balls it passes through the annular opening formed by the intermediate grinding rings and the coal basket. Any foreign material such as tramp iron, pyrites and rock, is discharged by the balls to the coal basket. Upon passing through the opening the coarser particles drop to the lower row of grinding balls for further pulverizing while the finer particles are entrained by the air stream.

The separating air, admitted to the grinding zone through cored passages in the base of the mill, moves upward inside and through the lower row of balls, then outward through the cored holes in the intermediate grinding ring. These changes in direction of the air stream tend to cause the coarse particles to readily separate from the fine. Separation is further assisted by an adjustable sleeve at the discharge of the mill, which also prevents the coal stream from short circuiting through the classifier. It was pointed out by the speaker that the new mill is especially well adapted to the use of preheated air as a separating medium. The absence of lubricated bearings within the pulverizing zone precludes the necessity for limitations on the allowable temperature of incoming air; consequently the temperature of the air can be adapted to suit the surface moisture content of the coal.

The meeting was attended by over 175 engineers and others interested in the subject of the combustion of pulverized fuel. Guests of the society were present from Windsor, London, Merriton, Thorold, Waterloo, Hamilton, Toronto, Fergus and Kitchener, and other western Ontario centres.

Weather Reporting to the R 100

"Weather Reporting to the R 100" was the subject of a most interesting lecture given before the Hamilton Branch on November 12th, at the Royal Connaught hotel, by J. Patterson, director of the Dominion Meteorological Service. He explained, at the outset, with considerable clarity, the fundamentals of meteorology, as applied to the guidance and warning of lighter-than-air craft.

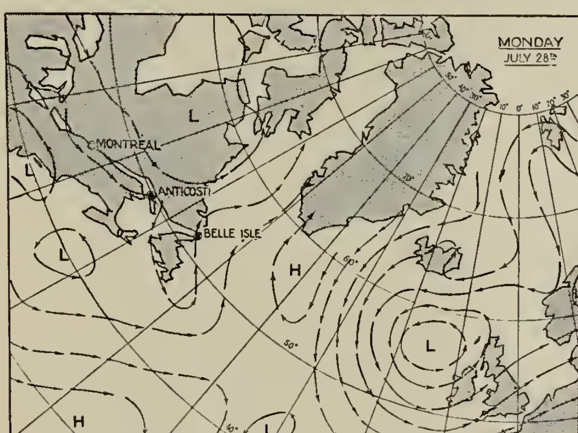
The first part of the lecture dealt with a general consideration of the technical work that is being performed by weather forecasters. A comparison of the first few slides showed how the number of observational points rapidly increased from a few isolated posts on the Great Lakes and the gulf of the St. Lawrence until now the entire Dominion is covered with meteorological posts. The duty of these posts is to send in to headquarters (Toronto) an account of weather conditions at that point giving barometric pressure, air temperature, wind velocity, humidity and cloud appearance. These are co-ordinated by headquarters and maps are plotted which show the exact meteorological condition of the Dominion. From a careful study of these maps, weather predictions can be made 48 hours in advance with considerable accuracy. Variations such as the speed and directional movements of pressure centres sometimes operate to upset these predictions.

"Airship meteorology is a study of growing importance," the speaker said. "We all think of the trip of the R 100 to this country as a decided success, but we cannot forget the later disaster to the R 101. I had the opportunity of going over this ship in England and we all marvelled at the ingenuity of its design at that time. But, after all, something unforeseen went wrong, and we all know of the terrible loss of the greatest airship minds in England. I knew many of the crew well. Some of them were pioneers, and all were firm believers in the future of airships. Lord Thomson, the air minister, was a great backer of lighter-than-air crafts and was largely instrumental in the establishment of the airship meteorological service."

"I have a letter from N. A. Giblett, meteorological officer of the R 101, written shortly before the craft set sail on its fatal journey, probably the last letter that he ever wrote. But it is not for the meteorologist to say whether or not the airship is practical; that is a job for the engineers. The task of the meteorologist is a more difficult one than that of the engineer, for he can have no laboratory to work in and he cannot perform experiments on a small scale."

In 1926, preparations were made in Canada for the development of a service for trans-oceanic flights of dirigible balloons. A central office was located at St. Hubert, and 13 balloon stations were set out in eastern Canada for making regular observations of weather conditions. Views of the intricate apparatus used at St. Hubert to make weather calculations such as temperature at different altitudes, and wind velocities, were shown on the screen.

Airships, in crossing the Atlantic, receive four weather reports daily. In such a trip, the first reports are from England, and as the ship



Map showing weather conditions, July 28th, 1930, prior to flight to Canada of R 100.

crosses the 35th degree of longitude, the Canadian stations take on the task of supplying the necessary information. During a crossing, extra men are put to work and a 24-hour service is maintained at the weather stations.

The R 100 started on its journey heading in a northerly direction to take advantage of favourable wind conditions. As the storm centre shifted shortly after the voyage was begun, the course was swung around to the south and some of the most favourable weather of the voyage was encountered. On reaching the St. Lawrence valley a storm centre was encountered and the passage became more laborious. This, Mr. Patterson explained, was due to the change in air temperature and the unrest of the atmospheric conditions usually prevailing in that part of the country. As Montreal was reached a marked trough of low pressure was struck and the ship experienced the storms that tore the fabric of her rudder and delayed the landing at St. Hubert. These subsided however and the ship was safely moored to the mooring mast. Mr. Patterson then traced out the course of the uneventful return trip.

A most interesting explanation of the danger to which an airship is exposed from line squalls was given by the speaker. This type of storm causes the rapid rise and fall of air which made the R 100 shoot up to an altitude of 4,000 feet near Montreal. The speaker explained that they were most troublesome. When the ship is fixed to the mast the meteorologist must keep a special look-out for line squalls, as they might seriously strain the structure of the dirigible.

R 101 Disaster

The last two slides were of the weather conditions before and after the fatal flight of the R 101. They showed the storm area which gave so much trouble to the unfortunate crew, but Mr. Patterson declined to comment in any way on the probability of bad weather being connected with the disaster.

At the conclusion of Mr. Patterson's lecture, J. J. MacKay, M.E.I.C., moved a hearty vote of thanks to the speaker for his very interesting address. In the discussion which followed, it was brought out that the weather reports are sent by special code to the airships and that only recently has there been a uniform code, called the Copenhagen code, which has been agreed to by all the nations in convention. In the voyage of the Graf Zeppelin, von Eckner had to contend with sixteen different codes.

The meeting was presided over by W. F. McLaren, M.E.I.C., the chairman. Prior to the address by Mr. Patterson, E. H. Darling, M.E.I.C., Hamilton Branch Councillor, gave a short report of the last Plenary Meeting of Council.

Mr. Darling mentioned the fact that the employment bureau of The Institute had turned out to be a great success, placing over eighteen engineers in the month of August. Other matters dealt with were the starting of a branch of the Aeronautical Institute in this country, to be run in conjunction with The Engineering Institute of Canada and the formation of Dominion and Provincial Institutes to do away with the friction at present resulting in some cases among the provincial societies.

There were 35 members in attendance.

Kingston Branch

Major L. F. Grant, M.E.I.C., Secretary-Treasurer.

On Nov. 6th, 1930, the Kingston Branch was addressed by Brig.-General Sir Chas. Delmé-Radcliffe, on the New Granumetric System of Aerial Surveying. Sir Charles, who has had a noted career as a surveyor and soldier, is now chairman of the British Cadastral and Topographical Air Survey Company.

H. H. Richardson, M.Sc., of the Aluminum Company of Canada gave a very interesting talk to a combined meeting of the Kingston Branch of The Institute and the Engineering Society of Queen's University of Friday, November 14th.

The speaker was introduced by Professor D. M. Jemmett, A.M.E.I.C., chairman of the Kingston Branch, who called attention to the fact that 20 per cent of the world's aluminum is produced in Canada, and that Mr. Richardson was the technical adviser to the largest aluminum producing company in the Dominion.

Mr. Richardson pointed out that his time was too short to tell of all the uses of aluminum alloys, and that he would confine himself to describing the more important characteristics of the metal, and its applications.

Pure aluminum has a very light weight, a pleasing appearance, high conductivity, and resists corrosion. Its first use as an industrial material was in connection with cooking utensils, about forty years ago. Its lack of tensile strength prevented its use as a structural material for some years, until the introduction of the modern aluminum alloys. The most common alloy, with about 4 per cent of copper, gives it a tensile strength of some 60,000 pounds. With heat treatment the ductility is raised sufficiently to give about 20 per cent elongation at fracture. Structural shapes are now being rolled for purposes in which saving of weight is important. Aluminum alloys may also be cast, and structural welding is not more difficult than in the case of steel.

In the transportation field, especially in the automobile and aircraft industries, the saving of weight is of so much importance that aluminum alloys have a distinct advantage over steel, sufficient to more than balance the higher cost per pound. In modern aircraft the frame, propeller, crankcase, and gas tanks are frequently of aluminum alloy, and aluminum sheets have been used for wing covering, fastened with small rivets by a contrivance resembling a sewing-machine. It has also been used for the frames of railway cars.

In architectural work an alloy containing 5 per cent of silicon has been used, principally for window sills and for ornamentation. The Chrysler building in New York, now the highest completed building in the world, has numerous ornamental plaques and panels of cast aluminum. A rather outstanding piece of work is the Sphinx on the St. Louis court house, which is an aluminum casting about 12 feet high.

The lecture, which was well illustrated with slides, deserved the hearty vote of thanks which it received.

Lethbridge Branch

Wm. Meldrum, A.M.E.I.C., Secretary-Treasurer.

On October 18th the Lethbridge Branch held a joint meeting with the Association of Professional Engineers of Alberta, on the occasion of the annual district meeting of the latter organization in Lethbridge.

The chair was taken by Dr. John A. Allan, professor of Geology at the University of Alberta, president of the Professional Engineers. Following an excellent dinner, a vigorous round of community singing was enjoyed, interspersed with real music in the form of vocal solos by Miss D. Patterson and Mr. G. Evans. During the dinner music was supplied by the Brown orchestra.

The speaker of the evening, F. N. Rhodes, A.M.E.I.C., of the Institute of Technology and Art, Calgary, was introduced by R. S. Trowsdale, A.M.E.I.C. Mr. Rhodes spoke on "Efficiency," illustrating many of the possibilities for improvement in the electrical and mechanical fields. "Efficiency" he defined, as the endeavour to produce sustenance, shelter and pleasure with the minimum expenditure of our resources. Any changes in the efficiency of one of our many specialized activities is bound to have its effects on other allied activities, and the resultant effort on the whole fabric must be considered. For instance, today we are busily engaged in mechanizing many of our economic processes with a view to lowering production costs. This is often accomplished by a prodigal use of our natural resources, and also results in many cases in widespread unemployment. The speaker mentioned that we have a definite duty to posterity to conserve our natural resources and hand them on in good shape for the use of future generations. Again we have a duty to the present generation, who have to be fed even if there is no work for them. It appears that we may have to turn from mechanization to some extent in order to strike a balance in the use of mechanical power and man power, in order to provide sustenance for the present generation and to conserve our resources.

Following Mr. Rhodes' address, R. A. Brown of Calgary, in a witty and reminiscent vein, extended the thanks of the Professional Engineers to the Lethbridge Branch for the dinner and entertainment which were enjoyed by all of the forty-five who were present.

Dr. Allan announced that the Association of Professional Engineers had conferred a life membership on Charles Raley, A.M.E.I.C., who for many years was connected with the engineering department of the Alberta Railway and Irrigation Company and the Canadian Pacific Railway Company and who has now retired and is living at the coast.

The thanks of those present to Mr. Rhodes for his very able address was offered by W. L. McKenzie, A.M.E.I.C., in well chosen words, and these were heartily accorded by the members.

Montreal Branch

C. K. McLeod, A.M.E.I.C., Secretary-Treasurer.

At the October 16th meeting, held under the auspices of the Aeronautical section, J. A. McCrory, M.E.I.C., announced that affiliation between the Royal Aeronautical Society and The Engineering Institute of Canada had been arranged. Also, R. J. Durley, M.E.I.C., General Secretary of The Institute, read an exchange of telegrams with the Canadian High Commissioner's office in London, conveying the sympathies of The Institute members on the occasion of the loss of the R. 101.

On October 16th, 1930, Flight Lieutenant Alan Ferrier, A.M.E.I.C., A.F.R.Ae.S., addressed the Montreal Branch on the subject "Aeronautics as a Branch of the Engineering Profession." In this connection it was pointed out that the chief engineering problem involved in aeronautics was that of the power plant. This was really a separate branch of the profession, and incidentally had most in common with non-aeronautical activities. The distinctions between aircraft power plants and those on the ground were incidental and with one exception involved none but common factors. This excepted factor is the variation of atmospheric pressure and density with altitude—for example, at a height of 20,000 feet, the atmospheric pressure is roughly one-half as intense as that on the ground. This variation has been responsible for the design of special carburetors as well as the device known as the supercharger.

Apart from the power plant, Lieutenant Ferrier went on to say, that the airplane as a vehicle offered considerable scope for the mechanical engineer in the design of alighting gears and control gears. For instance, the automatic gyroscopic control of aircraft has now been almost perfected and much ingenuity had been displayed in the design of various combination types of undercarriages as well as other accessories.

In conclusion, the speaker stated that the aeronautical engineer had problems common to most other branches of the profession, for example combustion, ventilating, transportation naval design and architecture, hydraulics, structural design and many others. However, insofar as the need for special training, or courses in our engineering schools was concerned, Lieutenant Ferrier expressed the opinion that this was quite unnecessary, except for some instruction in aerodynamics and aerostatics, and that in general the very best training which an aeronautical engineer could get would be a sound course in basic engineering principles.

Following the paper, a number of questions were asked by various members, and in reply to these the speaker stated that the selection of any one type of machine was largely a matter of personal opinion, except when some special condition or requirement of operation gave one or other certain specific advantages over the rest. Lieutenant Ferrier expressed the opinion that most operators were now inclined to favour the single-engined machine, and that further, there was every possibility of the Diesel engine replacing the gasoline motor for aircraft service in the not distant future.

J. L. Busfield, M.E.I.C., occupied the chair.

The October 23rd meeting of the Montreal Branch was addressed by Mr. C. L. Hackett of the General Railway Signal Company. The subject of the paper was, "The Operation of Trains on Single Track by Centralized Traffic Control," and it was illustrated by means of moving pictures.

The first part of the picture showed a train covering the 40-mile stretch of track where the control system was in operation and having been taken from the front of the moving locomotive, gave a very clear idea of the semaphore and other signals as they appeared to the engineer in charge of the train. The second part of the picture showed the control board in the despatcher's cabin. The positions of the trains were indicated by lights on the board while other lights showed the positions of the switches which were opened and closed by means of small levers in front of the despatcher.

Mr. Hackett explained the efficiency of the system and pointed out the economies effected by its installation, whereby a number of trains could be moved safely over a given stretch of single track at high speed without any danger and under the complete control of a single despatcher.

D. Hillman, M.E.I.C., occupied the chair.

Brig.-General Sir Charles Delmé-Radcliffe, K.C.M.G., C.B., C.V.O., spoke before the Montreal Branch on October 30th on the Nistri system of aerial surveying. Sir Charles, who has had a noted career as a surveyor and soldier, is now chairman of the British Cadastral and Topographical Air Survey Company, which controls the rights to the use of the Nistri system within the British Empire.

The system itself involved the use of a number of ground control points fixed in three dimensions. The photography could be done from any aeroplane with sufficient ceiling, according to the speaker, and it was pointed out that no clinometers, tiltmeters, clocks or other fittings were required because all corrections were applied automatically during reconstruction in the photo-cartograph. With reasonable care all work can be done by the pilot alone since the timing and flying are so arranged as to ensure an overlap of 66 per cent of each pair of plates, both in the direction of flight and laterally.

In perfecting his method of survey, Signor Nistri invented a photogrammetric-cartograph or plotter, a special aerial camera and an autochronometer. The cartograph consists of two parts, one carrying two projectors called the projector group while the other or reconstruction group includes the system of ground-glass targets and their holders, the traversing pointer and a mechanism that directs the pencil on the drawing board.

The system was claimed to be satisfactory for carrying out surveys to any scale desired, with contours inserted at the usual vertical intervals corresponding to the map scale or at closer intervals if required and lent itself particularly to all manner of general survey work, especially where the ground was difficult of access.

J. L. Busfield, M.E.I.C., presided.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

On October 24th, the Association of Professional Engineers of Ontario made St. Catharines headquarters for a day of business, sightseeing and a joint dinner meeting with the members of the local Branch of The Engineering Institute.

After a morning devoted to business, the trip along the flight locks of the Ship canal provided a welcome relaxation. Starting at lock No. 7, on the Lake Erie level, they were able to follow a freighter as she dropped down the series of four locks at the escarpment and to note the operation of filling valves, steel mitering gates, as well as the various control desks and interlocking devices whereby the safety of machinery and vessels is secured.

Finally, when the vertical lift bridge at the foot of the locks was raised to allow the freighter to pass, many of the visitors had found their way to the upper platform of the operators' cabin and enjoyed the view.

The evening meeting was presided over by chairman Walter Jackson, M.E.I.C., who had with him at the head table President G. R. Mickle of the A.P.E.O., President A. J. Grant, M.E.I.C., of The Engineering Institute of Canada, and E. T. Sterne, Past-President of the Association.

Naturally the theme of most of the speakers turned upon the relationship between the younger associations and the parent body.

Mr Grant divulged the interesting news that S. G. Porter, M.E.I.C., of Calgary was slated to be the nominee for the next President. Mr. Porter was chairman of the committee which for several years had been studying various possibilities of amalgamation or affiliation between the Provincial Associations and The Engineering Institute. There are nine separate associations, continued Mr. Grant, some of which were fairly strong, but the consequence of the formation of these bodies was a noticeable tendency to sap the strength of The Institute. From either viewpoint, some form of unified action was admittedly desirable and one of the first steps in that direction would seem to be the devising of common standards for admission. Most of the eastern Provincial Associations had already met and discussed with Mr. Porter's committee this phase of the question, but various western provinces had not yet appointed their sub-committees and therefore much work remained to be accomplished. Such a contemplated unification could not but strengthen an engineer's position regardless of whether he belonged to a provincial body or to The Engineering Institute of Canada and no existing right or privilege would, or could, be disturbed.

Mr. Mickle referred briefly to the aspects of the Ship canal which he had viewed during the afternoon, commenting upon the magnitude of the engineering problems which were involved and stating that he was particularly interested in the tree-planting campaign which had been inaugurated. Concerning the proposed affiliation between the various engineering bodies of Canada he believed that any scheme which had for its object the strengthening of the present position was highly desirable. Of course the fields in which the two associations worked were quite different; The Institute was interested in any and every phase of engineering, whereas the provincial corporations acted purely as registering bodies. Just at present, the Ontario Association found itself in a somewhat weak position legally but steps were now being taken to apply to the legislature for a "second set of teeth."

Engineers in this country had not the status to which they were entitled, either from an economic or from a legal point of view. When called in to act as expert witnesses they were seldom given any protection by the court and consequently were subject to all the badgering that a quick-witted lawyer could devise. In other countries professional assistance in the engineering aspects of various technical cases was highly recognized; the admiralty courts in particular are quick to realize the value of such assistance and naval assessors invariably take their seats on the judicial bench, thus being accorded a higher status than that of counsel.

Mr. Sterne said that he thoroughly agreed with the previous speakers and stated that engineers should strive to achieve the superiority complex which was theirs by right. One of the greatest difficulties to surmount was that their work was so complex and called for such a high degree of concentration that it generally absorbed the whole attention of engineers to the disregard of all other matters such as political questions and the training for fluent speaking in public. The Provincial Associations had a very useful part to play in engineering welfare and their relations with The Engineering Institute of Canada would continue as Kipling has so ably phrased it "daughter in her mother's house but mistress in her own." A very close degree of co-operation was nevertheless not only desirable but quite capable of accomplishment.

Following these speakers, J. B. McAndrew, A.M.E.I.C., mechanical engineer of the Ship canal, showed a series of views depicting a few of the more interesting features such as Taintor valves, lock gates, stoney sluice gates with the operating machines, slip frictions, clutches and gears. Most of this mechanism was of original design although standard makes were used when possible. The work however had been on such a large scale and was so much out of the ordinary that but few standard machines were available. As the result of six months' operation, a few changes were being made, but these were all of a minor nature and there had been no delay to traffic due to any failure.

Mr. L. P. Rundle then outlined some of the electrical features, giving the audience a slight conception of the studies which had been made in order to ensure correct lighting for the lock structures and Canal prism, as well as the various interlocking units necessary for the protection of vessels and equipment. Considering the abstruse nature of the subject, Mr. Rundle succeeded in making himself extraordinarily clear and lucid.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer

Luncheon Meeting

The opening meeting of the Ottawa Branch was held at the Chateau Laurier at noon on Thursday, October 23rd, at which about one hundred and fifty members and friends were present. The speaker for the meeting was Major L. T. Burwash, M.E.I.C., who gave an address on the subject "Exploration in Northern Canada." In the absence of the chairman, J. McLeish, M.E.I.C., who has been seriously ill, the chair was occupied by F. H. Peters, M.E.I.C., Surveyor General.

Those present at the head table, in addition to the chairman and speaker, included Honourable Thomas G. Murphy, Minister of the Interior; R. J. Durley, M.E.I.C., General Secretary of The Engineering Institute of Canada; Sir Charles Delmé-Radcliffe, Chairman of the British Cadastral and Topographical Air Survey Company; Dr. Hodgson, Dr. O. D. Skelton, G. J. Desbarats, C.M.G., M.E.I.C., J. L. Busfield, M.E.I.C., Roy A. Gibson, Dr. R. M. Anderson, John Murphy, M.E.I.C., T. L. Simmons, M.E.I.C., J. Mackintosh Bell, O. S. Finnie, M.E.I.C., D. Jenness and G. P. MacKenzie.

Major Burwash had a large map of Canada, showing the northern Arctic regions, from which he illustrated the various points dealt with in his address. He compared the means of transport of only a few years ago with those available to-day. By the old methods it took one year to get in and out whereas now it is a matter of a few days. The high cost of transport is offset by the saving of a year's time. The first aeroplanes reached the Arctic coast just about a year ago but during last summer they were so common in Coronation gulf that the Eskimos would hardly look up to see them. There is also an organized transport system from Vancouver as far east in the Arctic ocean as Cambridge bay. In using aeroplane transport, however, Major Burwash pointed out that the chief credit was undoubtedly due to those in charge of the planes.

The Department of the Interior has been carrying out a plan of exploration of Canada's Arctic lands and as a part of this plan the speaker has spent several years in these regions. He spent the winter of 1928 on King William island and one of the objects assigned him was to investigate the location and behaviour of the north magnetic pole. According to his observations, this pole has a daily swing east and west of about seven miles as observed from readings about one hundred miles south of it. He was unable to ascertain whether it had a similar north and south swing as he could not take the necessary observations from a point to east or west of the pole.

However, the chief interest at the present time was in his work of last year when he was sent to investigate certain stories of the ultimate fate of the Franklin expedition. This expedition left England in two boats in 1845 and that was the last ever seen of it. In 1852 certain traces were collected and natives said these had come from King William island. Additional relief expeditions have been sent out at various times and in 1858 conclusive proof of the loss of the expedition was obtained together with the only written record which has been found. This stated that one hundred and five of the crew including officers and men had abandoned the ships which were frozen in the ice to go south and attempt a passage up the Back river to reach Great Slave lake. Traces indicating the death of about half of this number have been found but the fate of the other fifty men has never been cleared up. During this summer Major Burwash took an aeroplane from Fort Norman about the middle of July to the mouth of the Copper mine river where he spent about a month waiting for open water to proceed further. The party reached King William island early in September, travelling in one day from nine o'clock a.m. to six o-clock p.m. a distance which the speaker had covered in a previous season between May 17th and August 1st. The next day he found an inland lake open on which they could land and commenced their explorations. No evidence was found of the Franklin party in the area in which it had been reported but they did find an old cairn and camp site in another locality. A careful investigation was made of this site and the cairn was taken down to search for records. No records, however, could be found and the speaker was convinced that none exist there. At the camp site a considerable number of fragments of cloth, rope, rusty iron, were found which would indicate that this had probably been used as a base camp by the party seeking to find a southern route to escape. However, evidence has been found before that some, at least, of the men who had attempted this southern route had turned back to the ships. Major Burwash advanced the theory that after an attempt of the southern route and losing about half their number the remainder gave it up as hopeless and turned back to the ships. These had eventually been freed from the ice but must both have been lost later. From stories the Eskimos still repeat one of these was probably wrecked on the mainland south of King William island and the other on the mainland east of the island, perhaps, one or even two years later. The fact that no records could be found would substantiate this theory, as the sailors would undoubtedly take them with them in returning to the ships.

Surveying by a New Photogrammetric Method

At the noon luncheon of the Ottawa branch held at the Chateau Laurier on October 30, the speaker was Sir Charles Delmé-Radcliffe, K.C.M.G., who took as his subject "Surveying by a new photogrammetric method." The chairman of the luncheon, in the absence of John McLeish, M.E.I.C., the regular branch chairman, on account of illness, was F. H. Peters, M.E.I.C., Surveyor General. At the head table in addition to the speaker and the chairman, there were the following guests:—Honourable Dr. Murray McLaren; V. M. Meek, M.E.I.C.; Dr. R. W. Boyle, M.E.I.C. of the National Research Council; Lieut.-Col. H. E. Matthews; Sir William Clark, British High Commissioner to Canada; Major General J. H. MacBrien; G. J. Desbarats, C.M.G., M.E.I.C.; Noulan Cauchon, A.M.E.I.C.; A. M. Narraway, M.E.I.C.; Squadron Leader F. G. Higgins, A.M.E.I.C.; Squadron Leader A. Ferrier, A.M.E.I.C.; Flight Lieut. E. Jellison; and Flight Lieut. N. C. Ogilvie Forbes.

Sir Charles, in his opening remarks, stated that the method which he was about to describe was not to be considered as a rival to existing Canadian methods but rather as a supplement to them. It will enable the work done by the present Canadian methods to be amplified wherever required in much closer detail.

This is called the "Nistri" method of photogrammetric survey. The inventor is a young Italian officer, whose acquaintance Sir Charles made when he was serving as an observer of the Royal Italian Air Force with the batteries of heavy artillery on the Carso in 1917 during the Great War. The speaker paid a glowing tribute to this young inventor, characterizing him as a remarkable mathematician and optician, with that marvellous inventive genius which is so frequently seen among his countrymen.

This young Italian officer has produced a process, and has invented instruments for use therewith, which have proved themselves to be eminently practical. The speaker indicated in a general way the salient points of the Nistri photogrammetric cartograph but stated that he would not attempt to go too deeply into the technical details of the invention. These would be described at length later in the Journal of the Royal Geographical Society and other technical publications.

Instead, by the use of lantern slides he showed views of the instruments used and of the results obtained by their use. The method, stated the speaker, has been fully tried out in such countries as Italy, France, Czecho-Slovakia, Albania, Brazil and Great Britain, and from these practical experiences the exact degree of reliability of the instruments determined.

The principal advantages of the method lie in (*a*) the great speed with which the most elaborate surveys can be completed, a speed which may lie anywhere between one-half and one-twentieth of the time required for corresponding surveys on the ground; (*b*) as a consequence of the speed, the comparative cheapness as compared with ground methods; and (*c*) the completeness and accuracy of the reproduction of the detail of the ground, which is surveyed in the three dimensions simultaneously.

This latter is a most striking feature. The contour lines, stated Sir Charles, giving the complete relief of the ground are absolutely accurate. Though this feature of the work may seem at first glance to be almost miraculous and impossible of belief, it is nevertheless a sober and practical fact. In this connection, the speaker stated that he trusted that before much time had elapsed a Canadian survey company would be in existence operating this method throughout Canada and co-operating with similar organizations all over the British Empire.

The lecturer then showed upon the screen a number of examples of specimens of maps made by this method, together with some of the aerial photographs employed. The first map was sheet No. 14 of the survey of Lundy island in the Bristol channel, one sheet out of seventeen which were issued on the 1:1000 scale with contours at 3-foot vertical intervals. In carrying out this survey the work had to be proceeded with "ab ovo", that is, it had to be commenced right at the beginning. The reason for this was that the points laid down in the Ordnance survey of the island, originally made in 1844 and revised in 1884, had with one exception entirely disappeared. A base was therefore measured, azimuth observations taken, the main triangulation laid out and computations made, and the flights undertaken. After this the secondary and photographic triangulation and control points were selected from the plates and fixed. The calculations for these points took another couple of days making about a week in all for the selection and determination of the control points. The flights took in all about one hour and forty-two minutes, forty-two plates being exposed. The flying was done at an altitude well over 3,000 feet above the sea and on one of the days in the teeth of a fifty-mile-an-hour gale. This did not in any way adversely affect the results of the work and is a tribute to the skill of the pilot in correctly covering this area in spite of the gale.

The time required for drawing the complicated detail with one photocartograph was two days per map sheet or thirty-four days in all. If four photocartographs had been used this part of the work could have been completed in eight or nine days and the whole survey finished in about two and a half weeks. The ordinary ground survey with contours on the same scale would have taken as many years.

The speaker then showed other samples of work done which illustrated similar points to those of the survey of Lundy island. In these various examples specimens of the maps were shown which had scales as follows: 1:2500 with 10-foot vertical interval contours; 1:2000 with one-metre vertical interval contours (this one being at Ariconduva, in Brazil); 1:1000 with one-half metre vertical interval contours (at Ostia in Italy, surveyed under Signor Mussolini's orders); and 1:500 with one-metre vertical interval contours.

Toward the end of his lecture the speaker, by way of comparison, showed a number of slides relating to the maps produced by the British Commission for the determination of the Anglo-German boundary in Uganda between 1902 and 1904. The speaker stated that he did not show this map as a specimen for its own sake, but rather in order to emphasize the difference between the old method and the new. In those days, long weary nights in the tropical rainy season for months on end had to be spent in waiting for glimpses of the stars between the flying clouds in order that by means of astronomical observations the difference in longitude at certain strategic points might be determined. This wearisome procedure entailed hardship such as being severely bitten by the tropical insects and the experiencing of a good deal of tropical fever.

At that time there was no permanent telegraph line which could be made use of and an effort to obtain telegraphic signals over a telephone line ended disastrously when several miles of the wire were carried off into the jungle by an elephant which was found strangled to death some forty miles away. Nowadays, one can obtain with very little effort wireless signals from an observatory in Europe or elsewhere and so the difference in longitude can be very easily and rapidly obtained.

Other difficulties in the work at that time were related by the speaker including his, as he stated, uncomfortable distinction of being the first white man to have a case of spirillum fever in those parts. This was a most distressing and almost disastrous experience. Terrific thunderstorms which occur nearly every afternoon at about four o'clock played havoc with the party, standing camps being burnt down twice and several of the men being struck by lightning, and killed.

In this work the 3,600 square miles of topographical survey on the scale of one to 100,000 with form lines at 100-foot vertical intervals and the insertion of numerous spot heights took nearly two years to complete. By modern methods this same amount of work could have been completed in about one-quarter of the time at one-quarter of the cost with a more accurate result. There would be real contours under modern methods instead of, as before, form lines controlled by spot heights.

The Engineer in the Nation

Dr. R. W. Boyle, M.E.I.C., of the National Research Council, was the speaker at the noon luncheon held on November 6th, 1930. F. H. Peters, M.E.I.C., Surveyor General, acted as chairman in the absence of John McLeish, M.E.I.C., who was unable to be present on account of illness. In addition to the chairman and speaker the guests at the head table included: Honourable H. A. Stewart, Minister of Public Works; Dr. A. H. McDougall, principal of the Ottawa Collegiate Institutes; W. W. Nicholl, principal of the Ottawa Technical School; B. F. Haanel, M.E.I.C.; George Saunders of Fernie, B.C.; John Murphy, M.E.I.C.; D. G. Munro; James Lovett, general superintendent of the Coppers Coke Manufacturing Company of Pittsburgh; Hugh McNair of the Winnipeg Electric Company; J. E. Noulan Cauchon, A.M.E.I.C., and L. L. Bolton, M.E.I.C., assistant Deputy Minister of Mines.

Dr. Boyle dealt with the subject of "The Engineer in the Nation." From his experience as an educationist on the Faculty of Applied Science of the University of Alberta, and later as Dean of that faculty, Dr. Boyle stated that he had been afforded ample opportunity of observing the deportment of students in engineering. He found them uniformly serious-minded, fond of associating with their own kind and rarely given to such things as attendance at or interest in philosophic debating, or literary societies. Individually, they seemed to exhibit an innate shyness and modesty and even, as it were, a sense of inferiority complex to the extent, at least, that they did not care to make any commitment until they were positively sure of the matter at issue.

Dr. Boyle was of the opinion that these qualities, as manifesting themselves in students of engineering, were but a regular result of the processes at work of natural selection. Under these processes their human characteristics, even from infancy, determined their life careers and influenced them in their selection of the professional life which they were undertaking. The regular training which these students had to undergo served also to accentuate these characteristics. Uniformly they exhibited a passion for inquiry into fundamental things, a caution in undertaking this inquiry, and a caution in carrying out the various operations in connection with such inquiry. To them a waste even in their processes of training constituted a sin, and it was their constant effort to keep their efficiency ratio at a high point.

An engineer has been defined as a man who "by art designs construction and attempts to divert the forces of nature toward the benefit of mankind." In remaining true to this definition the engineer will usually be found as a man who is sound, safe, stable and sane, so that, as it has been well stated, "a fool as an engineer cannot survive."

Mankind has been aptly placed into three categories: 1, those with one-storey intellects, intellects which cannot go far beyond the collecting of facts; 2, those with two-storey intellects, intellects which can compare and reason; 3, those with three-storey intellects with skylights. The latter are capable of idealizing, of imagining, and of predicting, and to them the best illumination comes from above. Engineers themselves do not make enough of their three-storey men and the public makes still less.

The country today, stated the speaker, depends for its advances upon pure and applied science, and the findings of science can proceed no further than the capabilities of the engineer to advance them. With the modern tendency of the world to become more and more scientific, the engineering type of man should come into greater prominence. This prominence should extend into every line of endeavour relating to national administration, whether relative to judicial, strategical or executive problems. But no such thing is happening — now, as formerly, the engineer is still the hired man.

Perhaps, in seeking for a reason for this we may find the answer in the workings of nature itself. The very qualities manifested in the individual, of a lack of self-seeking and of absorbing interest in the work on hand precludes any great possibility of his extending himself into what might be called the more human contacts. There might, conceivably, be something inherently wrong in the method of technical education, whereby too much emphasis is placed upon mere training and not enough upon real education. The engineer, indeed, as has been aptly stated, is always subject to the danger of becoming overtrained and under-educated.

Another reason may lie in the nature of his work. Engineers have a habit of staying too much to themselves, a habit resulting from the conditions under which they are forced to carry on their work. Unlike the doctor, the preacher, and the lawyer, their work takes them largely away from human contacts and accustoms them to "carrying on" alone. It is a pity, stated Dr. Boyle, that more engineers do not write for the public journals, do not make public speeches, do not engage in public enterprises, do not stand for parliament—in other words, do not come out of their shell. Who, for instance, is better placed than the engineer to study the effects upon modern society of modern devices due to science, and to observe and put down such observations, than the engineer?

The speaker characterized the average Canadian engineer's contribution to engineering and other learned journals as containing more of description and less of what is new than those, for instance, of Great Britain. Why not, he asked, have more variety? At this point, he mentioned that the new Canadian Journal of Research had found great difficulty in obtaining contributions of original material from engineers, although there was little difficulty with the other scientific professions. There was in prospect, in connection with the National Research Council, the building up of a major division devoted to engineering research and it was to be hoped that such a condition would be remedied.

There is no country in the world, stated Dr. Boyle, that can offer more of romance connected with engineering than can Canada and he hoped, incidentally, that the National Research Council in some readily observable form, could arrange by methods of display or otherwise to indicate something of this romance for the stimulation of Canadian youth and the pride of Canadian people. In this connection he spoke about a visit to the Neues Deutsches Museum of Munich, Germany, where the romance of bridge engineering, for instance, was traced through successive stages from the time of the first rude log flung across a stream to the massive structures of today, and the evolution of a city street presented from its earliest history when it was a mere footpath.

Dr. Boyle hoped that the time would not be long distant when there would be a truly national society of all engineers which would take its place as a first step in the education of the public in the professional status of the engineer such as similar societies do with the professions of law, medicine, etc. The consequences of the formation of such a society would redound to the everlasting credit and prestige of the engineer.

Dial Telephone Systems

A popular meeting, attended by members of the local branch and by the public, was held at the Victoria Memorial museum on the evening of November 14th, 1930. The speaker at this meeting was G. F. Inglis of Montreal, who is the dial system equipment engineer for the eastern area of the Bell Telephone Company of Canada.

Mr. Inglis spoke on the subject of "Dial System Telephony" and a feature of the lecture was a miniature dial system central office in actual operation upon the stage. In addition, a two-reel motion picture and numerous slides were shown. J. L. Rannie, M.E.I.C., acted as chairman at the meeting and at its conclusion a vote of thanks was moved by John McLeish, M.E.I.C.

Inasmuch as the dial system of telephony has not yet been introduced into the city of Ottawa but is intended to be within the course of the next few years, the lecture proved of great interest to the audience.

Dial system telephony has for its fundamental object the mechanical performance of the most common operations performed by operators under the old manual system. To each subscriber's instrument is added a dial, the operation of which causes the central office switching mechanism to establish any desired connection. It is, in fact, a very highly developed system of remote control; instead of calling a number into the telphone as is done at present in Ottawa, the subscriber will perform the operation of turning the dial in conformity with the number which he desires to call.

Two different types of dial system are in use by the Bell Telephone Company, (1) the panel system as developed by theAmericanTelephone and Telegraph Company and used in very large exchange areas, and (2) the step-by-step system invented by A. B. Strowger and developed to a great extent by the Automatic Electric Company of Chicago. The speaker briefly described the panel system but devoted the greater portion of his lecture to the step-by-step system.

The panel system is a power-driven system working on a non-decimal basis under the control of a mechanical operator termed a "sender" which determines the routing of the call through the various switching mechanisms.

The step-by-step system was first patented in 1889. An original installation at Grand Rapids, Michigan, in 1900, is still in operation and giving good service. It must be understood, however, that there are marked differences in the features of the early installations with those of today. The step-by-step system is essentially a system in which the connections are set up one step at a time on a decimal basis under the direct control of a series of electrical impulses originated by the subscriber's dial. Each pull of the dial sends out a series of electrical impulses equal in number to the digit dialed. Each of these series of impulses, on reaching the central office, operates a mechanism termed a "selector." Each selector extends the connection one step further until it finally reaches one of a group of "connector" switches which have access to the particular group of one hundred lines in which the desired number is located. The last two digits dialed cause the connector to make connection to the desired line.

If the line is not already in use the connector rings on it, but if the line is busy the connector will refuse to interfere and will inform the calling party by means of a special audible tone that the line called is in use. In the construction of the dial which is placed upon the subscriber's telephone, the digits from one to zero, 10 in all, are arranged. Distributed amongst the digits 2 to 9 inclusive are the letters of the alphabet with the exception of the letters Q and Z. Thus for each space upon the dial there will be a figure and three letters.

In what is known as a "six digit area," as in Montreal or Toronto, the first two letters of the central office name are capitalized in the directory and are dialed by the subscriber as well as the four digits which are also given. In effect, six digits are actually dialed but it has been found much easier to remember a name and four figures rather than six figures direct. In a "five digit area" the first letter only of the office name is used as well as the four digits.

In exchange areas with both manual and dial central offices, special apparatus is provided in the manual offices to handle calls to and from dial subscribers. The operation of this apparatus is such that the subscriber, in making a call to any other telephone, is not required to distinguish between telephones served from manual or from dial central offices.

During the course of the lecture slides were shown depicting the interiors as well as the exteriors of some of the central offices at various points in Canada and the two-reel motion picture served to show in a popular way the various steps taken in the operation of the step-by-step mechanism when a call is made.

Peterborough Branch

F. G. A. Tarr, A.M.E.I.C., Secretary-Treasurer.
B. Ottewell, A.M.E.I.C., Branch News Editor.

Patents

A regular meeting of the Peterborough Branch was held on the evening of October 23, 1930, B. Ottewell, A.M.E.I.C., chairman, the speaker being L. C. Prittie, A.M.E.I.C., patent attorney, whose subject was "Canadian Patents and the Requisites of a Patentable Invention."

Mr. Prittie is well qualified to address an engineering audience on this subject, being himself a graduate in engineering and having had extensive experience in the Government Patent Office as examiner, and since 1925 in charge of the patent department of the Canadian General Electric Company Ltd.

Going back to the early eras of civilization, the speaker pointed out that with the development of reasoning power in man, and the extension of commerce, the necessity for recognition of invention was realized.

In England the granting by royalty of monopolies resulted in abuses. The Statute of Monopolies abolished such monopolies, with the exception however of patents of invention, which were eventually covered by the Patent Act.

The United States Constitution of 1776 included a patent law. In eastern Canada before Confederation there were patent laws, and in 1869 the first Patent Act was passed. The essentials of patent law are the same in most countries.

As an indication of the number of patents, Mr. Prittie stated that about 10,000 a year are being taken out in Canada, 45,000 in the United States and 19,000 in England. Very large numbers of applications for patents are always awaiting or under examination in all Patent Offices.

After giving some examples of the infinite variety of subject matter in patent specifications, the speaker said that the law read simply that "any person who has invented any new and useful machine, process or art may obtain a patent" for a limited time, in this country 18 years. He stated that the word "invention" has never yet been satisfactorily defined. In discussing what constitutes a patentable invention it is convenient to consider a number of *negative* criteria, briefly summarized below, to many of which however there are exceptions. The following are *not* generally considered patentable:—

(1) Mere skill.
(2) Substitution of materials.
(3) Enlargement of parts.
(4) Change in degree or size.
(5) Aggregation of things.
(6) Duplication of parts.
(7) Omission of parts.
(8) Substitution of equivalents.
(9) Combinations of old devices.
(10) Use of an article for new or analogous purpose.

The concluding portion of the address dealt with patent procedure, explaining that a patent is in the nature of a contract and that full and complete disclosure is essential. A patent can be upset if incomplete. The purpose of the claims is to clearly define the invention, the idea being to draw first the broadest possible claims, then the narrower and more specific ones.

Very active discussion followed the address and Mr. Prittie kindly answered a large number of questions. A cordial vote of thanks was proposed by Mr. W. Sangster, and received with acclamation.

The R 100

On November 13th, 1930, the Branch listened to Councillor R. L. Dobbin, M.E.I.C. and A. L. Killaly, A.M.E.I.C., who showed motion pictures of their visit to the R 100 at St. Hubert airport with a party of Institute members. Mr. Dobbin was also present at the dinner to the ship's officers, tendered by the Council of The Institute.

Chairman W. E. Ross, A.M.E.I.C., tactfully allowed each speaker to introduce the other.

Mr. Killaly began with sympathetic reference to the recent tragedy of the sister ship R 101, and said that on that account and in view of the enquiry now proceeding, this might not be considered an opportune time for such an address. However, as they had been privileged through The Institute to inspect the R 100 he felt that they should pass on the information to the members of the Branch when the Branch directed.

After a brief outline of the history of lighter-than-air craft Mr. Dobbin showed the moving pictures taken by himself at St. Hubert airport which not only gave many good general views of the ship riding at the mast but also included closeups of detail of special interest where pictures could be taken.

Mr. Killaly followed with a description of the details of the interior of the ship which it had been impossible to photograph. He also referred to the intensive study made by the British Air Force upon which the main features of the R 100 and R 101 were based.

The interest of the local Branch in the subject was evidenced by the number of questions asked and the discussion which followed the pictures and description of the ship.

After the customary discussion and questions, R. H. Parsons, M.E.I.C., moved a hearty vote of thanks to both speakers, which was cordially approved.

Preliminary Notice

of Applications for Admission and for Transfer

November 20th, 1930

The By-laws provide that the Council of The Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in January, 1931.

R. J. Durley, *Secretary.*

* The professional requirements are as follows—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the Council. The term of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the Council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science of engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule P of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school, or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of Student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

CARON—WILLIAM ROBERT, of Quebec, Que., Born at Auld's Cove, N.S., Sept. 17th, 1898; Educ., civil engrg. grad., 1921, elect'l. engrg. grad., 1928, I.C.S.; 1913-14, constrn. office clerk, timekeeper and rodman, Canadian Stewart Co., grain elevator constrn., Quebec Harbour; 1914 to date, with the Quebec Harbour Commission, as follows: 1914-22, secretary to chief engr. and gen. supt., engrg. office work, specifications, estimates, dfting and field engrg. work; 1922-25, secretary to gen. mgr. and chief engr., duties as above, in addition work in steam electric plant, distribution lines, and misc. elect'l. equipment; 1925 to date, elect'l. supt., in direct charge of all harbour elect'l. equipment and sub-station-connected load 6,500 H.P. distribution lines—grain elevator installn. and mtce., power and lighting equipment, signals and telephone systems, dock and shed lighting, series circuits, cold storage power supply and equipment, elect'l. engrg. office work on new installns. and layouts.

References: T. L. Tremblay, H. E. Huestis, L. Beaudry, W. S. Buchanan.

CYR—SERAPHIN ADELARD, of 4395 St. Andre Street, Montreal, Que., Born at Montreal, Mar. 11th, 1899; Educ., Academie St. François Xavier, 1915; Passed Prelim. (1921) and Final (1922) examinations of the Province of Quebec Assn. of Architects; 1915-16, dftsman., P. E. Bourassa & Son, cabinet makers; 1916-20, arch'l. dftsman., for J. A. Godin, architect; 1920 to date, with Eastern Steel Products Limited, first as estimator, and since 1924 as asst. to supt. Duties included charge of design of standard steel bldgs., framing for grain elevator spouting and conveyor equipment, calculations of stresses in dockspouts, etc.

References: H. Fortier, C. A. Norris, E. W. Wall, L. H. D. Sutherland, E. V. Gage.

HEIMBURGER—BORIS, of 38 Classic Avenue, Toronto, Ont., Born at St. Petersburg, Russia, Apr. 24th, 1907; Educ., 1925-28, Technical High School, Helsingfors, Finland; At present 3rd year student, applied science, Univ. of Toronto; 1924-25, elect'l. machy. factory plants at Helsingfors, transformer section, test plant, etc.; 1928-29, asst. to the supervising engr. in the automatic centrals, Helsingfors Telephone Central; Aug. 1929 to July 1930, with Can. Gen. Elec. Co. Ltd., Toronto, in dfting divn. of engrg. and contract section, on layout of power station and sub-station equipment. (Expects to return to C.G.E. after receiving degree.)

References: G. N. Thomas, W. A. Bucke, J. J. Spence, T. Taylor, J. J. Traill.

MacLEOD—JOHN ANGUS, of Sydney, N.S., Born at St. Ann's, Victoria Co., N.S., Mar. 31st, 1891; Educ., Diploma in mech. engrg., I.C.S., 1917; 1911-24, with Dominion Iron & Steel Co., Sydney, N.S., as follows: 1911-14, served ap'ticeship in mech. engrg.; 1915-16, junior dftsman.; 1916-21, dftsman. and junior designer on gen. steel plant work such as struct'l. work for mill bldgs., and mech. work connected with steel mill mtce.; 1921-24, designer, engrg. dept.; 1924-25, with Dominion Bridge Company, Lachine, dftsman. and checker on gen. struct'l. steel work for pulp mill bldgs., hotels, etc., also some bridge work; 1925-26, in charge of design on bldg. constrn. for Grasselli Dye Stuff Corpn., Grasselli, N.J.; 1926 to date, with Dominion Iron & Steel Co. Ltd., Sydney, N.S., as designer on work in connection with steel plant and ore mine development.

References: A. P. Theuerkauf, W. S. Wilson, K. H. Marsh, W. C. Risley, M. W. Booth, R. R. Moffatt, K. G. Cameron, C. B. Archibald.

FOR TRANSFER FROM THE CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

CONNELL—CHARLES HERBERT NEWTON, of North Bay, Ont., Born at Woodstock, N.B., Aug. 26th, 1876; Educ., Woodstock High School; 1897-1900, chainman, rodman and topog'r. on survey and constrn., C.P.R. and C.N.R.; 1900-02, res. engr. on constrn., Algoma Central & Hudson Bay Rly.; 1902-03, asst. res. engr. on constrn., Halifax & Southwestern Rly.; 1903-09, engr., mtce. of way and chief engr., Alberta branch., Irrigation Co., Lethbridge, Alta.; 1909-14, engr., mtce of way, Can. Nor. Rly.; 1914-19, district engr., mtce., Montreal and Quebec, C.N. Rys.; 1919 to date, district engr., Northern Ontario District (Central Region), C.N.R., North Bay, Ont. (*A.M. 1915.*)

References: W. T. Moodie, H. T. Hazen, C. B. Brown, J. M. R. Fairbairn, T. T. Irving.

FRIGON—AUGUSTIN, of 125 Pagnuelo Ave., Outremont, Que., Born at Montreal, Mar. 6th, 1888; Educ., B.A.Sc. and C.E., Ecole Polytech., Montreal. Special student, Mass. Inst. Tech., 1909. Graduated E.E., Ecole Superieure d'Electricite de Paris, 1921. D.Sc., Univ. of Paris (Sorbonne), 1922; 1906, asst. engr., city of Montreal; 1907, asst. engr., rld. surveying; 1908-09, meter, transformers and motor testing, Montreal Light, Heat & Power; 1910, engr., for Quebec Public Utilities Commn.; 1910 to date, with the Ecole Polytechnique, Montreal, as follows: 1910-17, asst. professor, and 1917 to date, professor, of electr'l. engrg., and from 1922 to date, Dean; 1912-17, junior partner, Surveyer & Frigon, consltg. engrs.; 1923 to date, Director General of Technical Education for the Prov. of Quebec; 1926 to date, chairman, Electrical Commn. of Montreal; 1929, member of the Royal Commission on Radio Broadcasting; Also consltg. engr. for the Caxcade Silico Products Ltd., and for various municipalities in the prov. of Quebec, including Montreal, at different times. (*S. 1907, A.M. 1913.*)

References: A. R. Decary, A. Surveyer, F. C. Laberge, O. O. Lefebvre, A. Boyer, A. E. Dubuc.

HARKNESS—HAROLD WILSON, of Wolfville, N.S., Born at Kanazawan, Japan, Feb. 14th, 1891; Educ., B.A., 1915, B.Sc., 1913, Queen's Univ., M.Sc., 1929, Ph.D., 1930, McGill Univ.; Graduate study and research, Univ. of Chicago and Univ. of Toronto; 1912-14, asst. for firm of Magwood & Stidwell, Cornwall, Ont.; 1918-21, asst. supervisor of bldg. constrn., Cheeloo Univ., Tsinan, Shantung, China; 1918-19, instructor, and 1919-21, associate professor, engrg. and applied physics, Cheeloo Univ.; 1922-27, director of laboratory and professor of engineering and applied physics, also supt. of plant (power, water, light, sewage, bldg., etc.), Cheeloo Univ.; 1922-27, district representative, The Eastern Engineering Works, Tientsin, and consultant for Tsinan Power Co.; 1927-29, research asst., McGill Univ.; 1929 (1 month), asst. physicist, Quebec Forest Industries Assn.; 1930 (summer), research physicist, Price Bros. & Co. Ltd., (Forest fire hazard research); At present, associate professor of physics, Acadia University, Wolfville, N.S. (*A.M. 1920.*)

References: H. T. Barnes, W. H. Sutherland, W. H. Magwood, J. A. Duchastel, R. W. Boyle, C. V. Christie, H. W. McKiel.

PERRY—BRIAN RHODES, of Montreal, Que., Born at Hilton, Man., March 7th, 1895; Educ., B.Sc., McGill Univ., 1915; 1915, instr'man. i/c of one section of party on Intercolonial Rly.; 1915-16, engr., with New England Foundation Co., on foundations in New York City; 1916, dftsman., Shawinigan Water & Power Co.; 1917-18, overseas; 1919, dftsman., Shawinigan Water & Power Co.; 1920-22, supt. on constrn., for Peter Lyall Company; 1922-25, design and in charge of business in Montreal territory for MacKinnon Steel Company; 1925 to date, in private practice, as consltg. engr., Montreal. (*S 1914, A.M. 1923.*)

References: A. F. Byers, J. A. McCrory, F. S. Keith, G. D. MacKinnon, S. Svenningson.

FOR TRANSFER FROM THE CLASS OF JUNIOR TO A HIGHER CLASS

BRICKENDEN—WILLIAM THOMAS, of 301 Silverbirch Ave., Toronto, Ont., Born at Toronto, July 15th, 1897; Educ., B.A.Sc. (Honours), Univ. of Toronto, 1922; 1920 (Apr.-July), dftsman., Under-Feed Stoker Co. of America, Detroit; July 1920-Sept. 1921, dftsman and asst. engr., Under-Feed Stoker Co. of Canada, Ltd., Toronto; 1922-23, sales engr., A. W. Cash Co. of Canada Ltd. (subsidiary of above company), sale of regulating and reducing valves and combustion control equipment; 1923-27, chief engr., Under-Feed Stoker Co. of Canada, Ltd. (1924 name changed to Riley Engineering & Supply Co. Ltd.) in respon. charge of design, manufacturing, erection service of company's products; 1927-30, asst. to vice-president in charge of sales, Riley Engineering & Supply Co. Ltd., Toronto, direction of sales and consultant in engrg. and mfg.; At present, mech. engr., Thorne, Mulholland, Howson & McPherson, Toronto. (*Jr. 1923.*)

References: A. Ritchie, E. A. Allcut, R. W. Angus, C. B. Hamilton, Jr., F. A. Combe.

GORDON—CHARLES HOWARD, of Montreal, Que., Born at Montreal, Sept. 8th, 1902; Educ., Grad. R.M.C., 1922. B.Sc., McGill Univ., 1924; 1924-25, reinforced concrete designer and dftsman., Sir W. G. Armstrong Whitworth Co.; 1925 to date with Atlas Construction Co. Ltd., as follows: 1925-26, timekeeper and asst. engr.; 1926-27, engr. in charge C.N.R. car facilities, Toronto; 1927-28, engr. and asst. to supt., Welland Ship Canal syphon culvert; 1928-29, engr. in charge of Section 6 for contractors, Welland Ship Canal; 1929-30, in charge of estimating and running various jobs, including Prescott grain elevator, underground conduits, etc., and at present a director of the company. (*Jr. 1925.*)

References: J. B. Porter, A. S. Dawes, C. D. Howe, S. B. Wass, E. G. Cameron.

LAURIE—WILLIAM LITTLE, of Ottawa, Ont., Born at Malvern, Ont., Dec. 4th, 1896; Educ., B.A.Sc., Univ. of Toronto, 1924; 1912, radio operator, and 1914-15, commercial work, Canadian Marconi Co.; 1916-19, radio electr'n. C.E.F., France; 1923 to date, with Royal Canadian Signals, in charge of constrn. and operation of various radio stations operated by the Dept. of National Defence, at present, Capt., in charge of constrn. of radio beacon stations in western Canada on Winnipeg-Calgary-Edmonton air mail routes. (*Jr. 1924.*)

References: E. Forde, W. A. Steel, A. G. L. McNaughton.

LEWIS—JAMES WENTWORTH, of 1030 S. Oak Park Ave., Oak Park, Ill., Born at Saint John, N.B., July 5th, 1896; Educ., Completed 3rd year science, McGill Univ., 1920; 1914-17, student engr., Dept. Public Works, Canada, Saint John Harbour development, gen. survey, soundings, borings, instr'man., plotting and drafting. Charge of parties; 1922-25, transitman, C.P.R., mtce. and constrn., Saint John district; 1925-26, field engr., Riordon Pulp Corpn., layout of industrial bldgs., power line and pipe line surveys, Temiskaming, Que.; 1926-27, promotional engr., Portland Cement Assn., Chicago, concrete control, technical investigations and reports; 1927 to date, with American Concrete Products Co., now American Concrete Marbelite Co., supt. in full charge of production, development and purchasing for three plants, Chicago, Ill. (*Jr. 1920.*)

References: C. C. Kirby, G. H. Lowry, A. Gray, L. S. Dixon, A. G. Tapley, D. A. Abrams.

MURPHY—ALEXANDER GORDON SILCOX, of 1 Church Street, St. Catharines, Ont., Born at Montreal, Sept. 12th, 1899; Educ., B.Sc., McGill Univ., 1922; 1917 (8 mos.), inspr., Board of Engineers, Quebec Bridge; 1921 (5 mos.), inspr., Grand Trunk Arbitration Board; 1922-24, dftsman. and asst. designer, Canadian Bridge Company; 1924-25, asst. bridge engr., Welland Ship Canal, checking designs and estimates of movable bridges; 1925-26, checker, Canadian Bridge Company; 1926-28, asst. structural engr., and 1928 to date, structural engr., Welland Ship Canal, principal asst. in checking designs, estimates and shop drawings for various types of movable bridges. (*Jr. 1922.*)

References: A. J. Grant, M. B. Atkinson, E. Brown, J. Rankin, F. H. Kester, A. E. West.

FOR TRANSFER FROM THE CLASS OF STUDENT TO A HIGHER CLASS

CAMPBELL—WILFRED JOHN, of 4715 Maryland Ave., Detroit, Mich., Born at Ridgetown, Ont., Oct. 21st, 1900; Educ., B.A.Sc., Univ. of Toronto, 1925; Summers 1921-22-23-24, elect'n. with H.E.P.C. of Ontario, Ford Motor Co., and Dodge Bros.; 1925 (May-Oct.), dftsman. and engr. on elect'l. layout of a new plant, for Dodge Bros. Motor Co., Detroit; 1925 to date, with the Detroit Edison Co. as follows: 1925-27, dftsman. and engr. on elect'l. layout and design of substations; 1928 (Jan.-Sept.), elect'l. engr. on field tests of relays, control and indicating instruments and automatic protective equipment; 1928 to date, elect'l. engr., foreman over 16 graduate engrs. doing field testing of relays, control and indicating instruments, automatic protective equipment and automatic control equipment, also design of control and protective schemes. (*S. 1925.*)

References: R. J. Desmarais, F. Stevens, R. C. Leslie, C. G. R. Armstrong, O. Rolfson, L. M. Allan.

COPPING—BRUCE GRAY, of 146 Larch St., Sudbury, Ont., Born at Montreal, Que., Jan. 29th, 1905; Educ., B.Sc., McGill Univ., 1928; 1921-22, lab. asst., test. labs., Can. Gen. Elec. Co., Peterborough, Oht.; 1926 (summer), dftsman., Peterborough Public Utilities Commn.; 1927 (summer), millwright and dftsman., Laurentide Company, Grand Mere, Que.; 1928-29, i/c of mtce. in groundwood and sulphite mills, for above company; 1929-30, asst. and later supt. of sulphite mill, Canada Power & Paper Co., Grand Mere; At present, plant engr., Copper Cliff works, Canadian Industries, Ltd., Sudbury, Ont. (*S. 1926.*)

References: C. M. McKergow, H. O. Keay, R. L. Dobbin, A. B. Gates, A. N. Budden.

DONNELLY—JAMES HENRY L., of 6951 Terrebonne Ave., Montreal, Que., Born at Montreal, Apr. 24th, 1903; Educ., B.Sc., McGill Univ. 1928; 1923 (summer), Dome Mines; 1924 (summer), with Bertolf Bros., landscape contractors; 1926 (summer), with E. G. M. Cape & Co., 1928 to date, with Canada Cement Co., Plant No. 1, Montreal East, work included mech'l. and struct'l. dfting. and design of small steel and machy. repair jobs. Since 1929, asst. to C. W. Edmonds, A.M.E.I.C., chief constrn. engr. on surveying and layout work and erection of reinforced concrete bldgs. at Plant No. 1, also setting of foundation piers for four large rotary kilns. (*S. 1928.*)

References: C. W. Edmonds, H. B. Montizambert, K. L. MacMillan, S. Barr, W. G. H. Cam, J. Hvilivitsky.

SUTHERLAND—GEORGE MacKENZIE, of 43 Quebec St., Sherbrooke, Que., Born at Malagash, N.S., Oct. 4th, 1898; Educ., B.Sc., N.S. Tech. Coll., 1925; 1919-20, timekeeper and checker, D. G. Loomis & Son, contractors; 1925-26, student training course, Ingersoll-Rand Co. Ltd., Phillipsburg, N.J.; 1926-27, asst. supervisor student train'g. with above company; 1927 to date, with Canadian Ingersoll-Rand Co. Ltd., Sherbrooke, Que., as follows: 1927-28, dftsman; 1928-29, dftsman and design of drill steel sharpeners and small hoists; 1929 to date, dfting and design of above and steam condensers—surface type and barometric. (*S. 1924.*)

References: S. R. Newton, H. V. Haight, G. M. Dick, F. R. Faulkner.

EMPLOYMENT SERVICE BUREAU

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TOWN ENGINEER—Experienced municipal engineer wanted for a town in Ontario, 5,000 population. Apply giving full particulars to Box No. 647-V.

ENGINEER, between 30 and 34 years of age' experienced and broadly educated. Willing to accept a partnership with investment in a new firm established in large eastern Canadian centre. State fully experience and give references. Apply to Box No. 648-V.

MECHANICAL ENGINEER, university graduate preferred, with at least four years experience in the running, organization and operation of a manufacturing plant, including electric power, high and low pressure steam equipment, heating plant, and motor truck maintenance. A permanent position and good connection with an international company. Apply to Box No. 649-V.

Situations Wanted

CIVIL ENGINEER, A.M.E.I.C., married, desires employment with manufacturer of industrial products, selling to industrial and other markets. His experience includes engineering and building construction, administration and operation of utilities, municipal works, etc. Record of integrity; moderate salary; location immaterial. Apply to Box No. 14-W.

ELECTRICAL ENGINEER seeks connection with Montreal engineer or architect for part time work involving the design and specification for industrial and public buildings. Experienced and capable of complete responsibility. Apply to Box No. 40-W.

CIVIL AND MECHANICAL ENGINEER; aggressive, practical engineer, with background of experience in design, construction, maintenance and operation of pulp and paper mills. Especially qualified to reduce mill costs. Apply to Box No. 53-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), fifteen years experience, available on short notice. Experienced surveys, draughting, reinforced concrete design, municipal engineering, construction work, inspection, estimating. Apply to Box No. 107-W.

ELECTRICAL ENGINEER, B.Sc., age 30. Experienced in power distribution and electrical communication, including design of carrier current systems. Apply to Box No. 110-W.

ELECTRICAL ENGINEER, graduate '27, fifteen months students' test course; fifteen months switchboard layouts and substation design. Before graduation experience consisted of machine shop practice and electrical construction. Apply to Box No. 132-W.

COLLEGE GRADUATE, age 34, with over ten years experience in power developments and pulp and paper mill construction and maintenance, largely in direct charge of design or construction; desires new connection as chief or assistant engineer or construction superintendent. Apply to Box No. 167-W.

CIVIL ENGINEER, B.Sc. (McGill), M.E.I.C., P.E.Q. and B.C., with broad experience in hydro-electric power investigations, studies and exploration of forest lands, including design and construction driving and storage dams, wharves, flumes, piers and booms and loading plants, as well as general engineering and contracting, is open for engagement. Location immaterial. Now engaged but available on short notice as projects are nearing completion. Speak French fluently, physically fit, active and energetic, and can get results. References can be furnished if required. Apply to Box No. 177-W.

CIVIL ENGINEER, A.M.E.I.C., B.A.Sc. and C.E. University of Toronto, with twenty years experience, is open for engagement. Three years railroad construction, one year lake drainage and dam construction, nine years municipal engineering, including pavement and bridges, two years town management, one year paving contracting, and one year resident engineer of highway pavement construction. At present in Maritime Provinces. Apply to Box No. 216-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Ont., with twenty-four years experience embracing dams, wharves, grain elevators, foundations, pile driving, highways, municipal

Situations Wanted

engineering, water power surveys, road locations, inspections and estimating is open for engagement as engineer or superintendent in construction, operation or maintenance. Location immaterial. Apply to Box No. 358-W.

CIVIL ENGINEER, A.M.E.I.C., university graduate, O.L.S., married, twenty years experience city surveys, calculations for curved surveys, design, layout and supervision, sidewalks, pavements, sewers and water systems. Acted in capacity of chief engineer for large engineering and surveying firm for five years. Best of references. Available on short notice. Apply to Box No. 413-W.

ELECTRICAL AND MECHANICAL ENGINEER, S.E.I.C., educated Oundle and Manchester, age 24. Student course, Brit.-Westinghouse. Three years design, production, advertising, sales and control of sales force on mechanical and electrical goods. One year outside plant engineering leading public utility company. Desires work in sales, production or engineering capacity. Available immediately. Location immaterial. Apply to Box No. 415-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. (Ont.), graduate. Eighteen years experience in survey and construction, railway, hydro-electric and buildings. Experience comprises both office and outside work. Desires responsible position. Would consider position with commercial or manufacturing firm. Available immediately. Apply to Box No. 425-W.

CIVIL ENGINEER, S.E.I.C., 1930 graduate of Nova Scotia Tech. with experience as plane table topographer, instrumentman and draughtsman and particularly interested in hydro-electric power development and reinforced concrete design, desires position. Willing to go to foreign fields. Available at a few weeks notice. Apply to Box No. 431-W.

SALES ENGINEER, B.Sc. (McGill, 1914), A.M.E.I.C., 37, married, presently employed in position of responsibility, desires to communicate with a prominent railway equipment supply house, with a view to becoming its Pacific coast representative. Has a complete knowledge of railway locomotive equipment particularly. Excellent references can be furnished. Apply to Box No. 444-W.

CONSULTING ENGINEER. A member of The Institute with many years experience in general engineering is open for an engagement in consulting, advisory or inspecting capacity. Would like to meet corporation or large contracting firm to whom such qualifications may be useful. Apply to Box No. 445-W.

ELECTRICAL ENGINEER, S.E.I.C., B.Sc., (McGill Univ. '27), age 26. Fifteen months outside plant engineering with large public utility. Twenty months sales engineering experience with electrical manufacturing company. Available on reasonable notice. Apply to Box No. 463-W.

ELECTRICAL ENGINEER, B.Sc. (McGill), Jr.E.I.C., age 28, graduate Canadian General Electric Company test course, with two years experience in the design of induction motors and direct current machines. Previous experience includes electrical installation in large paper mill, and assistant to engineer in charge of small utilities company. Married. Location immaterial. Apply to Box No. 466-W.

CIVIL ENGINEER, experienced in road construction, mine surveying, transmission line survey and construction; paper mill construction; age 27. Available on short notice. Apply to Box No. 468-W.

CIVIL ENGINEER, A.M.E.I.C., age 39, with wide experience on design and construction of reinforced concrete structures, desires position. Apply to Box No. 475-W.

DESIGNING ENGINEER, A.M.E.I.C., P.E.Q., with extensive experience in design and construction of power plants, industrial buildings and hydraulic structures, desires position as designing engineer or resident engineer on construction. Apply to Box No. 492-W.

ELECTRICAL ENGINEER, B.A.Sc. (Univ. Toronto, '29), S.E.I.C., Can. Gen. Elec. Co. test course. Six months experience in the design of induction motors. Experience in electrical maintenance. Apply to Box No. 494-W.

MANAGING CIVIL ENGINEER, college graduate, A.M.E.I.C., C.P.E.Q., 18 years comprehensive experience in all lines of architectural engineering and contracting as designing, detailing, quantity surveying, cost estimating, superintending and general business management, desires to change and wants connection with Montreal firm, preferably with chance to share in business. At present in responsible position as engineer in charge and chief estimator, but available on few weeks notice. Apply to Box No. 495-W.

STRUCTURAL ENGINEER, 20 years experience in the design and construction of all types of steel and reinforced concrete buildings. Available shortly. Location Toronto. Apply to Box No. 501-W.

Electricity Supply and Fuel Consumption

At the beginning of 1922 the Electricity Commissioners for the first time issued a return, showing that during the year ended March 31, 1921, the average fuel consumption in 463 power stations in Great Britain was 3.32 pounds per kilowatt-hour generated, the best showing being made by a station, unnamed, which had generated less than 3,000,000 kilowatt-hours in the year for an average consumption of 1.7 pounds per kilowatt-hour, while the highest thermal efficiency, 17.75 per cent., was attained by a station generating more than 50,000,000 kilowatt-hours. The total coal and coke consumed was 7,356,757 tons. The "Return of Fuel Consumption and Units Generated" for the year ended March 31, 1930, which has now been published by H. M. Stationery Office at a price of 1s. 6d. net, shows the advance towards economy, which has taken place during the intervening period. The return covers 568 stations, in 318 of which coal, coke or oil-fired boilers were installed. These stations generated an aggregate of 11,436,600,400 kilowatt-hours and consumed 10,096,210 tons of fuel, the average consumption, therefore, being 1.97 pounds per kilowatt-hour generated. The most economical station was that at North Tees, which had a fuel consumption of 1.28 pounds per kilowatt-hour generated. Kearsley had a figure of 1.18 pounds, but this covered only six months operation. At the following stations the consumption was approximately equal to, or less than, 1.5 pounds per kilowatt-hour: Portishead (Bristol Corporation), Hayle (Cornwall Electric Power Company), Barking (County of London Electric Supply Company), Padiham (Lancashire Electric Power Company), Lister Drive, No. 3 (Liverpool Corporation), Deptford West (London Power Company), Maidstone, Barton (Manchester Corporation), Percival Lane (Mersey Power Company), Upper Boat (South Wales Electrical Power Distribution Company), and Ferrybridge (Yorkshire Electric Power Company). At 83 other stations the consumption was less or only slightly in excess of 2 pounds per kilowatt-hour, including all five stations of the London Power Company. There were, therefore, 96 stations consuming less than the latter figure, compared with 59 in 1928-29, 32 in 1927-28 and 16 in 1926-27, while at many others the consumption was only a little higher. This is a result on which all concerned are to be congratulated and the prospects of still further improvement are good. On the other hand, 29 steam stations consumed more than 5 pounds per kilowatt-hour, the highest figure being 10.68 pounds. It may be added that 77 oil-engine stations are recorded as consuming 1 pound or less of fuel per kilowatt-hour generated, compared with 70 in 1928-29 and 39 in 1927-28, the most economical being that at St. Martins Lane (Charing Cross Electricity Supply Company) where the consumption was 0.59 pound per kilowatt-hour. The most efficient gas producer station was that at Bude, where the consumption was of 1.5 pounds per kilowatt-hour generated.

The total electricity generated during 1929-30 was 11,961,621,965 kilowatt-hours, an increase of 9.95 per cent over the previous year, while the total fuel consumed was 10,141,291 tons, or an increase of 6.06 per cent.—*Engineering.*

New Type of Floor Construction

The first practical application of the new "battledeck" type of floor construction is soon to be made in Pittsfield, Mass., in a garage. The new type flooring consists of steel plates welded together by a self-propelled automatic welding machine designed by the General Electric Company.

The Pittsfield garage addition will house 300 cars. It will be two storeys high, and the plan dimensions will be 60 feet wide, by 140 feet long.

Announcement of the possibilities of the "battledeck" type of flooring was made at the recent annual convention of the American Institute of Steel Construction, Inc.

The only reason for erecting a building is to provide floors protected from the weather, and the use of material in a floor which weighs more than the expected load on the floor, is a decided disadvantage. The new type of flooring utilizing steel plates and structural steel beams involves much less weight and carries its savings into the vertical framework of the building.

The special automatic welding machine consists of a three-wheeled, self-propelled vehicle driven by an adjustable-speed motor. On the framework are mounted a welding wire feeding device, a reel of welding wire, the travel motor and the control devices. A motor-generator set at a remote point supplies, through a trailing cable, the current for welding and for operating the travel motor.

In operation the machine is placed on the beginning of the seam where it is lined up and started running. It can be easily steered if necessary, but it can usually run without assistance. At the end of the seam it is turned around and started in the opposite direction on the next seam.

The Testing of Watthour Meters

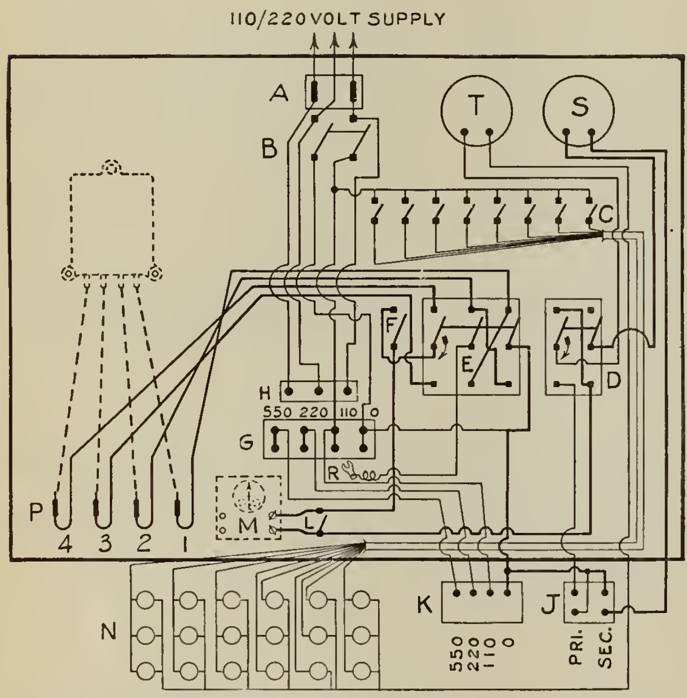
A convenient test panel for the accurate and complete testing of watthour meters has been developed by the meter department of the North York Hydro-Electric Commission. Variation of current on one-quarter ampere steps to 10 amperes may be obtained either direct through the meter under test or through the primary of the step-up loading transformer.

For testing 3-wire meters, a 3-pole double-throw switch transfers the load from one series coil to the other and at the same time retains line-side connection for the potential coil.

A 0-110/220/550 volt auto-transformer furnishes voltage for meters of various ratings. Convenient terminals for connecting a rotating standard are provided. Two hanger straps support a small front panel upon which the meter under test is placed. These can be seen in the photograph and serve to keep the meter away from stray fields and within convenient distance of the operator. Leads to the meter are flexible and weighted below like those on a telephone switchboard, keeping them out of the way when not in use.

A separate test rack provides for 10 meters under dial test.

An adjunct to the panel is a small air compressor and trigger nozzle which facilitates removal of dust from working parts of the meter.



Actual Wiring Diagram of Back of Watthour Meter Test Panel.

Surface mounting switches are shown with terminals projecting through to back of panel. All conductors carrying secondary load to or from current transformer are No. 6 B. and S.; all others are No. 12.

Key

A —30 a., 250 v. fuse block, 15 a., fuses.
B —30 a., 250 v., D.P.S.T. switch.
C —Eight 30 a., 250 v., S.P.S.T. switches.
D —60 a., 250 v., D.P.D.T. switch.
E —60 a., 250 v., 3 P.D.T. switch.
F —60 a., 250 v., S.P.S.T. switch.
G —Eight composition top binding posts.
H —Three plug jacks for potential supply to thermal demand meters when they must be left on line unattended.
J —5-100 a., Ferranti current transformer.
K—0-110/220/550 v., Ferranti auto transformer.
L —60 a., 250 v., S.P.S.T. switch located on outside of meter well.
M—Standard rotating watthour meter located in well in bench top.
N —Lamp bank.
P —Flexible leads to meter under test.
R —Flexible lead with spade terminal for connection to desired potential at terminals G. Potential leads and click switch of rotating standard are connected to corresponding terminals and voltage.
S —0-100 a., Ammeter, Ferranti flush type.
T —0-10 a., Ammeter, Ferranti flush type.

Fine Equipment for New Power Station at Newcastle

The Newcastle-on-Tyne Electric Supply Company, Ltd., are at present constructing a new power station to the west of their existing plant at Dunston. This will be known as Dunston B, and will have an ultimate capacity of six 50,000-kw. sets. To begin with, however, only three sets will be installed, orders for which have already been placed with C. A. Parsons and Company, Ltd. These will be of the tandem type, with one high-pressure and one low-pressure cylinder, the latter having a single exhaust. The initial pressure and temperature will be 600 pounds per square steam inch, and 800 degrees F. respectively, but after leaving the high-pressure turbine at a pressure and temperature of approximately 150 pounds per square inch, and 525 degrees F., the steam will be re-heated to 825 degrees F. before it enters the low-pressure cylinder. The condensers, which will be manufactured by Richardsons, Westgarth and Company, Ltd., of Hartlepool, will have a cooling surface of 40,000 square feet and will be capable of maintaining a vacuum of 29 inches. It will be possible to isolate one-half of the unit for cleaning without completely shutting down the plant. The turbo-alternators will generate three-phase current at a pressure of 13,500 volts and a frequency of 50, the output being stepped up to 66,000 volts for transmission to the company's system, and to the Central Electricity Board. The main switchgear will be on the 66,000 volt circuits and will be manufactured by A. Reyrolle and Company, Ltd., of Hebburn-on-Tyne. The rupturing capacity of the units will be 1,500,000 kv.a. and they will be remotely controlled from a central operating room.

As regards steam raising there will eventually be three boiler houses, arranged at right angles to the engine-room. To begin with, however, one complete stoker-fired boiler-house and one-half of a pulverized fuel fired boiler-house only will be built. Four units will be arranged on each side of each boiler-house with a central firing aisle, half being supplied by Clarke, Chapman and Company, Ltd., of Gateshead-on-Tyne, and half by Babcock and Wilcox, Ltd., of London. Two units in each row will be designed for both steam raising and reheating, and the remainder for steam raising alone. The latter will have an output of 156,000 pounds per hour from water at a temperature of 340 degrees F., while the former will supply 125,000 pounds of steam and be also capable of reheating 180,000 pounds of steam at 150 pounds per square inch from 525 degrees F. to 825 degrees F. The stoker-fired units will be equipped with tubular air heaters and Foster economizers, and the pulverized fuel units with plate air-heaters and return tube economizers of the Babcock type. The stokers will also be of the latest Babcock chain gate type, while eight 5-ton Resolutor mills, manufactured by Clarke, Chapman and Company will supply the pulverized fuel. Cyclone dust extraction plant will be installed between the boilers and chimneys.

The incoming coal will be handled by a duplicate system of elevators for each boiler house with a capacity of 75 tons per hour, while the water for condensing and other purposes will be drawn from the Tyne by six electrically driven vertical centrifugal pumps. These will be installed in a separate pump house.—*Engineering.*

Road Map of Canada

Imperial Oil Limited have issued a four-sheet road map of Canada and northern United States, prepared by Rolph-Clark-Stone, Limited. Toronto, Ont.

These four maps are on a scale of 30 miles to 1 inch and embrace Canada from coast to coast. They also show United States territory as far south as Washington, D.C., in the east and Salem, Ore., in the west. The territory covered is in excess of two million square miles.

Two classes of roads are shown and the main highways are featured by a bold red line. Mileage and highway numbers are conspicuously indicated, also in red. The size of type of place names is governed by the populations of the cities, towns and villages.

On the backs of the maps are to be found plans of the principal cities and elaborate district maps of the principal summer playgrounds in Canada.

Copies may be procured on application to Imperial Oil Limited at any point in Canada.

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to every branch of the engineering profession.

A

AERIAL PHOTOGRAPHY

In Industry. Aerial Photography Aids Industry, H. N. Brown. Mfrs. Rec., vol. 94, no. 18, Oct. 31, 1929, pp. 44-45, 3 figs. Examples of value in showing development of new building enterprises, in taking place of progress reports on building construction, and in showing volume of water available for new industries.

AERIAL SURVEYING

Canada. Aerial Surveying in Canada. Engineer (Lond.), vol. 148, no. 3849, Oct. 18, 1929, pp. 404-405, 1 fig. Field, probably unequalled in any country, exists in Canada for useful and economical application of aircraft to investigation of natural resources; upwards of 200,000 sq. mi. have been covered; early experiments; forestry surveying; water powers; mapping of mineral areas; index and filing system.

AERODYNAMICS

Theory. The Theory of Aerodynamics, H. Leavy. Aircraft Eng. (Lond.), vol. 1, no. 4, June, 1929, pp. 121-124. Survey of problems in aerodynamics still awaiting solution on mathematical lines; fundamental equations governing motion of viscous fluid; analogy with elastic structures; importance of Reynolds' number; dimensional theory; Stanton's classic experiments; direct attacks on equations of motion slightly disturbed from steady state has yielded nothing but disappointment; no relative motion; boundary conditions; Von Karman's method. Summary of paper presented before Math. Assn.

AIR COMPRESSORS

Design. Design for Volume Change Differentiates Compressors from Blowers, S. A. Moss. Power, vol. 70, no. 15, Oct. 8, 1929, pp. 564-565, 2 figs. Scientific distinction between blower and compressor is that compressor is definitely designed to take account of appreciable change of volume when air is passing through machine whereas blower takes care of constant volume; theoretical work performed by blower and compressor.

AIRPLANE DESIGN

Factors in. Factors in the Design of Commercial Airplanes, C. T. Porter. Am. Soc. Mech. Engrs.—Advance Paper, no. 36, for mtg. Dec. 2 to 6, 1929, 3 pp. Designing passenger transport planes with right combination of speed and comfort to compete with extra-fare trains is discussed; development of 30- to 40-passenger airplane to equal present speed requirements with reduction of power to 50 to 60 hp. per passenger advocated; direct-drive air-cooled radial engines replaced by geared engines placed inside wing with remote drive to propellers; airplane should approach flying wing with high wing loading and retractable landing gear.

AIRPLANE ENGINES

Cooling for. High-Temperature Liquid-Cooling, G. W. Frank. Soc. Automotive Engrs. Jl., vol. 25, no. 4, Oct. 1929, pp. 329-340 and (discussion) 340-343, 25 figs.; see also West. Flying, vol. 6, no. 4, Oct. 1929, p. 56, 1 fig.

Design. Effect of Surrounding Temperature on Air-Cooled Engines (Effet de la Température Ambiante sur le Fonctionnement des Moteurs). Bulletin Technique du Bureau Veritas (Paris), vol. 11, no. 9, Sept. 1929, pp. 197-201, 3 figs. Notes on self-ignition and detonation; influence of temperature on performance of engine; experimental results.

AIRPLANES

Airfoils. Aerodynamic Characteristics of Twenty-Four Airfoils at High Speeds, L. J. Briggs and H. L. Dryden. Nat. Advisory Committee for Aeronautics—Report No. 319, 1929, 32 pp., 45 figs.

Catapults. Accelerations of Transatlantic Mail by Means of Catapult (L'accélération des courriers transatlantiques par la catapulte). Aéronautique (Paris), no. 124, Sept. 1929, pp. 313-314, 4 figs.

Sheet-Metal Stamping. Sheet Metal Pressing for Airplanes, R. Hudson. Sheet Metal Worker, vol. 20, no. 16, Aug. 9, 1929, pp. 503-504 and 510, 4 figs. Methods employed in sheet-metal department of Boeing Airplane Co., Seattle, for manufacture of airplanes; in manufacture of ailerons and empennages for airplanes, 700-ton press is used to produce corrugated and stream-lined surfaces.

AIRPORTS

Rating. The Selection of Airports and Their Rating, E. Jones. Airports, vol. 3, no. 4, Oct. 1929, pp. 19-20. Unavailability of airport sites meeting present ideal as to area should not be necessarily permitted to discourage acquirement and improvement of airports of lesser size; improvements must tend toward approval of areas now failing to meet present high ratings; advantages of airport located will not depend entirely upon long-distance passenger-mail-goods conveyance; private owners are greatest purchasers of aircrafts.

AIRSHIPS

Design. The External Forces on an Airship Structure with Special Reference to the Requirements of Rigid Airship Design, H. R. Cox. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 33, no. 225, Sept. 1929, pp. 725-811, 41 figs.

Metal Construction. Building the Structure of British Rigid Airship R-101, P. W. Peel. Can. Machy. (Toronto), vol. 40, no. 20, Oct. 3, 1929, pp. 42-47, 5 figs.

R-101. The Large Airships of Great Britain (Les grands dirigeables britanniques), L. Mercier. Aérophile (Paris), vol. 37, no. 11/12, June 1/15, 1929, pp. 163-166, 5 figs. Brief description of British airship R-100 precedes discussion of design of R-101; form of hull and construction of frame; nature of metals employed; ballonets for gas, netting and valves used; Beardmore Tornado engines; arrangement of engine nacelles; distribution of pressure on envelop of R-101.

ALLOYS

Age Hardening. Age-Hardening. Metallurgist (Supp. to Engineer, Lond.), Sept. 27, 1929, p. 130. Remarks based on lengthy discussion of age hardening at meeting of Gesellschaft fuer Metallkinde at Duesseldorf; question upon which discussion centered was whether phenomena of age hardening could be accounted for by dispersion theory; certain number of German metallurgists held view that phenomena are too complex to be accounted for by so simple an explanation; what may prove important step towards general acceptance of dispersion theory was explanation of way in which so-called anomalides in hardening phenomena could be readily fitted into dispersion theory.

Aluminum. *See Aluminum Alloys.*
Bearing Metals. *See Bearing Metals.*
Copper. *See Copper Alloys.*
Magnesium. *See Magnesium Alloys.*
Non-Ferrous. *See Non-Ferrous Metals and Alloys.*

ALUMINUM

Sheet. Some Aspects of the Commercial Manipulation of Aluminum, C. F. Nagel, Jr. Sheet Metal Worker, vol. 20, nos. 19 and 20, Sept. 20, and Oct. 4, 1929, pp. 611-612, 615, and 642-643. Sept. 20: Essentials in which aluminum differs from other metals; controlling factors of processes; heat treating aluminum alloys; properties of duralumin; changes during aging; mechanical properties of certain alloys in various tempers. Oct. 4: Aging methods and mediums; annealing aluminum; differences of crystallization; growth of crystals; time and temperature important; annealing heat-treatable alloys. Paper presented before Am. Inst. Min. and Met. Engrs.

ALUMINUM ALLOYS

Cold Working. Effect of Cold Rolling on Physical Properties of Metals, R. L. Templin. Rolling Mill Jl., vol. 3, no. 9, Sept. 1929, pp. 393-394, 1 fig. Abstract of paper presented before Am. Inst. Min. and Met. Engrs.

Welding. Gas Welding Aluminum, W. A. Dunlap. Welding Engr., vol. 14, no. 10, Oct. 1929, pp. 38 43, 7 figs.

ARCHES, CONCRETE

Construction Stresses. The Behaviour of a Reinforced Concrete Arch During Construction, S. B. Slack. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2279-2299, 14 figs. Results of measurements to determine initial behaviour of 160-ft. span, open-spandrel, reinforced-concrete arch rib of bridge at Eatonton, Ga., measurements of which began while concrete was being placed and continued until about one month after bridge was completed.

ARCHES, CONTINUOUS

Theory of. Theory of the Continuous Elastic Arch Resting on Elastic Support (Sulla teoria dell'arco elastico continuo su appoggi elastici), E. Garnier. Politecnico (Milan), vol. 77, no. 6, June 1929, pp. 344-350, 4 figs.

ASBESTOS INDUSTRY

Quebec. Development of the Asbestos Industry in Quebec, J. G. Ross. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 91-94, 3 figs. Historical note of discovery; mining began in 1878 and production was 50 tons; rapid development during 12 years; mechanical treatment of mine product; data concerning large producers and men prominent in asbestos industry; 1928 production was 295,821 tons, valued at $11,251,830; 5,159,247 tons rock mined, of which 4,109,823 tons were milled; average value of rock mined was $2.17 per ton.

AUTOMOBILE PLANTS

X-Ray Laboratories. Radiographic Analysis of Metals Suitable for Stressed Parts, W. L. Fink and R. S. Archer. Automotive Industries, vol. 61, no. 16, Oct. 19, 1929, pp. 571-574, 9 figs. Description of X-ray laboratory installed at new foundry of U. S. Aluminum Co. at Fairfield, Conn., field of advantageous use of radiography in metal industry is determined by balancing cost, which is comparatively high, against benefits obtainable through accurate inspection; X-ray apparatus employed was well developed for both diagnostic and deep-therapy medical work; general principles underlying radiography; most of radiographic work has been done on highly stressed parts.

AUTOMOTIVE FUELS

Standardization. Standardization of Automotive Fuels (Erwaegungen zu einer Normung von fluessigen Kraftstoffen), W. Schmidt. Automobiltechnische Zeit. (Berlin), vol. 32, no. 26, Sept. 20, 1929, pp. 569-570. Author suggests test method for standardization of oil fuel, according to which fuel would be tested only in engine, using standard experimental engine for this purpose.

B

BEAMS

Design. Chart for Beam Design Gives Equivalent Distributed Loads, E. McCullough. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, p. 585, 1 fig. Diagram giving factors for converting uniform to equivalent distributed loads.

Curved. The Plaster-Model Method of Determining Stresses Applied to Curved Beams, F. B. Seeley and R. V. James. University of Ill.—Bul., vol. 194, no. 49, Aug. 6, 1929, 36 pp., 15 figs. Explanation of investigation, purpose of which was to determine whether or not brittle-material method using pottery plaster as material, could be made to yield consistent and reliable results, particularly with members of rather irregular shapes requiring complicated moulds for casting members; it also investigated radial tensile stress in curved beam.

BEARING METALS

PROPERTIES. Bearing Metals with Lead, Antimony and Tin Basis (Ueber Lagermetalle aug Blei-, Antimon- und Zinn-Basis), H. Mueller. Zeit. fuer Metallkunde (Berlin), vol. 21, no. 9, Sept. 1929, pp. 305-309 and (discussion), 309-310, 15 figs. Physical requirements of modern highly stressed bearing metals are discussed, i.e., Brinell hardness tensile strength, dilation, and wear; texture and its interrelation with requirements mentioned; suggestions for further development.

BELTS AND BELTING

TESTING. Modern Belt Testing (Neuzeitliche Riemenpruefung), F. Pelckmann. V.D.I. Zeit. (Berlin), vol. 73, no. 40, Oct. 5, 1929, pp. 1425-1427, 6 figs. Modern testing equipment; explanation of engineering terminology; friction coefficient independent of load; test results and their utilization; testing standards.

BOILER CORROSION

RECENT INSTANCES. Recent Instances of Embrittlement in Steam Boilers, F. G. Straub. Am. Soc. Mech. Engrs.—Advance Paper for mtg., Dec. 2 to 6, 1929, no. 43, 2 pp., 2 figs. Cause of recent boiler explosion at Crossett, Ark. is described, failure being attributed to embrittlement produced as result of using soda-ash treatment on water too low in sulphate content; other instances of cracking of seams in steam boilers are also described; emphasis is placed upon regular inspection of leaky seams in steam boilers, particularly when boiler water does not meet A.S.M.E. recommendation.

BOILERS

CORROSION. Heat Conductivity of Boiler Scale (Die Waermeleitfaehigkeit von Kesselstein), A. C. Eberle. Archiv fuer Waermewirtschaft (Berlin), vol. 10, no. 10, Oct. 1929, pp. 334-336, 7 figs.

FAILURES. Cracking of Boiler Plates, A. Pomp and P. Bardenheuer. Metallurgist (Supp. to Engineer, Lond.), Sept. 27, 1929, pp. 131-132, 1 fig. Extensive application is made of Fry's reagent to reveal areas in which local plastic straining of steel has occurred, and which therefore has reduced ductility and increased solubility in corrosive media; three cases of cracking of boiler plates in service are discussed. Review of paper, previously indexed from Mitteilungen aus dem Kaiser-Wilhelm Institut fuer Einsenforschung zu Duesseldorf, No. 128, 1929.

MARINE, DESIGN OF. Type of Marine Boiler with High Steaming Capacity (Note sur un type de chaudière marine à haute vaporisation), E. Rauber. Bul. Technique du Bureau Veritas (Paris), vol. 11, no. 8, Aug. 1929, pp. 170-172, 2 figs. Details of design which was developed with purpose of increasing steaming capacity of tubes with too low output; results of tests on industrial and marine boilers.

OPERATION—LOAD CURVES. How to Prepare a Schedule for Economic Boiler Loadings, H. B. Reynolds. Power, vol. 70, nos. 15 and 16, Oct. 8 and 15, 1929, pp. 553-557 and 593-594, 14 figs.

BRICK

GLASS. Seven Floors of New Skyscraper to be Built of Glass Bricks, Am. Glass Rev., vol. 49, no. 2, Oct. 12, 1929, pp.27-28. 65 storey Palais de France to be erected in New York will be example of use of glass as major building material; upper seven floors will be constructed of glass brick and new type of plate glass, almost exclusively.

BRIDGE DESIGN

STRESSES. Variations in Stresses and Design of Bridges (Om spannings- och formforandringsmatningar a broar), C. R. Kolm. Teknisk Tidskrift (Stockholm), vol. 59, no. 30, July 27, 1929 (Vag och Vattenbyggnadskonst), pp. 81-87, 10 figs. Importance of measuring changes in stresses and design of bridges; progress in technique of measuring and description of present measuring and testing instruments.

BRIDGE PIERS

CONSTRUCTION. Rebuilding Colorado River Bridge after Collapse. Eng. News-Rec., vol. 103, no. 18, Oct. 31, 1929, pp. 683-684, 4 figs. Reconstruction of concrete piers consisting of two concrete-filled cylinders 11.5 ft. in diam., to support two 190-ft. steel spans of highway bridge, at Blythe, Calif.; overturned pier and debris in two submerged spans hinder work; deep sheet piling and tremie concrete used.

Pier Construction for the Mid-Hudson Bridge at Poughkeepsie, New York, J. W. Rollings. Boston Soc. Civ. Engrs.—Jl., vol. 16, no. 8, Oct. 1929, pp. 423-428 and (discussion) 448-449, 15 figs. Construction of two piers, each 60 ft. in width by 130 ft. in length, with semi-circular ends having radii of 30 ft., by open-caisson method; outside walls of caissons were 3 to 3½ ft. thick; details of mixing plant and anchorage of caissons; sudden sinking and tilting of one of caissons and method of righting it; author disapproves of type of caisson used at Poughkeepsie.

BRIDGE SPECIFICATIONS

FRANCE. New French Rules for the Design of Reinforced-Concrete and Metallic Bridges (Nouvelles instructions françaises pour le calcul des ponts en béton armé et métalliques). Annales de l'Association des Ingénieurs Sortis des Ecoles Spéciales de Gand (Ghent), vol. 19, no. 1, 1929, pp. 93-100. Discussion and abridged text of specifications approved by Ministry of Public Works and dated May 10, 1927; load diagrams and general directions for design of highways bridges and bridges for standard-gauge and narrow-gauge railroads.

BRIDGES, CONCRETE ARCH

CONSTRUCTION. Bridge Contractor Uses Floating Machine to Cut Underwater Piles. Construction Methods, vol. 11, no. 10, Oct. 1929, pp. 50-53, 10 figs. Methods of constructing Washington Bridge, Providence, R.I.; bridge consists of double-leaf bascule span 150 ft. long and 12 concrete-arch spans, 89 to 105 ft. long; bridge piers are founded on timber piles; details of mechanical underwater pile cutter; steel truss centering used in construction of river arches are supported on false sand jacks.

The Freyssinet Method of Concrete Arch Construction, A. L. Gemeny. Pub. Roads, vol. 10, no. 8, Oct. 1929, pp. 148-150, 2 figs. Freyssinet method which is applicable to any type of concrete arch eliminates parasitical stresses, which limit concrete arch to comparatively short spans of high rise; temperature as well as combined dead and live-load stresses may be adjusted so as to reduce bending moments to minimum; correction may be made for small foundation movements.

PLOUGASTEL. Unique Construction Procedure on Long-Span Concrete Bridge Arches at Brest, France. Eng. News-Rec., vol. 103, no. 18, Oct. 31, 1929, pp. 691-695, 13 figs. See editorial comment p. 677. Three 612-ft. arches of Plougastel bridge, designed and constructed by E. Freyssinet, were concreted in succession on single centre shifted by barges; box arch design edfor 1,000-lb. load per sq. in. of concrete section; cofferdams constructed of concrete, and concrete caisson used as diving bell; double cableway with travelling electric hoists serves operation.

FRANCE. Reinforced Concrete Bridge Over the Elorn River, Finisterre, H. E. Steinberg. Engineering (Lond.), vol. 128, no. 3327, Oct. 18, 1929, pp. 485-487, 20 figs. partly on supp. plate. Bridge was subject of competition in design, and conditions indicated that it had to be capable of carrying single line of standard railway, as well as roadway 30 ft. wide, for vehicular traffic; it consists of relatively short-approach viaducts and three arched spans over water, each bring 590 ft. in clear; arches consist of hollow reinforced-concrete vaults having four longitudinal walls and top and bottom slabs.

The Plougastel Bridge (Die Bruecke von Plougastel), Beton u. Eisen (Berlin), vol. 28, no. 16, Aug. 20, 1929, pp. 293-297, 17 figs. Design and construction of combined reinforced-concrete bridge consisting of three hollow arches of 186.4 m. span; details of foundation work, timber arch centering, etc.

BRIDGES, HIGHWAY

JAMES RIVER. Construction of the James River Bridge Project, R. C. Wilson and H. B. Pope. Am. Soc. of Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2357-2374, 10 figs. Design and construction of project consisting of three bridges, totaling 5⅗ mi. in length, and about 11 mi. of concrete roads; largest of these bridges, near Newport News, Va., is about 4½ mi. long; project includes four 210-ft. through trusses, direct-drive lift bridge, 300 ft. long with clearance of 145 ft. when fully opened, double-leaf bascules of rolling type, 110 ft. in length, etc.; materials testing; pile-casting and handling.

BRIDGES, MASONRY ARCH

DESIGN. Design of Continuous Arches Resting on Elastic Supports (Calcolo degli archi continui su appoggi elastici), E. LoCigno. Ingegnere (Rome), vol. 3, no. 8, Aug. 1929, pp. 486-494, 6 figs. Discussion of exact and approximate theoretical formulae by Ritter, Guidi, and Lossier; application of theory to checking of stability of masonry-arch railroad bridge consisting of 13 arches 16.5 m. in span, located at Casale on River Po.

BRIDGES, RAILROAD

STRESSES. The Report of the Bridge Stress Committee, L. H. Swain. Engineering (Lond.), vol. 128, no. 3327, Oct. 18, 1929, pp. 506-507, 3 figs. A propos of publication of British Stress Committee's report and recent discussion as to work done in India on this subject, comparative results are given of actual test values of impact on an Indian railway bridge and corresponding calculated values of impact by Indian basic formula and by Indian covering formula.

BRIDGES, STEEL

PAINTING. Spray-Painting of the Quebec Bridge. Can. Engr. (Toronto), vol. 57, no. 18, Oct. 29, 1929, pp. 665-667, 7 figs. Marked economies effected by spray-painting method; equipment consists of spray guns, air compressor, air-operated winch and pressure-type paint containers; men work for three months each year; single coating requires 7,500 gals. of paint.

BRIDGES, STEEL TRUSS

ARGENTINA. Combined Railroad and Highway Bridge over Rio Dulce in Argentina (Die Eisenbahn und Strassenbruecke ueber den Rio Dulce in Argentinien), F. Bohny. Bautechnik (Berlin), vol. 7, no. 33, Aug. 2, 1929, pp. 501-504, 10 figs. Design and construction of steel-truss bridge consisting of twelve 71-m. spans, having total length of 856 m., located at Santiago del Estero.

CINCINNATI. Continuous Truss Bridge 1,575 Ft. Long at Cincinnati. Eng. News-Rec., vol. 103, no. 19, Nov. 7, 1929, pp. 734-737, 5 figs. Design and construction of river structure forming part of $12,000,000 improvement program of C. and O. Railway; erection of double-tract E-70 silicon steel continuous truss bridge having centre span of 675 ft. and two side spans of 450 ft. each; caisson and foundation details; shoes and expansion details; locomotive crane used in setting heavy steel.

MAINTENANCE AND REPAIR. Turnbuckles Welded into Bridge Eyebar Diagonals, H. F. Cole. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, pp. 585-586, 1 fig. Methods of restressing diagonal of railroad bridge over Kiskiminetas River near Pittsburgh, Pa., with special device consisting of two turnbuckles welded between pair of wing plates at either end.

BRIDGES, SUSPENSION

DISMANTLING. Dismantling Two Long Suspension Bridges. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, pp. 562-569, 16 figs. Removal of condemned structural members and wire cables of Mount Hope and Detroit bridges in record time; cable was separated into strands and flame-cut into sections 15 to 30 ft. long; cuts made between seizings about 6 in. apart.

HUDSON RIVER. Column Test Completed for the Port of New York Authority. Eng. News-Rec., vol. 103, no. 18, Oct. 31, 1929, p. 690. Notes on results of tests by Bureau of Standards on 24-ft. long half-scale models of columns which form portions of towers of new suspension bridge to cross Hudson River; concrete encasement increases strength of steel columns by 40 per cent.

C

CABLEWAYS

AERIAL. The Application of Aerial Tramways to Long and Short Hills, M. P. Morrison. Am. Soc. Mech. Engrs.—Advance Paper, no. 29, for mtg. Dec. 2-6, 1929, 6 pp., 6 figs. Aerial tramways are of value where no other means of transportation is possible and also in competition with other methods of transportation; with aerial tramways length and capacity are unlimited from engineering standpoint; author discusses several locations where tramway has been successfully applied.

CAISSONS

OBLIQUE. Oblique Compressed-Air Sinking Operations in Theory and in Practice (Die schraege Druckluftabsenkung in Theorie und Praxis), E. Paproth. Bautechnik (Berlin), vol. 7, no. 37, Aug. 27, 1929, pp. 566-574, 17 figs. Description of German patented method, invented by C. P. Hansen, for sinking of non-vertical pneumatic caissons in building of bridge piers and abutments; advantages of oblique over vertical sinking of caissons; practical use of method in construction of bridge piers and open weir piers in Germany; theoretical foundations of method, computation of stresses in oblique caissons; application of method to construction of seawalls.

CALCIUM CARBIDE

MANUFACTURE OF. The Manufacture of Calcium Carbide. Chem. Age (Lond.), vol. 21, no. 538, Oct. 19, 1929, p. 356. Discussion of raw materials; suspension of electrodes; electric furnace operates quietly with excess of lime present in charge, but tends to be disturbed if, in order to obtain high-grade carbide or to protect electrodes, excess of carbon in charge is present; large furnace of modern type should work for years continuously without shutting down for serious repairs, if properly handled.

CANADIAN MINES DEPARTMENT

FUNCTIONS OF. The Mines Branch and Its Functions, J. McLeish. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 66-70, 8 figs. Comprehensive statement by Director of Mines Branch of Mines Department; general organization; division of Mineral Resources under A. W. G. Wilson; Ore Dressing and Metallurgical division under W. B. Timm; Fuels and Fuel Testing under B. F. Haanel; Ceramics and Road Materials under H. Frechette; Chemical Divisions under F. G. Wait; cooperation with other departments and agencies.

CANALS

WELLAND. The Welland Ship Canal. Engineering (Lond.), vol. 128, no. 3326, Oct. 11, 1929, pp. 462-465, 5 figs. Description of Section No. 6, which was one of later parts for which contract was awarded; solution adopted has included straightening out and realignment of creek along new course to east of channel for ship canal, which, itself is considerably to east of present channel; it is estimated that work involved in this section embraced 11 million cu. yds. of earth excavation, and use of 2 million cu. yds. in water-tank embankments; in making rock dams, run of dumps was employed. (Continuation of serial.)

IRRIGATION. Irrigation Canal and Drainage Ditch Crossings in the Imperial Valley, J. F. Lamb. Hydraulic Eng., vol. 5, no. 10, Oct. 1929, pp. 35-36, 9 figs. Illustrated examples from author's practical experience.

DESIGN. Simplified Method for the Design of Canal Sections (Vereinfachtes Verfahren zur Berechnung der Kanalprofile), O. Schmiedel. Gesundheits-Ingenieur (Munich), vol. 52, no. 31, Aug. 3, 1929, pp. 557-559, 2 figs. Procedure and tables for design of canal sections on basis of Bazin formula, when velocity of stream and hydraulic radius are not given.

CARBON DIOXIDE

Properties. The Thermal Properties of Carbon Dioxide in the Gaseous, Liquid, and Solid States, R. Plank and E. J. Kuprianoff. Information on Refrigeration—Bul. (Paris), no. 11, Mar. and Apr. 1929, pp. 3p-15p, 3 figs. partly on supp. plates. Discussion of such factors as specific volume, equilibrium, latent heats, enthalpies, entropy; tables and charts for carbon-dioxide in solid, liquid, and vapour states.

CARBON DIOXIDE COMPRESSORS

Design. Design Problems of a Carbon-dioxide Refrigeration Machine, T. Mitchell. Power, vol. 70, no. 15, Oct. 8, 1929, pp. 566-567, 1 fig. Solution of various problems may be grouped under two headings: design of pistons and arrangement of parts centering about shaft; illustration of inclosed vertical-dioxide compressor.

CARS

Refrigerator. A Résumé of the Mobile Refrigerator, L. K. Wright. Ice and Refrigeration, vol. 77, no. 4, Oct. 1929, pp. 204-206. Insulation thickness of cars; shipment of produce; circulation of air in cars; artificial refrigeration of cars; refrigerated barges; refrigerated milk cars and ice-cream trucks; overhead bunkers in freight cars; ice consumption of overhead bunker cars.

Street Railroad, Montreal. Two Car Trains, Montreal Tramways Company. Can. Ry. and Mar. World (Toronto), Oct. 1929, p. 638, 2 figs. Illustrated description of two-car trains used on Montreal Tramways Co. which have proved of distinct advantage at heavy-traffic intersections where very short headways are necessary to maintain traffic flow.

CASTINGS

Strength. Strength of Metal Castings and Relation of Iron to Method of Casting (Die Festigkeitseigenschaften von Metallguss einschliessl. Eisen in Abhaengigkeit von der Giessweise), G. Schreiber and H. Menking. Zeit. fuer Metallkunde (Berlin), vol. 21, no. 9, Sept. 1929, pp. 297-302 and (discussion), p. 302, 22 figs. Cause of fluctuations in strength values of all cast metals is investigated; various physical influences are explained with aid of testing model.

CEMENT MORTAR

Steam Treatment. Steam Curing of Portland Cement Mortars, T. Thorvaldson and G. R. Shelton. Can. Jl. of Research (Ottawa), vol. 1, no. 2, July 1929, pp. 148-154. Steam curing of Portland cement mortars in saturated steam at 100, 125, 150, 175 and 200 deg. cent. studied, both as to variations in tensile strength of 2-day and 28-day mortar briquets and as to changes which occurred in crystalline matter in cement; great increase in resistance of Portland cement mortars to alkali action produced by steam curing is connected with production of new crystalline material.

Water Ratio. Fineness of Grinding, Water-Cement Ratio, and Compression Strength of Cement (Malningsfinhet, Vattencementtal och Tryck-Hallfasthet hos Cement), V. Bahrner. Teknisk Tidskrift (Stockholm), vol. 59, no. 39, Sept. 28, 1929, (Vag och Vattenbyggnadskonst), pp. 114-116, 4 figs. Attempt to clarify question of relation between fineness of grinding of cement and water-cement ratio, and show direction in which to seek solution of related questions.

CITY PLANNING

Hexagonal. Hexagonal Planning, N. Cauchon. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 56, no. 6, Sept. 17, 1929, pp. 340-348, 6 figs. Past president of Town Planning Institute of Canada reports on city-planning activities in Canada and discusses main features and advantages of his town-planning system having hexagonal block as its basic element.

CLAY

New Brunswick. Clays and Shales of the Grand Lake Area, New Brunswick, H. Fréchette and J. F. McMahon. Can. Department Mines—Investigations (Ottawa), no. 697, 1929, pp. 26-45. In mining thin coal seam, it is necessary to mine and hoist large tonnage of shales; samples taken for investigation of possibilities of establishment of clay-working industry; description of location, nature of material, working properties, burned properties and dry-press tests; recommendations as to suitability of materials for manufacture of products.

COAL

Pulverized. *See Pulverized Coal.*

COAL CARBONIZATION

Low Temperature. Combined Low-Temperature Carbonization, Gasification and Combustion, D. Brownlie. Iron and Coal Trades Rev. (Lond.), vol. 139, no. 3216, Oct. 18, 1929, pp. 575-576. Discussion of recent developments in watertube boiler practice; pulverized-fuel developments; low-temperature carbonization plants integral with boiler settings; yield of by-products; other combined processes. Abstract of paper read before Instn. Mech. Engrs.

CONCRETE

Acid Water Effect. Effect on Concrete of Acid Water From Stored Bituminous Coal, E. F. Wolf. Indus. and Eng. Chem., vol. 21, no. 10, Oct. 1929, pp. 908-910, 3 figs. This report covers some observations that have been made on effect of acid water from stored bituminous coal on concrete structures at Gould Street power plant of Consolidated Gas Electric Light and Power Co. of Baltimore; structure of particular interest is 18-in. reinforced-concrete crane-runway wall situated along coal storage field and extending to depth of 11 ft. below ground level.

CONCRETE CONSTRUCTION

Pneumatic Placing. Pneumatically Placed Concrete in Sewage Plant and Outfall Construction, A. T. Cassiere. Hydraulic Eng., vol. 5, no. 10, Oct. 1929, pp. 16-17 and 43-44, 4 figs. In construction of Imhoff tanks, for sewage disposal plant, San Bernardino, Calif., pneumatically placed concrete known as pneucrete was used; detail of core-breaker type nozzle, used in placing concrete; exposed surfaces of concrete structures also show with pneucrete coating.

CONCRETE DESIGN

Charts. Special Charts Simplify Design Problems, R. C. Reese. Eng. News-Rec., vol. 103, no. 17, Oct. 24, 1929, pp. 661-662, 2 figs. Author presents chart for finding minimum depth of concrete beam and required steel area of slab when load, span, etc., are given.

CONVEYORS

Belt. Seattle Uses Belt Conveyors for Big Earth Moving Job, W. E. Philips. Power Transmission, vol. 35, no. 4, Oct. 1929, p. 36, 2 figs. Use of belt conveyors for moving 5,000,000 cu. yds. of earth from Denny-Hill to Elliott Bay, in Denny-Hill Regrade Project No. 2, is described; striking difference between what were considered good standard methods of moving materials before, and simpler, more efficient and economical uses of conveyors, as now applied, was studied.

COPPER ALLOYS

Melting. Development of New Deoxidation and Melting Process for Metals, Especially Copper Alloys (Die Entwicklung eines neuen Desoxydations und Schmelzverfahrens fuer Metalle insbesondere fuer Kupferlegierungen), W. Reitmeister, Giesserei (Duesseldorf), vol. 16, no. 41, Oct. 11, 1929, pp. 945-952 and (discussion) 952-953, 4 figs. Relations between copper and iron alloys are set forth; casting difficulties with bronze; relation between tendency to segregation in raw and cast material; deoxidation of molten bronze with carbon; influence of deoxidation on one segregation, and other causes for zone segregation; new deoxidation process is described.

COPPER ORE TREATMENT

Arizona. Co-ordination of Operation and Research at Clarkdale, Ariz., G. J. Young. Eng. and Min. Jl., vol. 128, no. 16, Oct. 19, 1929, pp. 619-620, 1 fig. Notes on research laboratory organized by United Verde Copper Co.; work is under direction of O. C. Ralston; flotation occupies important place in current studies.

Leaching. Factors Governing Removal of Soluble Copper from Leached Ores, J. D. Sullivan and A. J. Sweet. U. S. Bur. of Mines—Tech. Paper, no. 453, 26 pp., 13 figs. partly on supp. plates. Supplement to U. S. Bur. of Mines—Tech. Paper, no. 441; problem as applied to vat or tank leaching; diffusion and absorption; experimental work; problem as applied to heap leaching; study of manner of crystallization of copper sulphate from solutions evaporating; study of manner of crystallization of copper sulphate from solutions evaporating in capillary and small-bore glass tubes; concentration of copper salts on surface and in interior of ores saturated with copper sulphate and then dried.

CULVERTS

Concrete, Holland. Erection of Some Reinforced-Concrete Structures on the Schaesberg-Kerkrade-Simpelveld Railroad Line in Southern Limburg, Holland (Die Ausfuehrung einiger Kunstbauten aus Eisenbeton in der Eisenbahnlinie Schaesberg-Kerkrade-Simpelveld im Sueden der Provinz Limburg, Holland), L. J. M. Dirickx. Beton u. Eisen (Berlin), vol. 28, no. 12, June 20, 1929, pp. 213-218, 16 figs. Design and construction of three heavy-section culverts under railroad embankment; also of two reinforced concrete slab bridges carrying road over railroad tracks.

Jacking. Cost of Jacking Culvert through Fill Compared with Open Cut Method, W. M. Angas. Eng. News-Rec., vol. 103, no. 17, Oct. 24, 1929, pp. 663-664, 2 figs. Author reports on 48-in. corrugated-iron culvert, 126 ft. long, which was jacked through 34-ft. fill carrying concrete highway at Naval Fuel Depot, San Diego, at cost of but one-third of that estimated for open-cut work; comparative itemized costs.

CUTTING TOOLS

Lathe, Cutting Speeds of. Turning with Shallow Cuts at High Speeds, H. J. French and T. G. Digges. Am. Soc. Mech. Engrs.—Advance Paper, no. 17, for mtg. Dec. 2 to 6, 1929, 31 pp., 42 figs.

D

DAMS

Concrete, Great Britain. Lac Seul Conservation Dam, Ear Falls, T. H. Hogg. Can. Engr. (Toronto), vol. 57, no. 19, Nov. 5, 1929, pp. 683-684, 5 figs. Description of concrete dam containing twenty stop-log sluices of 14 ft. clear width and 40 ft. maximum height, which was built jointly by Ontario and Manitoba Governments on English river at lower Ear Falls, to provide 4,000,000 acre-feet of storage in Lac Seul.

Concrete, Construction. Ryburn Dam. Water and Water Eng. (Lond.), vol. 31, no. 370, Oct. 21, 1929, pp. 451-454, 7 figs. Construction of curved gravity, concrete dam having maximum height of 121 ft. and thickness of 84 ft. at base, to form compensation reservoir of 222,000,000 gals. capacity; details of excavation, concrete pouring, grouting, etc.

Concrete Arch. Small Arch Dam Design Governed by Concrete Economy Need, J. Girand, Jr. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, pp. 569-570, 3 figs. Design and construction of variable-radius arch dam, 110 ft. high, near Safford, Ariz.; dam is about 140 ft. long and contains only 970 cu. yds. of concrete; radii vary from 14 ft. at base to 80 ft. near top; central angle is about 130 deg.; temperature reinforcement is doweled to abutments and grouted.

Concrete Arch, Idaho. Construction Starts on Concrete Arch Dam on the Deadwood River, Idaho. Hydraulic Eng., vol. 5, no. 10, Oct. 1929, pp. 26-28, 1 fig. Feature of single arch dam having radius of 290 ft., height 160 ft., length 700 ft. on crest; central portion of dam being 6 ft. below top to form overflow spillway. Reprinted from New Reclamation Era, Sept. 1929, previously indexed.

Earth, Spillways. Earth Dam with Spillway Channel through Embankment. Eng. News-Rec., vol. 103, no. 19, Nov. 7, 1929, pp. 725-727, 2 figs. Design and construction of water-supply dams for Mitchell, S. Dakota; dam has maximum height of 40 ft. and is ¼ mi. long; central clay core has steel and wood sheet; spillway crest which is 10 ft. below top of dam and is 140 ft. long with constructed concrete lime channel over central portion of dam; report on erosion of dam and settlement of spillway; criticism of design.

Failures. Causes of Failures of Concrete Dams (Orsaken til retongforstorelser i dammbyggnader), A. Elkwall. Teknisk Tidskrift (Stockholm), vol. 59, no. 21, May 25, 1929, (Vag och Vattenbyggnadskonst Supp.), pp. 64-68. Investigation of several dams show that failure is due to disintegration of concrete; Swedish State Commission reports on materials.

Foundations, Geology. Classification, Selection and Adaptation of High Dams, D. C. Henny. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2327-2346. Historical sketch; examples of high dams; foundations for earth, rock-fill and masonry dams; flood, earthquake and earth movement dangers; uplift; tension in foundation; geological requirements for reservoirs; significance of topography at dam site; permeability of rocks of dam site; solubility, softening and disintegration of rocks in water; changes in volume of rocks.

Gravity, Curved. Effect of Curvature on Gravity Dam (L'effet de la courbure des barrages-poids), F. Campus. Génie Civil (Paris), vol. 95, no. 15, Oct. 12, 1929, pp. 352-355, 3 figs. Theoretical mathematical analysis resulting in simplified mathematical expressions.

High. Past Experience with High Dams and Outlook for the Future, A. J. Wiley. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2318-2326. Account of past practice in design of high dams; comments indicate that higher dams of future will be of solid masonry gravity type, preferably of arch-gravity type; comparisons and selection of type; uplift in and under dams; seepage from dams; pressure grouting of contraction joints.

Multiple Dome, Coolidge, Ariz. Construction Methods and Plant Layout at Coolidge Dam, in Arizona, J. G. Tripp. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2347-2356, 3 figs. Planning of concrete plant and excavation; layout of concrete plant; distribution of concrete; choice of concrete mixers; general service problems; construction work.

DEPARTMENT STORES

Construction. Record Speed in Building Construction Due to Ingenious Foundation Scheme, W. T. McIntosh. Eng. and Contracting, vol. 118, no. 11, Nov. 1929, pp. 451-455, 5 figs. Unusual methods of installing foundations make it possible to begin erection of steel work for new Abraham and Strauss department store, Brooklyn, as soon as demolition of old building had been completed; electric shovels taking out general excavation while steel erection was in progress on upper floors; cross section through foundation pits, showing details of work.

DIES

Forging, Manufacture of. Forging Dies Made by Improved Methods, C. B. Phillips. Iron Trade Rev., vol. 85, no. 15, Oct. 10, 1929, pp. 901-903, 5 figs. Practice employed in die-making division of Studebaker Corp., South Bend, Ind., is described; die blocks are bought annealed, impressions cut, and block heat treated and finished; careful heat treating methods described; daily inspection of dies in use; two distinct methods used in forging crankshaft with these dies outlined; new block steel employed for crankshaft and all heat-treating operations eliminated except normalizing.

DIESEL-ELECTRIC POWER PLANTS

COSTS. Diesel Engine Power Costs, E. J. Kates. Power Plant Eng., vol. 33, no. 20, Oct. 15, 1929, pp. 1114-1115, 1 fig. Operating costs of well designed and modernly equipped Diesel plant of Vulcan Rail and Construction Co.; chart showing relationships between output, efficiency, load factor, and operating cost.

Diesel Engine Power Costs for 1927-1928, F. Edler. Power Plant Eng., vol. 33, no. 21, Nov. 1, 1929, pp. 1168-1170. Analysis of Diesel power costs indicate trend toward further plant refinement and need of standardization of cost methods; summary of Diesel-engine data; summary of Diesel-plant operating costs.

DIESEL ENGINES

SUPERCHARGING. Compounding and Supercharging of Diesel Engines (La question du compoundage et de la suralimentation du moteur Diesel), Gautier. Bul. Technique du Bureau Véritas (Paris), vol. 11, nos. 7 and 8, July and Aug. 1929, pp. 155-159 and 177-180, 18 figs. Engines of 4-stroke cycle only are dealt with; notes on recovery of energy lost in exhaust gas; supercharging and means of effecting it; supercharging with exhaust-gas turbo-compressor; comparison of three types of engines; standard 4-stroke supercharged 4-stroke and standard 2-stroke engines; results of tests; conclusions.

New System of Supercharging Werkspoor Engines (Nouveau Système de Suralimentation des Moteurs Werkspoor), Abbat. Bul. Technique du Bureau Véritas (Paris), vol. 11, no. 7, July 1929, pp. 138-139, 1 fig. Details of Van Essen supercharging system employed in Werkspoor engines installed in oil tanker, Megara; instead of supplying necessary air from a rotary blower, underside of main working pistons is utilized; box casting around cylinder forms receiver from which air is supplied to inlet valve at alternate strokes of piston; results of running tests.

DIPHENYL

PROPERTIES. Diphenyl. Indus. Power, Nov. 1929, pp. 41-42, 146 and 148, 2 figs. New substitute for water in heat engineering; yellowish crystalline substance at temperatures below its boiling point, and smelling much like moth balls; threatens to displace water wherever more rapid heat transferring is necessary has no corrosive action on any material; it will burn at high temperatures, presumably around 1,800 deg. fahr.; not to be confused with diphenyl oxide, which is not so stable, and has not proven satisfactory because of tendency to carbonize in tubes; preliminary table of values for diphenyl.

DUST PRECIPITATION

ELECTRIC. Electric Precipitation in Power Plants. Power Engr. (Lond.), vol. 24, no. 284, Nov. 1929, p. 450. Present stage of application of electrical precipitation to central station chimneys and prospects of its further use in this connection.

E

ELECTRIC CABLES

DESIGN. The Most Efficient Size of Cable Conductor, C. G. Watson. Elecn. (Lond.), vol. 103, no. 2682, Oct. 25, 1929, pp. 488-490. Important considerations on designing of low-tension distributing system for heavy loads; calculations involved.

UNDERGROUND, LAYING. Longer Duct Runs Made Possible with Dynamometer Control. Elec. World, vol. 94, no. 13, Sept. 28, 1929, p. 645, 3 figs. 45,000-volt transmission feeder, consisting of three single-conductor, 200,000-cir. mil. lead-covered cables, 1.8 in. in diam. installed in one 5-in. duct, was recently placed in service by Westchester Lighting Co.; maximum duct length in system was 1,002 ft.; to get accurate observation of stresses involved special recording cable pulling stress indicator was constructed which is illustrated.

ELECTRIC CAPACITORS

HIGH-VOLTAGE. With the High-Voltage Capacitor Small Loads Can be Economically Connected to High-Tension Lines, H. Brooks. Elec. Jl., vol. 26, no. 10, Oct. 1929, pp. 477-478, 6 figs. Vector diagram and connections showing how parallel operation can be obtained, are discussed; new scheme has been developed, which, for low-power installations, has number of advantages over direct transformations by means of transfer.

ELECTRIC CONDUCTORS

COPPER. Correlation of the Ultimate Structure of Hard-drawn Copper Wire with the Electrical Conductivity, R. W. Drier and C. T. Eddy. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 259, 1929, 12 pp., 5 figs.; see also abstract in Rolling Mill Jl., vol. 3, no. 10, Oct. 1929, pp. 433-434, 1 fig. Preliminary report of work done on research program for intensive study of copper, effect of direction of drawing; description of samples used; microscopic study showed no structural differences; diffraction; resistivity measurements indicate increase of resistivity with degree of orientation in which cube edge is parallel to fibre axis or direction of drawing.

ELECTRIC GENERATORS

DESIGN. Characteristic Constants of Electric Generators (Constantes caractéristiques des générateurs électriques), E. M. Galvez. Académie des Sciences—Comptes Rendus (Paris), vol. 189, no. 8, Aug. 21, 1929, pp. 329-331. Interrelation between e.m.f. and interior resistance is mathematically analyzed.

ELECTRIC INSULATORS

FLASHOVER. Time Lag of Flashover, P. H. McAuley. Elec. World, vol. 94, no 16, Oct. 19, 1929, p. 780, 1 fig. Cathode-ray oscillogram obtained from five successive, accurately synchronized, voltage applications to string of 16 suspension insulators equipped with arcing rings, shows graphically meaning and relationships of time lag of flashover.

ELECTRIC LINES

CALCULATION. Calculation of Voltage Drop of Long Alternating-Current Lines (Berechnung langer Wechselstromleitungen auf Spannungsabfall), W. Buetow. Elektrotechnische Zeit. (Berlin), vol. 50, no. 42, Oct. 17, 1929, pp. 1515-1519, 22 figs. Graphical method, closely related to methods already known as used in electric works of W. Lahmeyer and Co., in Frankfort on Main; it has advantage that hyperbolic functions are avoided and, because of illustrativeness, errors are easily distracted; method is approximately exact.

GROUNDING. A.W.W.A. Takes Action on Grounding of Electrical Lines on Water Pipes. Water Works Eng., vol. 82, no. 23, Nov. 6, 1929, pp. 1597-1598 and 1634, 1 fig. Text of resolution adopted by executive committee; history of association's stand on matter.

POLES, SETTING. Economical Pole Setting. Elec. World, vol. 94, no. 17, Oct. 26, 1929, pp. 833-834, 3 figs. Comparison of expense of manual and machine methods; variability of soils, labour rates, accounting practices, and other conditions, prevent general conclusion regarding machine economy.

HIGH TENSION, GROUNDING. Installing Grounding Chains on Pole Lines. Elec. World, vol. 94, no. 16, Oct. 19, 1929, pp. 777-779, 11 figs. Methods for using grounding chains on lines of Public Service Co. of Northern Illinois for voltages between 2,300 and 33,000 are illustrated.

HIGH-TENSION, DESIGN. Barren Jack Hydro-Electric Development, N.S.W. Transmission Lines and Substations, J. J. Richardson. Instn. of Engrs. Australia—Jl. (Sydney), vol. 1, no. 8, Aug. 1929, pp. 295-308, 6 figs. Record of principles and methods adopted in design and construction of 66,000-volt transmission lines and substations of Barren Jack system (Australia), including details of surveys, easements and resumptions, towers and poles, insulators, conductors, steelwork and switchgear; tables of transmission-line costs, transmission-line sections, and details and technical data of insulators are given.

ELECTRIC MANUFACTURING PLANTS

MATERIALS HANDLING. Production Method Used in the Electrical Industry, E. L. Spray. Materials Handling (A.S.M.E. Trans.), vol. 51, no. 19, May-Aug., 1929, pp. 61-63. Production methods used in plant of Westinghouse Electric and Manufacturing Co. at Mansfield, Ohio, are described; sad irons, ranges, switches, waffle irons and toasters are now assembled on conveyors, and assembly costs have been reduced from 15 to 35 per cent; results obtained include lower labour costs, reduced inventories, fewer rejects, less floor space, better processes, better machining, and more uniform product.

ELECTRIC MOTORS, ALTERNATING CURRENT

WINDINGS. Locating Winding Faults in Alternating-Current Motors, M. E. Wagner. Power, vol. 70, no. 18, Oct. 29, 1929, pp. 680-683, 8 figs. Short circuits, open circuits and grounds are three faults in a.c. motor winding that operating engineers are most likely to have to contend with; effects of these faults and how to locate source of trouble are explained; a.c. motor windings connected four-pole series-delta; simplified diagrams of three-phase motor connections.

ELECTRIC NETWORKS

PROTECTION. Some Developments in Relay Protection for Power Systems, W. F. Mainguy. Elec. News (Toronto). vol. 38, nos. 19 and 20, Oct. 1 and 15, 1929, pp. 35-40 and 44-48 and 63, 11 figs. Oct. 1: General principles of over-current, directional and differential protection. Oct. 15: Canadian impedance type, distance type and ratio differential type relays and outline of British split-pilot feeder protective gear.

ELECTRIC REACTORS

CHOKE COIL. Effect of Choke Coils, S. M. Jones and R. A. Hudson. Elec. World, vol. 94, no. 15, Oct. 12, 1929, pp. 729-733, 8 figs. Very high inductance needed for choke coils to decrease voltage or steepness of travelling waves; mathematical analysis shows doubtful value of coils for arresters or lines; curves showing effect of choke coil on various types of waves, are given.

DESIGN. Calculation of Enlarged Inductivity of Air-Core Reactors due to Insulation of Windings (Berechnung der durch die Windungsisolation hervorgerufenen Vergroesserung der Induktivitaet von eisenlosen Drosselspulen), J. Hak. Elektrotechnische Zeit. (Berlin), vol. 50, no. 40, Oct. 3, 1929, pp. 1440-1442, 6 figs. Mathematical design analysis.

ELECTRIC RECTIFIERS

METAL. AEG All-Metal Rectifiers Serving an Extensive Urban and District Railway, F. Laun. A.E.G. Progress (Berlin), vol. 5, no. 9, Sept. 1929, pp. 285-290, 8 figs. Details of standard type rectifier; layout, equipment, and diagram of connection of substation of German State Railway in Berlin with all-metal rectifiers of 2,700/1,000 amperes of 800 volts and 3,000/300 amperes of 800 volts.

ELECTRIC SUBSTATIONS

PORTABLE. This Automatic, Portable Substation Supplies Power When and Where It Is Needed. Elec. Jl., vol. 26, no. 10, Oct. 1929, p. 464, 3 figs. Railroad-car type, 500-kw. 600-volt d.c., 2,300-volts at 710 hp. synchronous motor as developed by Missouri Pacific lines is described; it can be used to supply power for seasonal loads, or in emergency.

ELECTRIC WELDING

ARC. Application of Electric Arc Welding, A. Churchward. Heat Treating and Forging, vol. 15, no. 10, Oct. 1929, pp. 1304-1306, 7 figs. Recent progress in fabrication of metals by arc welding is reviewed; description of apparatus by means of which globular formation of any electrode can be observed as well as effect of different kinds of current values with various arc lengths and electrodes with different coatings.

ELEVATORS

ELECTRIC, SAFETY DEVICES FOR. Safety Devices for Elevators (Ueber Sicherheitsvorrichtungen an Aufzuegen). Waerme (Berlin), vol. 52, no. 42, Oct. 19, 1929, pp. 794-795, 1 fig. Description of modern safety methods and equipment including shaft-door closing, counterweights, etc.

ENGINEERS

BRITISH COLUMBIA. Engineering Profession Act of B.C. Can. Engr. (Toronto), vol. 57, no. 15, Oct. 8, 1929, pp. 613-614. Explanation of act and status of engineer in British Columbia as result of Act; beneficial influence to profession; attitude of legislature; formal system of training and examinations.

EVAPORATION

HEAT TRANSMISSION AND. Evaporation and Heat Transmission (Verdunstung und Waermeuebergang), E. Schmidt. Gesundheits-Ingenieur (Munich), vol. 52, no. 29, July 20, 1929, pp. 525-529, 1 fig. Derivation of differential equations; application of these equations to study of condensation on cold surfaces.

F

FERTILIZERS

SEWAGE WASTE. Pulverizing and Screening Dried Sewage Sludge. Eng. News-Rec., vol. 103, no. 16, Oct. 17, 1929, pp. 617-618, 1 fig. At Milwaukee sewage disposal plant fertilizer is made by passing slude over vibrating screens; oversize reduced in disintegrators; cost data; features of disintegrator for sewage sludge.

FLOW OF FLUIDS

RESEARCH. Investigations into the Flow of Fluids (Ergebnisse aus dem Stroemungsinstitut der Technischen Hochschule Danzig), G. Fluegel. Werft-Reederei-Hafen (Berlin), vol. 10, no. 16, Aug. 22, 1929, pp. 335-337, 5 figs.: see translated abstract in Mar. Engr. and Motorship Bldr., Oct., pp. 426-427. Description of equipment of Institute for Hydrodynamics and Aerodynamics of Danzig Technical University, including wind tunnel, circulating water tank for testing floating models, and hydraulic laboratory for stream-flow research on small models; ease with which otherwise complicated flow phenomena, such as through turbines and scavenge process in Diesel engines, can be investigated, is emphasized.

FLOW OF GASES

MEASUREMENT OF. Simplified Formula for Calculating Velocity of Escaping Gases (Forenklad utstromningsformel), B. A. Afzelius. Teknisk Tidskrift (Stockholm), vol. 59, no. 24, June 15, 1929 (Mekanik), pp. 82-83, 2 figs. Three formulae are evolved by which velocity of escaping gases of all pressures beyond critical may be determined with accuracy of less than 1 per cent.

FLOW OF STEAM

PIPES. Simplification of Calculation With Trottle Flange Measurement (Forenkling av raknearbetet vid strypflans-matningar), C. E. Nilson. Teknisk Tidskrift (Stockholm), vol. 59, no 29, July 20, 1929 (Mekanik), pp. 85-96, 7 figs. Adquist and Haerlin's Formulae for measuring steam flow in pipes are given and from these are developed formulae that are accurate, but much simpler.

FLOW OF WATER

CURVED CHANNELS. Loss of Head in Curved Channels (Ueber den Stroemungsverlust in gekruemmten Kanaelen), H. Nippert. V.D.I. Zeit. (Berlin), vol. 73, no. 39, Sept. 28, 1929, pp. 1391-1392. Report on theoretical and experimental study of loss of head in models of channels of rectangular and circular sections, made at hydraulic laboratory of Danzig Institute of Technology. Abstract from Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, no. 320.

SURFACE CURVES. Approximate Tracing of Backwater Curves in Prismatic Canals, etc. (Sul tracciamento approssimato dei profili di rigurgito nei canali ad alveo prismatico in regime permanente), E. Campini. Energia Elettrica (Milan), vol. 6, no. 6, June 1929, pp. 600-607, 8 figs. Theoretical mathematical discussion of methods of computing surface curves of flow in open channels of trapezoidal section, as well as in sewers of ovoidal and other cross-sections; study of hydraulic jump.

FORGING

TIME ELEMENTS IN. Study of Time in Forging Operations (Etude des temps de forgeage), L. Faure. Arts et Métiers (Paris), vol. 82, no. 106, July 1929, pp. 241-248, 14 figs. Elements entering into time in forging are discussed covering preparation of work, tools, and fire, time for re-heating, time for rough forging, and finishing to exact form and trimming, time for inspection, time for displacement, and lost time.

FRAMES, CONCRETE

DESIGN. Statistical Behaviour of Reinforced-Concrete Frames Subject to Shrinkage Stresses (Das statische Verhalten der unter Schwindeinfluss stehenden Rahmentragwerke aus Eisenbeton), L. Herzka. Beton u. Eisen (Berlin), vol. 28, nos. 12, 14, 15 and 16, June 20, July 20, Aug. 5 and Aug. 20, 1929, pp. 220-224, 264-269, 286-288 and 298-304, 16 figs. Theoretical analysis of stresses induced by contraction of concrete in several types of girders and frames; studies of deformation caused by shrinkage; tables of values for solving equations derived; results of laboratory tests of reinforced-concrete frames; numerical examples illustrating application of formulae.

FURNACES, ANNEALING

ROTARY. Multiple-Hearth Rotary Furnace. Iron Age, vol. 124, no. 14, Oct. 3, 1929, p. 908, 1 fig. Description of rotating furnace for bluing, drawing, annealing, and heating at temperatures from 700 to 1,650 deg. fahr., which is produced by Strong, Carlisle & Hammond Co.; central heating chamber is surrounded by 10 compartments for holding work.

G

GAS ENGINES

TESTING. Complete Thermodynamic and Experimental Study of a Gas Engine (Etude thermodynamique et expérimentale complète d'un moteur à gaz), A. Duchesne. Revue Universelle des Mines (Liége), vol. 72, no. 4, Aug. 15, 1929, pp. 97-107, 32 figs. Study of test of May 10, 1927; tabular data and detailed discussion of results; comparison of two tests; correction of errata in issues of Jan. 1, Feb. 1, and 15, Apr. 1, and May 1, 1929.

GASES

IGNITION TEMPERATURES OF. Ignition Temperatures of Mixtures of Carbon Monoxide with Air (Sur les températures d'inflammation des mélanges d'oxyde de carbone et d'air), M. Prettre and P. Lafitte. Académie des Sciences—Comptes Rendus (Paris), vol. 188, no. 22, May 27, 1929, pp. 1403-1410. Ignition temperatures were found to be fairly constant and to have value of 655 deg. cent. for mixtures containing between 10 and 40 per cent carbon monoxide; for greater proportions of carbon monoxide, ignition temperature increased with percentage of carbon monoxide until value of 727 deg. was obtained for mixture containing 72.9 per cent carbon monoxide.

GEOLOGICAL SURVEYS

CANADA. The Geological Survey of Canada, W. H. Collins. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 53-65, 6 figs. Historical review of establishment of Geological Survey in 1842 and progress to 1867; expansion from 1867 to 1907; concentration of effort in 1907; present activities in exploration, study of mineral deposits, other investigations, geological and topographic mapping, maintenance of National Museum, and incidental research and educational work.

GEOLOGY

MANITOBA. Geology of Oiseau River Area Manitoba, J. F. Wright. Can. Min. Jl. (Gardenvale, Que.), vol. 50, nos. 4 and 43, Oct. 18 and 25, 1929, pp. 987-990 and 1014 and 1027. Oct. 18: Area about 70 mi. northeast of Winnipeg and 98 mi. north of international boundary; historical notes; topography; water powers; general summary of geology; tabular data on geological formations. Oct. 25: General distribution of rocks and basis of subdivision; quartz-mica schist and conglomerate; quartzite, akose, and greywacke. Condensed abstract of summary report of Geological Survey of Canada 1924, part B. Bibliography. (To be continued.)

GEOPHYSICAL EXPLORATION

ELECTRIC. Some Earth Resistivity Measurements, F. W. Lee, J. W. Joyce, and P. Boyer. U. S. Bur. of Mines—Information Cir., no. 6171, Oct. 1929, 16 pp., 25 figs. on supp. plates. Ground resistivity measurements originally of direct interest in location of ore deposits; further applications in location of proper bridge, dam, and building foundations; factors influencing average resistivity; single-electrode method; methods for measuring earth resistivity; surface and structure effects on resistivity; comparisons of measurements; differentiative resistivity measurements; stratigraphy.

GOLD MINES AND MINING

COMPRESSED AIR. Compressed Air Supply on the Rand, B. Price. Engineering (Lond.), vol. 128, nos. 3326 and 3327, Oct. 11 and 18, 1929, pp. 479-481 and 510-511, 10 figs. Within central area, compressed air supply is furnished in bulk by Victoria Falls and Transvaal Power Co., from pipe system fed by two central compressing stations; detailed descriptions of plant and pipe lines.

GRAIN ELEVATORS

PRESCOTT, ONT. Lower Lake Grain Transshipping Terminal Near Prescott. Can. Ry. and Mar. World (Toronto), Nov. 1929, pp. 720-721, 2 figs. Discussion of design features of proposed grain elevator to be built near Prescott; railroad-track layout and bird's-eye view of site.

HUNGARY. The Grain Elevator of the Free Port of Budapest (Der Getreidespeicher im Freihafen von Budapest), V. Mihaillich. Beton u. Eisen (Berlin), vol. 28, nos. 13 and 14, July 5 and 20, 1929, pp. 229-232 and 261-264, 26 figs. Design and construction of 11-storey reinforced concrete building 96 by 36 m. having total capacity of 32,000 tons; structural details of silos and bins, columns and column footings, etc.; method of erection.

H

HARDNESS TESTING

METHODS. "Cloudburst" Hardness Testing. Iron and Steel Industry (Lond.), vol. 3, no. 1, Oct. 1929, p. 28, 2 figs. Latest improvements and modifications adopted in applying Cloudburst method for hardness testing are given; test is applied to whole surface of many articles simultaneously; hardening is effected by same machines and is continuation of same process as that used in hardness testing.

Modern Method for Testing of Materials in the Workshop (Ein Neuzeitiges Verfahren zur Werkstattmaessigen Pruefung von Werkstoffen), C. Sonanini. Werkstattstechnik (Berlin), vol. 23, no. 16, Aug. 15, 1929, pp. 495-496, 5 figs. Usual methods of hardness testing and their advantages and disadvantages; hardness coefficient and its relation to breakdown strength; description of new hardness tester.

HEAT-INSULATING MATERIALS

THERMAL CONDUCTIVITY. Determining Thermal Conductivity of Heat Insulating Materials, H. Stiles. Chem. and Met. Eng., vol. 36, no. 10, Oct. 1929, pp. 625-626, 2 figs. Description of apparatus for determining heat transfer which has advantage that plant operators can be trained to use method quite satisfactorily; apparatus was designed by writer primarily for purpose of testing heat-insulating properties of wallboard and certain other products made from cornstalks in chemical engineering laboratories of Iowa State College.

HIGHWAY ADMINISTRATION

FINANCING. Pertinent Aspects of Highway Finance, A. D. Ferguson. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 136-141. Comparative discussion of following methods of financing: pay-as-you-go method, borrowing, serial bonds, and annuity bonds; highway revenues and expenditures; statistics. Paper read before Canadian Good Roads Assn.

HIGHWAY ENGINEERING

CANADA. Canadian Good Roads Convention, W. C. Coo. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 115-153. Verbatim report of proceedings, papers, and discussions of 16th annual meeting of Canadian Good Roads Association held September 17-19, at Charlottetown, P.E.I.; principal papers and discussions included in this report are indexed separately.

HIGHWAY MARKINGS

ROCK ASPHALT. Rock Asphalt Strip in Concrete Road Makes Permanent Centre Line, J. Pope. Eng. News-Rec., vol. 103, no. 17, Oct. 24, 1929, p. 661, 1 fig. Author commends practice on concrete road between Jefferson City and Louisiana, Mo.

HIGHWAY SYSTEMS

CANADA. Municipal, Township and County Roads. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 189-212B. Condensed information on population, administration, types and mileage of pavements now laid, future programmes, etc., of great number of Canadian communities.

QUEBEC. Highways in the Province of Quebec, J. E. Perrault. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 161-164. Good roads making headway; historical sketch of highway development; educational campaign; maintenance; government control; mileage maintained by government; plans for future; expenditures; six-year programme; cost of resurfacing; elimination of railroad crossings and full-stop regulation; tourist traffic; automobile registrations. Paper presented before Can. Good Roads Assn.

PRINCE EDWARD ISLAND. Roads in Prince Edward Island, H. H. Shaw. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 121-127. History of highway systems of Prince Edward Island since beginning of 18th century. Read before Can. Good Roads Assn.

NEWFOUNDLAND. Road Development in Newfoundland, W. R. Hibbs. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 127 and (discussion) 127-129. Brief report on work of Newfoundland Road Commission and Highroads Commission. Read before Can. Good Roads Assn.

HOT WATER HEATING SYSTEMS

DESIGN. Numerical Design of Single-Line Hot-Water Heating Systems (Die Berechnung der Einrohr-Warmwasserheizung), F. W. Berli. Gesundheits-Ingenieur (Munich), vol. 52, no. 27, July 6, 1929, pp. 493-496, 3 figs. Discussion of advantages and disadvantages of single-line heating systems; theory of primary and secondary heat circuits; procedure of numerical design and example.

HYDRAULIC POWER DEVELOPMENTS

VERMONT. A Marble Company's Complete Hydro System, F. A. Westbrook. Elec. Light and Power, vol. 7, no. 10, Oct. 1929, pp. 42-43, 120 and 122, 4 figs. Vermont Marble Co. owns six developed water-power sites along Otter Creek between Rutland and in Middlebury, distance of 40 mi.; these are tied together with high-tension transmission line which in turn serves some ten of Company's workings; system is tied in with Vermont Hydro-Electric Corp. from which it purchases power at times of low water and to which it sells its surplus power at times of high water; station equipment is described.

HYDRAULIC TURBINES

DESIGN. Lines of Development and Trends in Present-Day Design of Hydraulic Turbines (Linee di Sviluppo ed Orientamenti costruttivi attuali per le turbine idrauliche), M. Medici. Elettrotecnica (Milan), vol. 16, nos. 19 and 20, July 5 and 15, 1929, pp. 438-448 and 461-468, 52 figs. Review of recent progress in design and construction of reaction turbines, diffusers, rotors, draft tubes, etc. with special reference to Kaplan turbines and Pelton wheels; notes on German, Swiss, and American practice.

TESTING. Measurements of Water Volume in Testing Turbines in the Hammarfors Power Station (Vattenmangdsmatningen vid provningen av turbinerna i Hammarforsens kraftverk), B. Norsell. Tecknisk Tidskrift (Stockholm), vol. 59, no. 42, Oct. 19, 1929, (Mekanik), pp. 131-132, 4 figs. Account of how turbines were tested; turbines together draw 100 cu. m. water per sec. with head of 19.7 m. and efficiency of 93 per cent was reached.

Thermometric Method of Measuring of Efficiency Coefficient of Hydraulic Turbines (Méthode thermométrique de mesure du rendement des turbines hydrauliques), L. Barbillion. Revue Générale d'Electricité (Paris), vol. 26, no. 13, Sept. 28, 1929, pp. 487-497, 11 figs. Method is based on measurement of temperature differences; details of method and equipment required and measures to be taken in order to obtain satisfactory results.

HYDRO-ELECTRIC POWER DEVELOPMENTS

SWITZERLAND. Swiss Water-Power Development—The Oberhasli Scheme. Times Trade and Eng. Supp. (Lond.), vol. 25, no. 587, Oct. 5, 1929, pp. 71, 1 fig. Hydro-electric undertaking, drawing energy from several Aar glaciers, and situated in Haslithal, in Bernese Oberland of Switzerland, will shortly come into partial operation; first portion of scheme is estimated to yield yearly output of 223,000,000 kw-hr. while final development will amount to 538,000,000 kw-hr. for installed horsepower of nearly 250,000.

QUEBEC. A Start Has Been Made on the Beauharnois Power Development. Contract Rec. (Toronto), vol. 43, no. 41, Oct. 9, 1929, pp. 1207-1211, 5 figs. Features of private hydro-electric development located about 25 mi. from Montreal; development forms part of St. Lawrence waterway project; 83 ft. fall and 2,000,000 hp. are available; initial development consists of ten 50,000-hp. generator units and is estimated to cost $65,000,000; engineering features and progress of work.

The Beauharnois Power Development. Elec. News (Toronto), vol. 38, no. 20, Oct. 15, 1929, pp. 39-43, 5 figs. Start has been made on Beauharnois power development; private company is now actively engaged in developing one of sections of St. Lawrence waterway project; provision is made for navigation; details of construction methods; when complete development will use 5,000,000 hp. in hydro-electric power.

HYDRO-ELECTRIC POWER PLANTS

BRITISH COLUMBIA. West Kootenay Completes No. 3 Plant at South Slocan, B.C. Contract Rec. (Toronto), vol. 43, no. 42, Oct. 16, 1929, pp. 1242-1249, 9 figs. Description and details of construction of 56,000-kw. hydro-electric plant near Nelson, B.C., utilizing river having maximum flow of 150,000 cu. ft. per sec.; project comprises two concrete dams, 60 and 70 ft. high, containing respectively 13,000 and 42,000 cu. yds.; camp features; stream control; aggregate storage bins; mixing plant; power house erection methods.

CONOWINGO, MD. The Conowingo Hydro-Electric Development. Engineering (Lond.), vol. 128, nos. 3328 and 3329, Oct. 25 and Nov. 1, 1929, pp. 515-518 and 551-554, 54 figs. partly on supp. plates and p. 560. Oct. 25: Plant as at present developed can produce, with all units working, 378,000 hp.; eventual output will be 594,000 hp.; development consists of dam and power house incorporated in dam structure. Nov. 1: Details of installation of larger gates used for normal spillway section; power plant and equipment, which at present consists of 7 units, with 2 station generators.

ONTARIO. Smoky Falls Development. Elec. News (Toronto), vol. 38, no. 19, Oct. 1, 1929, pp. 29-33, 9 figs. Spruce Falls Power and Paper Co.'s plant on Mattagami River, Ont., to supply power to Kapuskasing pulp and paper mill, some 50 mi. distant; Allis Chalmers vertical-shaft turbines with maximum rating of 18,750 hp. each at 113 ft. head and speed of 163.5 r.p.m.; each directly connected to General Electric 16,500-kva., three-phase, 60-cycle, 6,600-volt generator; power is stepped to 110,000 volts for transmission; description of equipment and wiring diagrams.

OPERATION. Simple Basis for Securing Efficient Hydro Operation, F. Nagler. Elec. World, vol. 94, no 18, Nov. 2, 1929, pp. 875-878, 4 figs. Determination of characteristics of unit performance is necessary in order to make fullest use of available water; calculation of operating curve does not require complete test of unit, but may be based on index of one factor; operating curves developed from velocity gauge index; from current-meter index, and from impact-gauge index.

POWER CALCULATION. Graphic Representation of Energy to be Derived from a Proposed Hydro-electric Installation (Représentation graphique facilitant la recherche d'aménagements hydro-électriques rationnels), R. Blom. Houille Blanche (Lyon), vol. 28, no. 147-148, Mar.-Apr. 1929, pp. 36-38, 2 figs. Description and illustration of systems of graphs to show amount of water available from river basin and to estimate distribution of water in river for power development between two heads in order to determine best sections to be utilized for plurality of stations.

REMOTE CONTROL. Automatic Remote Control of Hydraulic Machinery of the Achensee Power Plant in Tyrol (Die automatische Fernregulierung der Wasserkraftmaschinen im Achensee-Kraftwerk der Tiroler Wasserkraftwerke A.-G.), H. Latzko and O. Plechl. Elektrotechnik u. Maschinenbau (Vienna), vol. 47, no. 36, Sept. 8, 1929, pp. 791-798, 8 figs. Layout of network and formulation of problem; remote-control equipment supplied by Hartmann and Braun; wiring diagrams; operating experience and diagrams; comparison of results obtained with manual regulation.

I

IMHOFF TANKS

OPERATION. Sludge Disposal at the Calumet Sewage Treatment Works, A. H. Goodman and C. E. Wheeler. Water Works and Sewerage, vol. 76, no. 10, Oct. 1929, pp. 440-441, 2 figs. Experiences at Imhoff tank plant of Sanitary District of Chicago; Imhoff sludge-removal data; sludge analysis; record of temperatures in Imhoff tanks; digestion of settled and activated sludge; mechanical removal of slugde; collection of gas from Imhoff tanks.

INDUSTRIAL MANAGEMENT

PLANT ENGINEERING ORGANIZATION. A Practical-Ideal Organization for Plant Engineering, L. C. Morrow. Indus. Eng., vol. 87, no. 10, Oct. 19 9, pp. 504-508, 3 figs. Composite chart of plant engineering function, and personnel of plant engineering department; organization charts of 15 plants; table giving place of plant engineering function in 15 plants; table of equipment for which plant engineering organization is factor in selection; kinds of work included as part of plant engineering function.

INTERNAL-COMBUSTION ENGINES

CRANKSHAFTS. The Design of Dynamically Balanced Crankshafts for Two Stroke Cycle Engines, P. Cormac. Engineering (Lond.), vol. 128, no. 3326, Oct. 11, 1929, pp. 458-461, 1 fig.; see also letter to editor, by C. R. King, in no. 3327, Oct. 18, p. 507.

SCAVENGING. Scavenging and Supercharging of Two-Cycle Engines (Spuelung und Aufladung bei Zweitaktmotoren), E. Stier. V.D.I. Zeit. (Berlin), vol. 73, no. 39, Sept. 28, 1929, pp. 1389-1391, 10 figs. Test results show how through interconnection of scavenging air, line of suitable proportions between cylinder and receiver, constant-pressure scavenging can be replaced by scavenging method with increased pressure and energy of scavenging air can be utilized for subsequent supercharging purposes.

SPECIFIC POWER OF. Problem of Specific Power of Liquid-Fuel Engines (La question de la puissance spécifique des moteurs à combustible liquide), A. Coppens. Union des Ingénieurs sortis des Ecoles Spéciales de Louvain (Brussels), vol. 56, no. 3, Aug. 15, 1929, pp. 3-52, 18 figs. Capacity of engine per unit of weight or inversely; horsepower per kg. engine weight is dependent on inherent characteristics of engine and its calculation; curves, tables, and design data for various types of engines in different fields of application.

(*See also Airplane Engines; Diesel Engines; Gas Engines.*)

IRON MINES AND MINING

LAKE SUPERIOR DISTRICT. The Cleveland-Cliffs Iron Company—History and Organization, S. R. Elliott. Min. Congress Jl., vol. 15, no. 10, Oct. 1929, pp. 727-729, 5 figs. Company organized in 1850 and shipped its first ore in 1852; history of growth and development of one of iron industry's most interesting producers is outlined.

MICHIGAN. The Negaunee District Underground Properties, W. W. Graff and C. Brewer. Min. Congress Jl., vol. 15, no. 10, Oct. 1929, pp. 741-747, 14 figs. Three mines in this district are connected underground for ventilation and safety, but have separate shaft and surface equipment; all equipment is standardized and interchangeable as far as possible; full description of method and equipment.

IRON ORE REDUCTION

ILMENITE. Metallization of the Oxide of Iron in Ilmenite, R. J. Traill and W. N. McClelland. Can. Chem. and Met. (Toronto), vol. 13, no. 10, Oct. 1929, pp. 265-268 and 272. Article previously indexed from Am. Electrochem. Soc.—Advance Paper, no. K. for mtg. May 27-29, 1929.

IRRIGATION

UNITED STATES. Report of the Committee of the Irrigation Division on a National Reclamation Policy. Am. Soc. of Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2375-2392, 4 figs. Discussion by G. E. P. Smith, R. K. Tiffany and D. Weeks, of report previously indexed from issue of May 1929; tentative five-year national reclamation programme; Federal reclamation and agricultural surplus; prices; effect of federal reclamation on potato industry; economic questions confronting reclamation; cost of reclamation and agricultural development should be apportioned among those receiving general and special benefits.

L

LATHES

MULTIPLE-TOOL. Multiple Machine-Tool Operation and Multiple-Machine Piece Rates (Mehrbankbedienung und Mehrbanakakkord), E. Hermann. Werkstattstechnik (Berlin), no. 18, Sept. 15, 1929, pp. 532-535, 3 figs. Conditions under which multiple-tool operation is efficient; output possibilities with relation to working times; dead time; time in-put, costs, contract wages, limits of efficiency; wage-payment plans.

LEVEES

CONSTRUCTION, MISSISSIPPI RIVER. Mississippi River Levee Work Uses Varied Equipment, V. J. Brown. Eng. and Contracting, vol. 118, no. 11, Nov. 1929, pp. 443-448, 16 figs. First of series of articles on Mississippi River levee work; features of draglines, hydraulic dredges and tower machines being used in contract of Sweet Price Dredging Corp.; general construction plan; progressive stages of work; hydraulic dredging work; drag line work; job control; progress charts and progress reports. (To be continued.)

LIGHTING

INDUSTRIAL INTENSITIES FOR USE IN. Profitable Foot-Candles, M. Luckiesh. Elec. World, vol. 94, no. 15, Oct. 12, 1929, pp. 743-744. In case of lighting, with its many psycho-physiological factors, maximum level of illumination fixed by law of diminishing returns is not so readily determined; it has become necessary not only to supply data on science of seeing, but also to insure its correct interpretation; table of results from test on effect of lighting is given; conclusion from data is that, where critical vision is required, 100 foot-candle represents economic level of illumination.

LIGHTNING GENERATORS

PORTABLE. Portable Lightning Generator for Testing Transmission Lines. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, p. 570, 1 fig. Equipment for generating over 1,000,000 volts assembled in portable form for testing transmission lines by Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., is housed in four-wheel trailer which is drawn by tractor equipped with low-voltage generator, belt-driven by tractor motor; five hours are required to assemble apparatus from travelling position.

LIGNITE CARBONIZATION

SASKATCHEWAN. The Carbonization of Saskatchewan Lignite, J. P. de Wet. Can. Min. Jl. (Gardenvale, Que.), vol. 50, no. 41, Oct. 11, 1929, pp. 958-960, 1 fig. Brief general description of commercial carbonization plant of Western Dominion Collieries, Ltd.; advantages of Lurgi process are summarized; output is being increased from 100 to 200 tons per day; coke residue is manufactured into briquettes.

LIMESTONE QUARRIES AND QUARRYING

ONTARIO. Operating a Quarry for Road Contract. Can. Engr. (Toronto), vol. 57, no. 16, Oct. 15, 1929, pp. 621-623, 9 figs. Routly Construction Co., Toronto, operates old limestone quarry to supply stone for highway contract near Cornwall, Ont.; crushing plant operating in conjunction with road contractor's plant has output of 700 tons per day.

LOCOMOTIVE REPAIR SHOPS

PRODUCTION CONTROL. Production Methods in the Railroad Shops, A. E. Iveson. Am. Mach., vol. 71, no. 16, Oct. 17, 1929, p. 672. Savings obtained in railroad shop by modern shop-production methods are discussed; conditions such that mass production can only be practiced on very limited scale; standardization of repair parts difficult; major contributing factors in shop savings include placing materials adjacent to spot where it is to be utilized and giving each group of workmen one particular line of work and specified limited time to perform it; transportation often neglected. Abstract of paper presented before Int. Ry. Gen. Foremen's Assn.

LOCOMOTIVES

DESIGN. Theory of Locomotive Performance in its Development (Die Leistungstheorie der Lokomotive in ihrer Entwicklung), H. Nordman. V.D.I. Zeit. (Berlin), vol. 73, no. 40, Oct. 5, 1929, pp. 1413-1416. Theory of initial train resistance; power characteristics of locomotives originally neither properly represented nor interpreted; better understanding of these principles at present but still presupposes unchangeability of output of full load of boiler; cognizance of dependence of minimum output on speed.

DIESEL VS. STEAM. Economic Comparison of the Steam Locomotive with Different Types of Diesel Locomotives. Locomotive (Lond.), vol. 35, no. 446, Oct. 15, 1929, pp. 384-385. Economic value of steam locomotive as compared with different types of Diesel; description of test run together with test results; conclusion is drawn that Diesel locomotive is economical, although it is only in early stages of development.

HIGH-PRESSURE. High Pressure Locomotive Developments, A. F. Steubing. Am. Soc. Mech. Engrs.—Advance Paper for mtg. Dec. 2-6, 1929, 7 pp., 5 figs. Loeffler and Winterthur locomotives are described; former is express locomotive of 2,500 hp. with pressure of 1,470 lbs. per sq. in.; 1,200 hp. with boiler pressure of 850 lbs. per sq. in.; it is expected to result in fuel saving of 40 to 45 per cent compared with modern superheated locomotives; in road test of Winterthur locomotive but 330 lbs. of coal was necessary for firing up, as compared with double amount necessary for conventional locomotive of equivalent output.

OIL-BURNING. Oil-Burning Locomotives, 2-10-4 Type, Canadian Pacific Railway. Can. Ry. and Mar. World (Toronto), Nov. 1929, pp. 667-669, 4 figs. Low-carbon single steel is employed in crank pins and main and side rods; six cylinders, 25½ by 32 in.; driving wheel 63 in.; locomotive weight in working order 452,500 lbs.; wheel base 46 ft. ½ in.; boiler pressure 275 lbs.; locomotive tractive effort 77,200 lbs.

OIL-ELECTRIC. Canadian National's 2,600 hp. Oil-Electric Locomotives. Ry. Mech. Engr., vol. 103, no. 10, Oct. 1929, pp. 574-577, 5 figs. Demonstration run made with eight-car train; locomotive, which is largest and most powerful of its kind consists of two units and weighs 650,000 lbs. when fully equipped, of which 480,000 lbs. is carried on driving wheels; each unit contains Beardmore 12-cylinder oil engine of solid-injection type, with cylinders of 12-in. bore and 12-in. stroke; nominal rating of engine is 1,330 hp. at 800 r.p.m.; exhaust heat aids oil-fired boiler to heat train; selective data and dimensions of oil electric and steam locomotives.

STEAM-TURBINE. The Steam Turbine Locomotive, J. MacLeod. Ry. Gaz. (Lond.), vol. 51, no. 17, Oct. 25, 1929, pp. 618-609, 2 figs.; see also abstract in Modern Transport (Lond.), vol. 22, no. 554, Oct. 26, 1929, pp. 3 and 5, 1 fig. Discussion of condensing and non-condensing turbine locomotives; general arrangement of geared steam-turbine non-condensing locomotive, 4 ft. 8½ in. gauge, express passenger 4-6-4 type; boiler pressure, 750 lbs. per sq. in.; total steam temperature 750 deg. fahr.; tractive effort, 39,000 lbs., train load, 600 tons; maximum gradient, 1 in 100; steam per drawbar hp. per hr., 12.5 lbs.; coal per drawhar hp. per hr., 1.6 lbs. Abstract of paper before Instn. of Engrs. and Shipbldrs.

LUBRICANTS

CUTTING. Present Practice in the Use of Cutting Fluids, S. A. McKee. Am. Soc. Mech. Engrs.—Advance Paper, no. 59, for mtg. Dec. 2 to 6, 1929, 4 pp. Report is attempt to indicate trend or lack of trend toward use of particular type of cutting agent for given machining operation on given kind of metal; it is based on information obtained from 68 large users of cutting fluids in United States; list of number of plants using any of three general types of cutting agent (dry, water or emulsions, oils or oil mixtures) for each of 19 machining operations on eight kinds of metals; cutting agents used for various operations on given metal.

Oils, Properties of. Relation between Physical Characteristics and Lubricating Values of Petroleum Oils, E. D. Ries. Indus. and Eng. Chem.—Analytical Edition, vol. 1, no. 4, Oct. 15, 1929, pp. 187-191, 3 figs. Preliminary report of work done thus far in projected experimental programme of Chemical Engineering Laboratory of Pennsylvania State College.

LUBRICATION

Oil Films and Bearings. Oil Films and Bearings, H. Brillie and A. M. Robb. Engineer (Lond.), vol. 138, no. 3848, Oct. 11, 1929, pp. 382-384, 5 figs.; see also Shipbldg. and Shipg. Rec., vol. 26, no. 14, Oct. 3, 1929, pp. 405-406. Paper is based on work of G. Reynolds and suggestion that so-called "wedge formation" is not essential to maintenance of perfect film lubrication; expression is developed for giving actual thickness of oil film, or clearance between shaft and journal; outline of bearing for turbine machinery, based on considerations discussed is shown. Abstract of paper before Instn. Naval Architects.

Problems. Lubrication and Lubricants, R. M. Deeley. Engineer (Lond.), vol. 148, no. 3849, Oct. 18, 1929, pp. 405-407, 1 fig. Problem of lubrication is dealt with by first considering friction that occurs when two solid surfaces are in contact (adsorbed film lubrication), and then the state when they are entirely separated by viscous liquid (viscous film lubrication.)

M

MACHINE TOOLS

Hydraulic Feeds. Hydraulic Feeds and Speeds, A. L. DeLeeuw. Am. Mach., vol. 71, no. 19, Nov. 7, 1929, pp. 774-776. Present practice and trend in use of hydraulic feeds and speeds in machine tools are discussed; theoretical advantages and disadvantages of hydraulic feed are taken up; means for overcoming difficulty in having entire feed enme to standstill during certain period of time; it is possible to aid hydraulic feed by mechanical means in such a way that perfect timing is reached. Abstract of paper presented before World Eng. Congress.

MACHINERY

Welded, Design of. Welded Power Apparatus, H. V. Putnam and C. C. Brinton. Welding Engr., vol. 14, no. 10, Oct. 1929, pp. 46-49, 9 figs. Fundamental considerations involved in substitution of electrically welded fabricated steel parts for castings for engines, electric motors, and generators, vertical water wheel generators, high-speed and low-speed d.c. generators and converters and turbo-generators; advantages in this type of construction; equipment needed for electric cutting and arc welding materials; tolerances allowed in fabrication of structural-steel parts; design of structural-steel parts; limitations of fabricated-steel construction.

Vibrations in. Vibrations of Machinery and Foundations (Maschinen- und Fundamentschwingungen). Elektrizitaetswirtschaft (Berlin), vol. 28, no. 492, Sept. 2, 1929, pp. 486-488. Brief review of causes and remedies of vibration in large machinery of any kind in modern practice; short notes on papers read before special convention of Verein deutscher Elektrizitaet Werke.

MATERIALS HANDLING

Industrial Plants. Some Fundamental Principles of Materials Handling, H. V. Coes. Can. Machy. (Toronto), vol. 40, no. 21, Oct. 17, 1929, pp. 66, 68, 70 and 72. Cost of handling materials in two American industries; materials handling an important factor in determining plant layout in new industrial undertaking; principles of laying out materials-handling system; selection of equipment; question of whether return on investment is justified; rules for securing materials-handling economies.

Trends in Standardized Quality Production, J. H. Van Deventer. Am. Mach., vol. 71, no. 19, Nov. 7, 1929, pp. 777-779. Discussion of methods of gaining quality in mass production and how mechanical handling has been applied to attain it; machines grouped according to sequence; automobile production in two divisions; production creates consuming power; production development forces remodeling. Abstract of paper presented before World Eng. Congress.

Iron and Steel Plants. Materials Handling in a Structural Steel Fabricating Plant (Das Foerderwesen in einer Eisenkonstruktionswerkstaette), W. Meyer. Bautechnik (Berlin), vol. 7, no. 37, Aug. 27, 1929, pp. 589-596, 14 figs. Layout of plant fabricating structural steel members, with special reference to organization of conveyor system consisting of various types of platforms, overhead travelling cranes and elevators; statistics on operation and output of plant; cost data on operations; forms of records.

MAGNESIUM ALLOYS

Castings. A Note on Magnesium Alloy for Castings, E. Player. Aircraft Eng. (Lond.), vol. 1, no. 5, July 1929, pp. 175-178, 5 figs. Properties and practical processes in production of magnesium alloy castings are discussed with special reference to Elektron; foundry practice in regard to melting, moulding, and core making of magnesium alloys castings; trimming; machine-shop practice; protection against corrosion; die-castings.

Temperature Effect. High-Temperature Compression and Extrusion Tests of Metals and Alloys (Les essais à chaud métaux et alliages par compression et par filage), A. Portevin. Revue de Métallurgie (Paris), vol. 26, no. 8, Aug. 1929, pp. 435-443, 9 figs. Results of tests carried out on magnesium and magnesium alloys at temperatures not exceeding 500 deg. cent.; extrusion tests were carried out on hydraulic press.

MALLEABLE-IRON CASTINGS

Annealing. Shortens Malleable Anneal. Foundry, vol. 57, no. 19, Oct. 1, 1929, pp. 825-826, 3 figs. Results of investigations conducted by General Electric Co. to learn something of mechanism of carbon precipitation with view of possible shortening of process; high temperature with quick drop to 740 deg. cent. decreases heat-treating interval to 28 or 30 hours.

METALS

Deep-Drawn Plate. Testing of Deep-Drawn Plate (Die Pruefung von Tiefziehblech), M. Schmidt. Archiv. fuer das Eisenhuettenwesen (Duesseldorf), vol. 3, no. 3, Sept. 1929, pp. 213-220 and (discussion) 220-222, 15 figs. Requirement of deep-drawn plates; determination of deep-drawing capacity on drawing press; practical determination of drawing limit; description of simple process and results obtained; comparison with other testing methods.

The Fatigue of Metals—A Review of Progress from 1920 to 1929, H. F. Moore. Am. Iron and Steel Inst.—Advance Paper, for mtg., Oct. 25, 1929, 24 pp., 10 figs.

Machinability. Methods of Tests for Determining the Machinability of Metals in General, with Results, O. W. Boston. Am. Soc. Steel Treating—Trans., vol. 16, no. 6, Nov. 1929, pp. 659-694 and (discussion) 694-710, 54 figs.

Testing, Electric. Nondestructive Testing, E. A. Sperry. Am. Soc. for Steel Treating—Trans., vol. 16, no. 6, Nov. 1929, pp. 771-790 and (discussion), 790-798, 13 figs.

MECHANICAL ENGINEERING

Research with Models. Research in Mechanical Engineering by Small-Scale Apparatus, F. C. Johansen. Instn. Mech. Engrs.—Jl. (Lond.), no. 2, Mar. 1929, pp. 151-271, 29 figs. Objects of paper are to review present position of research by small-scale apparatus to suggest problems in mechanical engineering for which small-scale research appears to promise success; to refer, with brief descriptions, to existing examples of small-scale research in wide range of engineering subjects; and, most particularly, to evoke suggestions for improved methods and new lines of small-scale research in mechanical engineering.

MINES AND MINING

Practice, Developments in. Developments in Mining Practice, W. G. McBride. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 116-122 and 174, 5 figs. General review of progress during 50 years; increased production and efficiency; prospecting; technical training; mining methods and mechanization.

British Columbia. A History of Mining in British Columbia, R. Dunn. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 82-87, 162-166, 168-170, and 196-201. Brief historical review of mining development, dating from rush to gold placer fields of Cariboo district; Cassiar, Omineca, Similkameen, Atlin and other fields; rock mining; opening of transportation; Kootenay silver mines; Rossland, Trail, and Slocan district; zinc and copper production; northern districts; Premier mine; coal mining; résumé of mineral production; total value to end of 1927 is estimated at $1,048,837,828, during 77 years.

Canada. The Mining Industry in Canada, C. Stewart. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, p. 37. Brief article by Canadian Minister of Mines; value of 1928 mineral output was $271,000,000, about 10 per cent more than 1927 or about $30 for each inhabitant of Canada; Canada produces about 70 metals or mineral products of economic value and 18 per cent of these constitute about 98 per cent of total annual output value; importance of miner to human industry is stressed.

Nova Scotia. A History of Mining in Nova Scotia. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 113-114, 2 figs. Brief review, dating from report by mining engineer in 1640; notes on coal, copper, gold, gypsum, zinc, and lead deposits and mining operations.

MINE VENTILATION

Montana. Ventilation of the Butte Mines, Anaconda Copper Mining Company, A. S. Richardson. Min. Congress Jl., vol. 15, no. 10, Oct. 1929, pp. 813-816. Latest ventilation practice outlined; problem is temperature rather than purity; mine timber heat important factor; exhaust ventilation adopted; shaft compartments surfaced to reduce frictional resistance; flexible tubing used in dead ends.

N

NICKEL DEPOSITS

Ontario. Origin of the Frood Deposits of International Nickel, C. V. Corless. Eng. and Min. Jl., vol. 128, no. 16, Oct. 19, 1929, pp. 624-625. Discussion of paper previously indexed from Can. Min. and Met. Bul., Mar. 1929; submitted by A. C. Halferdahl, who submits interpretation of facts that he concedes may have hypothetical bearing on problem of origin of Frood deposit.

NITRIDATION

Fundamentals of. A Few Practical Fundamentals of the Nitriding Process, H. W. McQuaid and W. J. Ketcham. Am. Soc. Steel Treating—Trans., vol. 16, no. 5, Oct. 1929, pp. 183-195 and (discussion) 194-203, 18 figs. Results obtained in attempting to determine effects of some factors of nitriding process on depth hardness curves as shown by Vicker's test; results indicate that heat treatment prior to nitriding is essential to obtain satisfactory toughness and resistance to shock load; decarburization is not necessarily detrimental to nitriding operation; tests made with tantalum to eliminate or reduce hydrogen on surface being nitrided indicate that hardness is decreased thereby.

Special Steels. Influence of Nitrogen on Special Steels and Some Experiments on Case-hardening with Nitrogen, S. Satoh. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 260, 1929, 19 pp., 20 figs. Notes on tests, with current of ammonia gas at 580 deg. cent. and at 560 deg., on electrolytic iron, iron alloys, and specially prepared steels; effects of carbon, chromium, aluminum, titanium, manganese, molybdenum, zirconium, and of uranium; effect of nickel on penetration of nitrogen in electric arc welding. Bibliography.

NOISE

Instruments for Measuring. Determination of Noise Disturbances with Aid of Barkhausen Noise Meters (Pruefung von Geraeuschbelaestigungen mit Hilfe des Geraeuschmessers nach Barkhausen), E. Neitzel. Gesundheits-Ingenieur (Munich), vol. 52, no. 3 , Aug. 10, 1929, pp. 575-577, 2 figs. Acoustic principles of design of so-called noise meters, to serve as guide for policemen in enforcing rules against unnecessary noise; review of studies of Barkhausen, Lewicki, and Tischner; features of Barkhausen noise meter and methods of its use; scale of noise intensities.

NON-FERROUS METALS AND ALLOYS

Annealing. Annealing of Non-Ferrous Metals, J. F. Schrumn. New England Indus. Elec. Heating Conference—Proc., June 1929, pp. 41-42. Selection of sources of heat for annealing of non-ferrous metals and alloys is economic problem and decision made should be based on overall cost of finished product with different forms of heat; experience of large Connecticut company manufacturing non-ferrous tubing, mainly brass and copper; electric furnaces of other mill using counterflow electric recuperative furnace of 150-kw. capacity, etc.; operation and performance data are given.

Research. Volume Changes During the Solidification of Metals and Alloys of Low Melting Point, W. E. Goodrich. Faraday Soc.—Trans., vol. 25, no. 101, Oct. 1929, pp. 531-569, 21 figs. Metals investigated consist of tin, lead, bismuth, and zinc; lead-tin and bismuth-tin alloys; antimony-tin alloys; lead-antimony alloys; tin-antimony-copper and tin-lead-antimony ternary alloys, and some typical zinc-base alloys containing copper and tin and copper and aluminum.

O

OFFICE BUILDINGS

Construction. Confederation Building, Ottawa, Ont. Can. Engr. (Toronto), vol. 57, no. 17, Oct. 22, 1929, pp. 641-644, 4 figs. New office buildings, 9 storeys high with 16-storey tower, being built for Dominion Government, will cost about $2,500,000 and will have floor area for offices of 156,000 sq. ft.; plan of first floor; methods of steel erection, roof construction, etc.

Heightening. Extra Storeys Added to Steel Frame Building, J. G. Allen. Eng. News-Rec., vol. 103, no. 15, Oct. 10, 1929, pp. 574-575, 2 figs. Three-storey steel-frame building of Protective Life Insurance Co. in Birmingham, Ala., has been increased in height to 14½ storeys instead of to 12 as originally planned, through use of light-weight floor and fireproofing; typical details of reinforcing for wind in lower storeys.

OIL ENGINES

Cylinder Pressures. Pressure Effects in Pre-Combustion Oil Engines, J. A. Polson and H. E. Degler. Power Plant Eng., vol. 33, no. 21, Nov. 1, 1929, pp. 1165-1168, 5 figs. Investigation of pressures in Hvid type oil engine discloses conditions affecting power and efficiency; operation of engine; method of conducting tests; diaphragm indicator used for later tests; results and conclusions; several operating charts are given.

ORE TREATMENT

FLOTATION. Minerals and Flotation, B. M. Snyder and R. Lord. Can. Min. Jl. (Gardenvale, Que.), vol. 50, no. 41, Oct. 11, 1929, pp. 961-964 and 971, 1 fig. Brief résumé of responsiveness of various minerals to flotation; information is believed to be of interest to all mill operators.

CYANIDATION. Half a Century of Cyanidation, A. Anable. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 136-141, 190, 192 and 194, 9 figs. Annual world production of gold has almost quadrupled since introduction of cyanide process; essential steps in cyaniding are crushing and grinding, classification, agitation, decantation, percolation, filtration and precipitation; cyanide history from 1887 to 1900, 1900 to 1912, and 1912 to 1929.

OXYACETYLENE WELDING

BRONZE. The Largest Bronze Welding Job in Canada, W. A. Duncan. Can. Machy. (Toronto), vol. 40, no. 20, Oct. 3, 1929, pp. 74-76, 5 figs. Description of repair work made on huge cast-iron shearing press frame of approximately 14 tons weight; job required 1,560 lbs. of bronze welding rod and 45 hrs. of continuous welding; methods of pre-heating; cost figures for complete job are given, showing relative cost between replacement of casting by new one and repair by welding.

P

PAVEMENTS, CONCRETE

EXPANSION JOINTS. Dummy Joints Prevent Cracks in Seattle Concrete Pavements, H. F. Faulkner. Eng. News-Rec., vol. 103, no. 16, Oct. 17, 1929, pp. 607-608, 4 figs. Surveys indicate that transverse dummy joints, which were adopted by city of Seattle as standard construction on concrete pavement three years ago, have almost eliminated cracks; method of construction of dummy joints, using T-bar to make groove, inserting premoulded filler, longitudinal floating over joint; testing continuity over finished dummy joints.

REINFORCEMENT. Reinforcing for Concrete Pavements, B. C. Briody. Can. Engr. (Toronto), vol. 57, no. 15, Oct. 8, 1929, pp. 616-618. Theory and practice in design of reinforcing steel for pavements; expansion and shrinkage of concrete and its effect on slab; frictional resistances to concrete slabs; calculations for design of reinforcement. Bibliography.

PILES

CONCRETE. Concrete Piles Cast Under New High-Pressure System, W. Walls. Compressed Air Mag., vol. 34, no. 10, Oct. 1929, pp. 2897-2898, 4 figs. Casting piles, in place, under air pressure; principal equipment required includes air compressor, casings, and tools commonly employed by well drillers; first length of steel casing is fitted with cutting edge; lengths that make up casing are flush jointed; when firm footing has been struck, hole is carried 2 or 3 ft. deeper and enlarged; subsoil water is removed by air-displacement, cement is introduced under pressure, air at 100 lbs. pressure admitted to compact grout foundation, and pile cast on top of it.

PIPE LINES

LAYING. Modern Pipe Line Construction Methods, E. F. Schmidt. Natural Gas, vol. 10, no. 10, Oct. 1929, pp. 5-7 and 64, 10 figs. Improved construction methods and equipment at lower cost of large lines and reduced time to complete them; advantage of airplane for survey and inspection; mechanized ditching and bandling of materials; organization of labour; welding of pipe line; protective coatings; increased efficiency and lowered accident rates, due to medical examination of applicants before employment.

PIPE, WELDED

TESTING. Tests of Oxwelded Joints in Steel Pipe. Can. Engr. (Toronto), vol. 57, no. 17, Oct. 22, 1929, pp. 649-651, 10 figs. Results of extensive tests made on full-size specimens in all commonly used sizes of pipe; 600-ton testing machine used for tests; types of joints tested; compressive and tensile tests of oxyacetylene welded joints in lap-welded steel pipe. From Dominion Service Tips.

PORTS

QUEBEC. Port Authorities Convention in Quebec. Can. Engr. (Toronto), vol. 57, no. 16, Oct. 15, 1929, pp. 636-638. Report on convention of American Association of Port Authorities; abstracts of papers on tackle vs. cranes, grain-handling equipment, Wolfe's Cove terminals, etc.

CONSTRUCTION, GROUND WATER CONTROL. Lowering Ground-water level in Construction of Port Structures in Antwerp (Le rabattement de la nappe aquifère, les grands travaux du port d'Anvers), P. De Smet. Union des Ingénieurs Sortis des Ecoles Spéciales de Louvain (Brussels), vol. 56, no. 3, Aug. 15, 1929, pp. 53-85, 13 figs. Description of methods of groundwater control in excavation for new marine structures, such as quay-walls and drydocks; use of well-points for draining trenches and foundation pit at various levels.

POWER PLANTS

COMBINED STEAM AND HYDRO-ELECTRIC. Combined Hydro and Steam Power Plants (Die Vereinbeitlichung von hydrokalorischen Verbundbetrieben), M. Seidner. Elektrotechnische Zeit. (Berlin), vol. 50, no. 42, Oct. 17, 1929, pp. 1523-1524. Conditions are outlined by which hydro-electric plants with continuous daily, and annual storage should be combined with steam plants to compound units in order to obtain greater economy and least production costs.

INDUSTRIAL, COST ACCOUNTING IN. Classification of Costs for Industrial Power Plants, W. N. Polakov. Power, vol. 70, no. 15, Oct. 8, 1929, pp. 558-560. Accurate knowledge of power costs is vital to efficient plant management, and necessary to any analysis of manufacturing cost; classification of power-plant expense which should serve as helpful guide in any specific instance; power-plant expense classification.

PULVERIZED COAL

COMBUSTION. Combustion of Pulverized Coal (La Combustion du Charbon Pulvérisé), J. Lacasse. Arts et Métiers (Paris), vol. 82, no. 106, July 1929, pp. 254-260, 11 figs.

Influence of Particle Size on Rate of Combustion of Coal Dust (Einfluss der Korngroesse auf die Entzuendbarkeit von Kohlenstaub), H. Steinbrecher. Archiv. fuer Waermewirtschaft (Berlin), vol. 10, no. 10, Oct. 1929, p. 350.

PUMPING STATIONS

LONDON. The Kempton Park Pumping Station of the Metropolitan Water Board. Engineering (Lond.), vol. 128, nos. 3325 and 3326, Oct. 4 and 11, 1929, pp. 425-427 and 470 and 455-458, 15 figs. partly on supp. plates. Oct. 4: Account of addition consisting of complete pumping plant, and set of primary filters: water is derived from River Thames; arrangements of bunkers and coal and ash-handling plant. Oct. 11: Arrangement of engine house; pumping machinery, constructed by Worthington-Simpson, consists of two vertical triple-expansion engines each of over 1,000 pump hp.; battery of 24 rapid gravity filters is being constructed in reinforced concrete.

PUMPS

SCREW. Testing of Screw Pump with Spiral Casing Made by Deutsche Werke Kiel. A.G. (Beproeving van een schroefpomp met slakkenbuis der Deutsche Werke Kiel A.G.), W. L. H. Schmid. Ingenieur (The Hague), vol. 44, no. 37, Sept. 14, 1929, pp. W.172-W.180, 10 figs. Test results; brief derivation of principal equation for turbine pumps; analogy between characteristics of a turbine pump of various speeds; these can be combined into one uniform characteristic; transformation of kinetic into potential energy in housing; explanation of violent eddying of suction water, etc.

PUMPS, CENTRIFUGAL

EFFICIENCY. Calculations of Efficiency Coefficient of Centrifugal Pumps (Foerutberaekning av verkningsgraden bos centrifugalpumpar), H. O. Dahl. Tecknisk Tidskrift (Stockholm), vol. 59, no. 33, Aug. 17, 1929 (Mekanik), pp. 101-105, 3 figs. Considering different losses in pumps, author shows method of computing efficiency and illustrates its use in four examples.

PROBLEMS. Engineering Problems of Centrifugal Pumps in Thermal Electric and Hydro-electric Plants (Problemi tecnici inerenti alel pompe centrifughe per gli impianti termo ed idroelettrici attuali), M. Medici. Energia Elettrica (Milan), vol. 6, no. 5, May 1929, pp. 469-483, 26 figs. Cavitation and corrosion in boiler feed pumps, turbo-pumps and turbines are discussed; European and American experience reviewed.

PUMPS, ELECTRIC

CONTROL. Variable Speed Control for A.C. Motors Driving Pumps, P. B. Harwood. Power, vol. 70, no. 16, Oct. 15, 1929, pp. 599-601, 3 figs. Two constant-speed and two adjustable-speed pumps are driven by a.c. motors; control on adjustable-speed units automatically gives 16 speeds from flat switch of unique design; two-inch change in water level produces change in speed.

QUALITY CONTROL

BASIC PRINCIPLES. Quality Control and Production Gauges, E. Buckingham. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Dec. 2-6, 1929, no. 7, 8 pp. Basic principles entering into quantity control and use of production gauges; development of interchangeable manufacturing should result in economies; tolerances should be as large as will result in satisfactory operation; drawings and specifications should give tolerances; analysis of data received from manufacturers regarding cost of inspection and percentage of scrapped parts; comments from several manufacturers. Bibliography.

R

RAILROAD OPERATION

STATISTICS, CANADA. Railway Operating Revenues, Expenses and Other Statistics. Can. Ry. and Mar. World (Toronto), Oct. 1929, pp. 612-615. Operating revenues and expenses of specific and all railroads as a group for June, July and first six months of 1928 and 1929.

RAILROAD STATIONS

MONTREAL. Proposed Passenger Station for Montreal. Modern Transport (Lond.), vol. 22, no. 551, Oct. 5, 1929, p. 13, 2 figs. Continued discussion, together with architectural drawings of work involved in construction of new passenger terminus; sectional view of proposed station is also given; track capacity; viaduct construction.

RAILROAD SIGNALS AND SIGNALLING

CENTRALIZED CONTROL. The D. and R.G.W. Expedites Trains by Centralized Control. Ry. Age, vol. 27, no. 15, Oct. 12, 1929, pp. 856-858, 7 figs. Remote switch machines, spring switches, and direction of movements by signal indication assist in eliminating delays; tracks and signal plan of centralized-control system in vicinity of Tennessee Pass; method of operation by signal indication; satisfactory results.

RAILROAD TIES

CONCRETE. On the Question of the Use of Concrete and Reinforced Concrete on Railways, F. B. Freeman. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 11, no. 5, May 1929, pp. 433-445, 8 figs. Respective merits of various designs of reinforced-concrete ties of London, Midland and Scottish Railway; Norfolk and Portsmouth Line; Pennsylvania Railroad and others; reinforced-concrete roadbed of Pere Marquette Railway and New York Central Railroad.

RAILROADS

ONTARIO. Temiskaming and Northern Ontario Railway. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 151-153. Notes on railroad owned by Ontario and operated by Commission; originally built as colonization road to develop agriculture; value of mining areas; pulp and paper; power; coal; scenic and sporting attractions.

INDUSTRIAL DEVELOPMENT, CANADA. The Development Branch of a Railway and How it Works, G. G. Ommanney. Can. Min. Jl. (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 148-150 and 196. Summary of activities of Development Branch of Canadian Pacific Railway Co.; particular attention is given to agriculture, forests, minerals, water power, fisheries and allied industries.

RECLAMATION. The Railroads and Reclamation, J. G. Stuart. Ry. Age, vol. 87, no. 17, Oct. 26, 1929, pp. 977-980, 5 figs. Recovery of discarded material pictured as large field of economy if properly controlled; stores should handle reclamation; quality important; true costs required.

RAIN AND RAINFALL

RUN-OFF. Determination of Run-off Coefficient (Beitrag zur Bestimmung des Abflussbeiwertes bei Regenfaellen), F. Reinhold. Bautechnik (Berlin), vol. 7, nos. 33 and 35, Aug. 2 and 16, 1929, pp. 507-510 and 529-532, 11 figs. Description of experimental lysimeter arrangement at Neufahrwasser near Danzig. Data showing correlation between duration of rainfall and intensities of run-off for various paving materials, also relation between duration of rainfall and run-off coefficient.

REFRIGERATION

EVAPORATING SYSTEMS. The Multi-Feed Multi-Suction Evaporating System, G. Hilger. Ice and Refrigeration, vol. 77, no. 5, Nov. 1929, pp. 344-345, 2 figs. Description of constructive details of new evaporating system for ice-making and refrigerating plants; also description of system installed in large dairy in Pittsburgh; list of applications of system in various parts of country; illustration showing essential features of multi-feed multi-suction evaporating system.

RESERVOIRS

CONCRETE. Methods of Construction of 2,000,000 Gallons Service Reservoir, Hastings, S. Little. Surveyor (Lond.), vol. 76, no. 1968, Oct. 11, 1929, pp. 329-332, 3 figs. Description of new water works; construction of concrete reservoir occupying area of 136 sq. ft., having depth of 18 to 19 ft.; lower half is divided into two compartments by wall 9 ft. high; details of expansion joints; excavation and formworks; testing of concrete. Paper presented before Instn. Mun. and County Engrs.

RIVERS

REGULATION. Regulation of Levels, Flow, and Navigation, Niagara River, G. B. Pillsbury. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2427-2444, 7 figs. Discussion by R. E. Horton, L. L. Davis and T. M. Ripley, of paper published in issue of Sept. 1929; Lake level records of United States

Lake Survey up to 1924 with extension backward from 1859 to 1836; effect of channel deepening at lake outlet control point; prediction of maximum stages; use of storage schedules; operation of regulating works; commerce of Great Lakes; hydraulics of Niagara River; lowering of Lake Erie due to artificial changes.

ROAD CONSTRUCTION

ALBERTA. Improving Highways in Alberta, O. L. McPherson. Can. Engr. (Toronto), vol. 57, no. 16, Oct. 15, 1929, p. 624. Statement by Minister of Highways, reviewing work being undertaken on Jasper highway, Calgary-Edmonton Main Road, etc.; elimination of grade crossings.

ROAD MACHINERY

DEVELOPMENT IN. Road Construction and Maintenance Machinery, G. Marston. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 134-135 and (discussion) 135-136. Author discusses enormous development in road machinery; operation of tiling machine; preparing surfacing materials; maintenance of roads; costs and operation of equipment; standardization of construction equipment; maintenance and repair equipment. Read before Can. Good Roads Assn.

ROAD MATERIALS

TESTING. The Testing of Non-Bituminous Road Materials, R. H. Picher. Can. Department Mines—Investigations (Ottawa), no. 697, 1929, pp. 68-75. Description of test methods; bedrock and boulders; gravel and sand; sampling methods.

ROADS, CONCRETE

RESURFACING. Resurfacing with Concrete, E. H. Bagford. Highway Engr. and Contractor, vol. 35, no. 3, Sept. 1929, pp. 62-63, 5 figs. Resurfacing of 6-mi. section of Dixie highway between Piqua and Troy, Miami county, Ohio, carrying traffic of 3,000 vehicles per day; new resurfacing placed directly over old pavement and divided into 10 by 40-ft. sections, by means of dummy joints, which are 3 in. deep longitudinally and 2 in. deep transversely.

CONSTRUCTION. Modern Trends in Cement-Concrete Highway Construction, H. S. Van Scoyoc. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 141-144 and (discussion) 144-145. Discussion of Hunt process of curing, inundation-plant operation, proportioning and finishing, ready-mixed concrete manufacture, concrete testing, etc.; simpler specifications desirable; dummy joints. Paper read before Can. Good Roads Assn.

ROADS, GRAVEL

MAINTENANCE AND REPAIR. Gravel Highways and Their Treatment, R. W. McColough. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 164-167 and (discussion) 167. Principal operations necessary to maintain serviceable gravel roads; maintenance organization and materials; employment of machinery; blading and dragging; corrugations or ripples; dust layers; application of calcium chloride and common salt. Paper presented before Can. Good Roads Assn.

ROADS, LOW COST

CANADA. Secondary Roads and Their Place in Canadian Highway Development, R. M. Smith. Can. Engr. (Toronto), vol. 57, no. 14, Oct. 1, 1929, pp. 129-132 and (discussion) 032-133. General discussion of construction and maintenance of low-cost roads in Canada such as bituminous penetration pavement, water-bound macadam road, gravel roads, re-tread type of surface; application of bitumen; mulch treatment for gravel roads; Quebec secondary roads; cost of construction.

S

SCREWS

COLD HEADING AND THREAD ROLLING. Cold-Heading and Thread Rolling, F. R. Daniels. Iron Age, vol. 124, no. 16, Oct. 17, 1929, pp. 1027-1028. Characteristics of steel wire best suited to cold heading and thread rolling in making bolts, screws, and rivets are discussed; importanee of adequate drawing; wire finish for bolts, screws and rivets; temper is heavy factor; heat treatment of cold-headed blanks; numerous analyses suitable for cold heading and threading in alloy steel field.

SEAPLANES

DESIGN. Seaplane Design, T. P. Wright and G. A. Luburg. Aviation Eng., vol. 10, no. 2, Oct. 1929, pp. 32-35. Seaplane operation, although confined to sea and waterways, commercially can compete to great extent with that of land plane; requirements for float or hull design, including seaworthiness at rest or at anchor, seaworthiness and stability when under way, low water resistance and absence of suction, clean lines, proper free board and excess buoyancy, and aerodynamic cleanness; arrangements of floats; design of step location, bow, stern, bottom deck, and hydrovanes; structural composite arrangement. Abstract of paper presented before Am. Soc. Mech. Engrs.

LAUNCHING. A Rival to the Catapult. Aeroplane (Lond.), vol. 37, no. 10, Sept. 4, 1929, pp. 653-654, 3 figs. Kiwull Watersail method of launching and picking up seaplanes, which can be used when vessel is under way, is briefly described; Watersail is 98 by 32 ft. expanse of canvas with spreader booms on underside and kind of drogue of wide-mesh netting; plane taxis behind steamer and is run onto trailing runway.

SHEET METAL

TESTING MACHINE FOR. Sheet Metal Testing Machine. Engineering (Lond.), vol. 128, no. 3327, Oct. 18, 1929, p. 497, 4 figs. Tool has been introduced by W. and T. Avery, for testing quality of metal sheets intended for press work, or alternatively for controlling annealing of metal sheets of every description; tester can, if required, be used for mild sheets as much as 10 B.G. thick, but makers recommend that, in general, steel sheets to be tested should not be more than $\frac{1}{16}$ in. thick.

SLABS

CONCRETE. Flat and Corrugated Slabs as New Structural Element of Concrete Construction (Scheiben und Faltwerke als neue Konstruktionselemente im Eisenbetonbau), H. Craemer. Beton u. Eisen (Berlin), vol. 28, nos. 13 and 14, July 5 and 20, 1929, pp. 254-257 and 269-272, 22 figs. Author discusses advantages of self-supporting slabs in construction of bunkers, roofs, floors, walls, etc.

SNOW REMOVAL

ROADS. How the Various States are Handling Their Snow Removal Problems. Roads and Streets, vol. 69, no. 10, Oct. 1929, pp. 378, 380, 384, 386, 388, 390, 398 and 400, 15 figs. Notes on operations in winter of 1928-29 obtained from questionnaire sent to highway departments of states in snow belt.

STREETS. How 73 Cities Are Tackling the Snow Problem. Am. City, vol. 41, no. 5, Nov. 1929, pp. 101-102. Summary of reports from Municipal Officials in charge of snow removal. (To be concluded.)

STEAM CONDENSERS

SURFACE. Alignment Chart for Calculation and Analysis of Surface Condensers (Nomogramm zur Berechnung und Beurteilung von Oberflaechnkondensatoren), H. Kuegne. Waerme (Berlin), vol. 52, no. 37, Sept. 14, 1929, pp. 716-719, 2 figs. Plotting and description of nomogram for direct determination of performance of surface condensers.

Condensing Equipment. Nat. Elec. Light Assn.—Serial Report, Aug. 1929, 35 pp., 33 figs. Study of data received, corrected to common basis of water velocity and inlet water temperature, indicates that performance of single-pass condensers is somewhat better than that of two-pass type; performance of vertical condensers is appreciably better than horizontal condensers with same number of passes; tables and performance data for 15 two-pass and 11 single-pass condensers; leakage resulting from tube vibration has been most effectively remedied by installation of additional tube support sheets and by use of thicker tubes.

STEAM-ELECTRIC POWER PLANTS

DESIGN. Trends in Design of Electric Superpower Plants (Les tendances actuelles dans la construction des supercentrales électriques), L. Le Paige. Revue Universelle des Mines (Liége), vol. 72, nos. 4, 5 and 6, Aug. 15, Sept. 1, and Sept. 15, 1929, pp. 107-111, 144-156, and 173-182, 17 figs. Developments in Europe and United States; capacity of modern plants; fuel economy; guaranteed consumption of modern European turbines from 10,000 to 43,500 kw.; mechanical stokers; economizers and air heaters; boiler equipment; pipe lines; feedwater and water treatment; details of existing plants in United States and Europe.

DETROIT, MICH. New 100,000 Kw. Delray Power Plant Placed in Operation, F. J. Chatel. Power, vol. 70, no. 19, Nov. 5, 1929, pp. 710-715, 6 figs. General description of equipment in new Delray power house No. 3; standard 50,000-kw. units installed; main unit auxiliaries; illustration showing cross-section through boiler house; 15-retort 57-tuyère underfeed stokers.

EVANSVILLE, IND. Ohio River Station. Power Plant Eng., vol. 33, no. 21, Nov. 1, 1929, pp. 1148-1154, 8 figs. New 400-lb. station of Southern Indiana Gas and Electric Co. has initial capacity of 20,000 kw. in two units; steam supplied by two 1,152-hp. boilers fired by underfeed stokers; draft and furnace arrangements give extremely flexible control; coal has equipment enclosed to eliminate dust; cross section through station showing boiler, turbine and auxiliary arrangement; all auxiliary motors operate on 4,400 volts; list of equipment installed in Ohio River station.

STEAM ENGINES

EFFICIENCY. Thermic and Thermodynamic Efficiency Factor of Steam Power Machinery (Thermischer und thermodynamischer Wirkungsgrad von Dampfkraftmaschinen), G. Zerkowitz. V.D.I. Zeit. (Berlin), vol. 73, no. 40, Oct. 5, 1929, pp. 1429-1433, 7 figs. Graphical mathematical analysis.

STEAM HEATING

SATURATED VS. SUPERHEATED STEAM. Superheated vs. Saturated Steam for Heating Systems (Heissoder Sattdampf fuer Heizungsanlagen?), F. Kaiser. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 33, nos. 15, 16, 17 and 18, Aug. 15, 31, Sept. 15 and 30, 1929, pp. 216-218, 233-237, 249-252 and 259-263, 6 figs. Aug. 15: Notes on steam and surface temperatures. Aug. 31: Heat emission from different parts of heating element. Sept. 15: Results of steam measurement in cookers, drying and heating plants, etc. Sept. 30: Comparison of results with other researches; conclusions.

STEAM PIPE LINES

HIGH-PRESSURE. Construction of Steam Pipe Line of 44 Kg. Pressure and 450 Deg. Temperature (Note sur une exécution de tuyauterie de vapeur à 44 kilogrammes et 450 degrés), F. Battestini. Bull. Technique du Bureau Veritas (Paris), vol. 11, no. 8, Aug. 1929, pp. 173-174, 1 fig. Particulars of installation at power plant of Issy-les-Moulineaux, France; fatigue testing of tubes; properties of steel employed; use of welded joints.

Testing of Material Used in Piping for High-Pressure Steam (Essais des matériaux employés dans les canalisations de vapeur à température élevée), L. Guillet, J. Galibourg and M. Samsoen. Revue Générale de l'Electricité (Paris), vol. 26, no. 15, Oct. 12, 1929, pp. 577-580, 3 figs. Elasticity meter, which is used for keeping temperature of test piece constant at 450 deg. cent., is described; results of tensile-strength tests on nickel and chromium-nickel steels.

STEAM POWER PLANTS

HIGH-PRESSURE. Initial Costs of Power Plants Compared on a Pressure Basis. Power Plant Eng., vol. 33, no. 21, Nov. 1, 1929, pp. 1158-1162, 8 figs. Estimates and actual costs show that additional expense of high pressure ranges from $5 to $10 per kw. of capacity higher than for moderate pressures; analysis shows why higher pressure does not greatly increase total cost; relative costs of various parts in steam and electric generating stations, as prepared by Edison Electric Illuminating Co. of Boston; comparison of cost of following stations: Toronto, Deepwater, Lakeside, Holland, and Northeast.

High-Pressure Steam Installations in Austria (Hochdruck-Dampfanlagen in Oesterreich), P. Swiauer. Elektrotechnik u. Maschinenbau (Vienna), vol. 47, no. 36, Sept. 8, 1929, pp. 772-775. Development in high-pressure steam practice and equipment since 1924; tabulation of high-pressure boiler installations classified according to industries where used; year of installation; data regarding capacities and size.

STEAM TURBINES

HIGH-PRESSURE. Efficiencies of High-Pressure Steam Turbines, I. Melan. Power Plant Eng., vol. 33, no. 20, Oct. 15, 1929, pp. 1111-1112, 3 figs. Investigation of high-pressure turbine tests leads to conclusion that turbine efficiencies are function not only of Parsons characteristic but of weight of steam going through turbine as well; test data on various turbine units operating under wide range of steam conditions. From Siemens-Zeit.

LOSSES. Expansion of Saturated Steam in Steam Turbines (Die Entspannung von Nassdampf in der Dampfturbine), G. Zerkowitz. Archiv. fuer Waermewirtschaft (Berlin), vol. 10, no. 8, Aug. 1929, pp. 271-274, 3 figs. Thermodynamic loss does not occur with formation of large drops, but a flow loss does occur as water drops remain behind steam particles; taking into consideration fact that steam particles along upper boundary expand considerably, simple rules for efficiency loss are obtained.

TESTING. Consumption Tests on Steam Turbines and Influence of Different Factors on their Performance (Essais de consommation des turbines à vapeur et influence de différents facteurs sur leur fonctionnement), M. Hentsch. Science et Industrie (Paris), vol. 13, no. 182, Mar. 1929, pp. 161-165, 14 figs. Notes on condensation and bleeder turbine; definition of efficiency coefficient; variation of pressure at intermediate › oints, etc.

STEEL

AGE HARDENING. The Effect of Aging and Blue-Brittleness on the Toughness of Low-Carbon Steel, A. Kuehle. Metals and Alloys, vol. 1, no. 4, Oct. 1929, pp. 172-175, 11 figs.

Embrittlement. Embrittlement of Steel (Sur la fragilité des aciers), G. d'Huart. Science et Industrie (Paris), nos. 188 and 189, Sept. and Oct. 1929, pp. 559-569 and 636, 58 figs.

Quenching. Hot Aqueous Solutions for the Quenching of Steels, H. J. French and T. E. Hamill. U.S. Bur. Standards—Research Paper, vol. 3, no. 103, Sept. 1929, pp. 399-418, 13 figs.

STEEL FOUNDRIES

Production Control in. Production Control in Steel Foundry, R. A. Fiske. Iron Age, vol. 124, no. 16, Oct. 17, 1929, pp. 1029-1033, 11 figs. partly on supp. plate. Factors which have enabled Sivyer Steel Casting Co., Milwaukee, to keep close control of orders and materials in process, and to forward unusually high percentage of orders on dates scheduled are discussed; accurate checks on materials and plant methods used with frequent inspections and daily "pow-wow" to meet specifications and scheduled delivery dates; old patterns studied before again being sent into shop; shipping schedules discussed at production meetings; records disclose past difficulties.

STRUCTURAL STEEL

Arc Welding. Arc Welding of Steel Frame Structures, M. D. Fish. New England Indus. Elec. Heating Conference—Proc., June 1929, pp. 25-30, 5 figs. Economic side of welded construction; ways in which cost savings may be, and sometimes are, accomplished are pointed out; outstanding difficulties which are temporarily obstructing fair cost comparisons are explained; construction features having special economic significance are illustrated.

SURVEYING

Traverses. Adjustment of Transit and Stadia Traverses, H. S. Rappleye. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 9, Nov. 1929, pp. 2301-2305, 1 fig. Paper presents problem of adjusting transit and stadia traverses, by correcting lengths only, and sets forth simple method of applying theory of least squares.

SEWAGE DISPOSAL

Stream Flow Aeration. Sewage Treatment by Stream-Flow Aeration, H. N. Jenks and M. Levine. Water Works and Sewerage, vol. 76, no. 9, Sept. 1929, pp. 381-386, 5 figs. Improvement in activated-sludge method based on application of stream-flow principle; contrasts and similarities in aerobic sewage treatment; engineering design of stream-flow reaeration; effect of recirculation on retention period; pumping equipment; plant-operating data; efficiency; effect of biologic staging; power requirements; cost of construction. From Pub. Health Report.

Activated Sludge. Activated Sludge Plant Operation in Great Britain, A. S. M. Parsons. Water Works and Sewerage, vol. 76, no. 9, Sept. 1929, pp. 397-399. In attempting to deal with difficulties encountered in activated-sludge plant of Reading Corporation writer was forced to conclusion that many empirical rules of operation are not applicable, and that process is not simply biological; experiment proving that aeration is not essential; carbonaceous fermentation; direct cell action; experience on percolating beds; stages of activated-sludge process.

Sedimentation. Sedimentation of Sewage, A. M. Kivari. West. Construction News, vol. 4, no. 19, Oct. 10, 1929, p. 512. Discussion of principles of sedimentation of sewage in sewage disposal plants; relationship between settleable and suspended solids and biochemical-oxygen demand. Paper presented before Sanitary Engineering Section, University of Southern California.

Aeration. Aerating Sewage, J. L. Mason. West. Construction News, vol. 4, no. 19, Oct. 10, 1929, pp. 523-525, 2 figs. Principles, historical development and present-day practice of activated-sludge process; description of Watsco aerator, invented by F. V. Hammerly, consisting of direct-connected, semi-displacement, screw-type pump, discharging downward through venturi throat; suction produced by flow through restricted throat draws air into sewage stream; results of recent tests of Watsco aerator installation at Montezuma, Calif.

SEWAGE DISPOSAL PLANTS

Operating Costs. Cost of Sewage Works Operation, C. E. Keefer. Water Works and Sewerage, vol. 76, no. 10, Oct. 1929, pp. 423-424. Data for treatment plant of Baltimore, Md.; interest and depreciation charges; calculating depreciation; operation and maintenance charges; cost of sewage treatment at Baltimore per capita per year for 1921 to 1928, including cost of operating treatment units; personnel of Baltimore sewage works. From Sewage Works Jl.

Germany. The Emscher-Type Sewage Disposal Plant at Karnap near Essen (Die Emscher-Klaeranlage bei Essen-Karnap), M. Pruess. Gesundheits-Ingenieur (Munich), vol. 52, nos. 35, 36, and 37, Aug. 31, Sept. 7, and 14, 1929, pp. 615-620, 630-636 and 647-651, 41 figs. General discussion of sewage-disposal problems of Emscher Union of Municipalities; significance of work of Union for area served and particularly for protection of Rhine from pollution with phenol waste; description of very large sewage disposal plant having average daily capacities of 850,000 cu. m. and producing annually 250,000 tons of sludge containing 50 per cent of water; method of flood utilization; total cost over 3,000,000 marks.

SEWER SIPHONS

Design. Experience in Construction of Siphon Sewers (Erfahrungen beim Bau von Abwasserdueckern). H. Rossberg. Gesundheits-Ingenieur (Munich), vol. 52, no. 30, July 27, 1929, pp. 550-555, 3 figs. Comparison of old-fashioned and modern types of design in light of experience of sewer department of Leipzig; design and construction of new type siphon 1.2 m. in diam. under Elster River, in Leipzig, and reconstruction of old type sewer in Leipzig.

SEWERS

Design. Modern Construction of Sewers Greatly Increases Carrying Capacity, F. C. Scobey. Hydraulic Eng., vol. 5, no. 10, Oct. 1929, pp. 18-20 and 45-46, 3 figs. Discussion of elementary principles and formulae used in hydraulic design of concrete sewers; author states modern conduit will carry from 30 to 50 per cent more water, size for size, shape for shape, slope for slope, than was feasible 30 or 40 years ago. Abstract of paper presented before Univ. of South. Calif. short course.

T

TORSION TESTING

Foettinger Torsionmeter. The Foettinger Torsionmeter. Engineering (Lond.), vol. 128, no. 3328, Oct. 25, 1929, pp. 542-543, 2 figs. Indicator rotates with shaft and its dial, being brightly illuminated by proper shaded electric lamp which moves with it; there is, it is stated, no difficulty whatever in taking readings whether shaft be running fast or slow; sleeve disc and drum are all made of aluminum so that even largest sizes of torsion meter is of moderate weight; it is made in nine standard sizes.

TRACKLESS TROLLEYS

Double-Decked, Top-Covered. Trackless Trolley Extension and Modernized Tramcars, R. A. Fernley. Elec. Ry. Bus and Tram Jl. (Lond.), vol. 61, no. 1523, Sept. 20, 1929, pp. 193-195, 4 figs. Description of new double-deck top-covered trackless trolleys with seating capacity for 60 persons, which were manufactured by Richard Garrett and Sons, and are employed on Southend trolley omnibus route; overhead line construction.

TRANSPORTATION

Canada. The Development of Travel in the Canadian North, R. C. Rowe. Can. Min. Jl., (Gardenvale, Que.), 50th anniversary no., Aug. 1929, pp. 155-157 and 194. Review of development of transportation methods; recent accomplishments in airplane travel are featured.

TUBES

Seamless, Manufacture of. Germany Extruding Seamless Tubes of Stainless Steel, W. Trinks. Iron Age, vol. 124, no. 18, Oct. 31, 1929, p. 1160. Marked development in making of seamless tubes in Germany discussed; Mannesmann Tube Co. extrudes seamless tubes up to 3-in. in diam. of stainless steel; several expanding mills being developed; Mannesmann Co. has mill similar to Stiefel expanding mill but uses tension mandrel; new piercing mill; rolling from large hollow ingots. Abstract of paper presented before Am. Soc. Mech. Engrs.

TUNNELS, RAILROAD

Maintenance and Repair. Unusual Methods Used in Repair of Roof Girders in Street Underpass, H. T. Welty. Eng. News-Rec., vol. 103, no. 17, Oct. 24, 1929, pp. 642-643, 2 figs. Method of repairing roof of New York Central Railroad tunnel, under Brook Ave., Bronx, N.Y.C.; dead-load stress placed on new cover plates by torch heating prior to arc welding; details of girders reinforced by new arc-welded cover plates; features of special car equipment used.

TUNNELS, VEHICULAR

Detroit. The Detroit-Canada Vehicular Tunnel. Eng. News-Rec., vol. 103, no. 16, Oct. 17, 1929, pp. 600-606, 16 figs. Construction of tunnel under Detroit River between Detroit and Windsor, Ont., 5,135 ft. long from portal to portal, carrying two 14-ft. roadways, headroom 13.5 ft.; steel-lined reinforced-concrete segments of subaqueous portion, which is 2,454 ft. long, were fabricated on land, towed out and sunk in dredged trench on bottom of river; details of joints between subaqueous segments; shield-driven tunnel design and construction.

V

VIADUCTS, CONCRETE

Construction. Washington Highway Has Heavy Grading for Viaduct, W. A. Scott. Highway Engr. and Contractor, vol. 35, no. 3, Sept. 1929, pp. 43-47, 12 figs. Methods used in construction of Washington State Highway between Vancouver and Maryhill; drilling and blasting, truck haulage of rock, etc.; details of location, design and construction of Cape Horn viaduct consisting of twelve 34-ft. spans, supported by thirteen 3-column concrete bents, costing $110,000.

W

WALLS

Brick, Testing. Compressive Strength of Clay Brick Walls, A. H. Stang, D. E. Parsons and J. W. McBurney. U. S. Bur. of Standards—Jl. of Research, vol. 3, no. 4, Oct. 1929, pp. 507-571, 35 figs. Results are given of compressive tests of 168 brick walls, each 6 ft. long and about 9 ft. high and of 129 wallettes, about 18 in. long and 34 in. high; four kinds of brick, 3 mortar mixtures, 2 grades of workmanship, different curing conditions and 10 different types of masonry (3 solid and 7 holow) were variables; construction data are given which show relative saving in materials and time for hollow types; results of wallette tests confirm, in general, conclusions deduced from wall tests.

Concrete. Modern Concrete Walls (Tidsenliga betongvaggar), T. Bilde. Tecknisk Tidskrift (Stockholm), vol. 59, no. 18½, May 8, 1929, pp. 273-277, 10 figs. Description of fireproof, heat and sound-insulating walls of celluar cellular concrete; experiments with concrete brick with trade names, "gas concrete," "pool stone," and "Nopsa system"; table showing heat-insulating properties of different building materials.

WATER FILTRATION

Wash Water. A New Index for Determining Wash-Water Rates in Rapid Filters. Eng. News-Rec., vol. 103, no. 18, Oct. 31, 1929, pp. 696-698, 4 figs. Investigator of Detroit Water Department finds sand expansion is better than wash-water rise as criterion of effective cleaning; graphical charts for determination of loss of head, wash-water velocity required to expand various sands, etc.; benefits derived by varying wash-water rates with changes of water temperatures.

WATER FILTRATION PLANTS

Ottawa. Experimental Filter at Ottawa. Can. Engr. (Toronto), vol. 57, no. 19, Nov. 5, 1929, p. 686. Information obtained from operation of experimental filters; colourless, tasteless, and sparkling water assured; only alum used as coagulant; 90 per cent of floc will settle in sedimentation tanks and filters will remove remaining ten per cent; filtration requires only one-fifth present quantity of chlorine; corrosive action will be corrected by addition of two grains of lime per gallon.

WATER PIPE LINES

Welding. Electrically Welded Pipe Lines, S. Martin, Jr. Am. Water Works Assn.—Jl., vol. 21, no. 9, Sept. 1929, pp. 1117-1141 and (discussion) pp. 1141-1152, 8 figs. Comparison of riveted with welded pipe; results of preliminary tests to determine proper welding procedure to give reliable and uniform results; operation in manufacture of welded pipe; tentative set of specifications for procedure control for welding inspection and test of welded pipe.

WATER PURIFICATION

Odour and Taste. Improving the Odour and Taste of Potable Water (Verbesserung des Geruchs und Geschmacks von Trinkwasser), F. Sierp. Technisches Gemeindeblatt (Berlin), vol. 32, nos. 11 and 12, June 5 and 20, 1929, pp. 153-156 and 165-169. Review of results of recent studies made in United States, Great Britain, and Germany on tastes and odours caused by algae, fungi and phenol substances; methods of control.

Valuable Report. A Valuable Report, Metropolitan Water Board, London, N. J. Howard. Contract Rec. (Toronto), vol. 43, no. 34, Aug. 21, 1929, pp. 969-970. Report contains statistical data and information on results of purification methods; over 5,481,000,000 gals. of water received treatment of ammonia and permanganate of potash before chlorination at total cost of 46 cents per 1,000,000 gals.; details of bacteriological researches are given: tables of hydraulic equipment and conversion.

WATER SOFTENING

Marion, Ohio. Operating Experiences with a New Water Softening Plant at Marion, Ohio, M. E. Flentje and C. Whysall. Hydraulic Eng., vol. 5, no. 9, Sept. 1929, pp. 13-15 and 43, 1 fig. Plant described is unusual because of extreme hardness of water being treated; use of all-steel construction above ground; application of double carbonation to produce effluent of low alkalinity.

Zeolite Process. Softening Municipal Water Supplies, J. T. Campbell and D. E. Davis. Am. Water Works Assn.—Jl., vol. 21, no. 8, Aug. 1929, pp. 1035-1053, 3 figs. Comparative annual cost estimates for lime-soda vs. zeolite softening; design features of zeolite softener; operating procedure adopted at Ohio Valley Water Company; cost of zeolite softening plant; water softening at Sweickley, Pa. Paper presented before San Francisco Convention.

WATER SUPPLY

Vancouver. Development of Mountain Lake Reservoirs, W. H. Powel. Eng. Jl. (Montreal), vol. 12, no. 9, Sept. 1929, pp. 483-498, 14 figs. Results of experiments and experience with development of water supply system for Vancouver.

WATER SUPPLY ENGINEERING

Great Britain. British Rainfall, Water Consumption and Water Treatment, M. N. Baker. Eng. News-Rec., vol. 103, no. 13, Sept. 26, 1929, pp. 497-500. Notes on recent drought, with summaries of per capita water consumption, methods of water purification in use, etc.; rainfall and runoff of River Thames for 26 seasonal years 1903-1904 to 1928-29 inclusive; treatment of highly polluted water for compensation purposes at Sheffield.

WATER SUPPLY, SURFACE

Canada. Arctic and Western Hudson Bay Drainage. Canada Department of Interior—Water Resources Paper (Ottawa), no. 57, 1929, 224 pp. Results of hydrometric investigations in provinces of Alberta, Saskatchewan, Manitoba, and that portion of Ontario drained by Nelson River for climatic year ending September 30, 1927. See also Engineering Index 1928, p. 1975.

WATER TREATMENT

Ontario. Water Treatment Problems in Ontario and How They Were Solved, A. V. Delaporte. Contract Rec. (Toronto), vol. 43, no. 42, Oct. 16, 1929, pp. 1235-1236. Paper presented before Am. Water Works Assn., previously indexed from Can. Engr., July, 1929

Innovations in Water Treatment, A. V. Delaporte. Water Works and Sewerage, vol. 76, no. 9, Sept. 1929, pp. 390-391. Paper previously indexed from Can. Engr., July 9, 1929.

Taste and Odour Removal. Various Methods for the Removal of Tastes and Odours, L. B. Harrison. Water Works Eng., vol. 72, no. 23, Nov. 6, 1929, pp. 1621-1622, 1 fig. Tastes and their causes; superchlorination and dechlorination; chlorine-ammonia treatment: permanganate-chlorine treatment; activated carbon.

Disinfection. Two Laws of Drinking-Water Purification (Zwei Gesetze der Trinkwasserreinigung), N. Malischewski. Gesundheits-Ingenieur (Munich), vol. 52, no. 32, Aug. 10, 1929, pp. 569-571, 1 fig. On basis of American (Ohio River basin) and Russian practice data, author derives equation correlating bacterial contents of raw and filtered water from same source of supply, and concludes that repetition of same process of purification produces better results than more intensive one-time use of process.

WATER WORKS

Operation, Canada. The Operation of a Waterworks System, W. E. MacDonald. Contract Rec. and Eng. Rev. (Toronto), vol. 43, no. 34, Aug. 21, 1929, pp. 966-968. Maintenance problems discussed are: appurtenances inspection; maintenance of fire hydrants; valves and meters; prevention of electrolysis; regular and systematic survey for detection of leaks; thawing of frozen services; and finally, efficient handling of all general and emergency repairs to system throughout 24 hr. each day.

The Operation of a Waterworks System, W. E. MacDonald. Contract Rec. (Toronto), vol. 43, no. 30, July 24, 1929, pp. 863-865.. Paper presented before Am. Water Works Assn., previously indexed from Can. Engr., July 9, 1929. (To be continued).

Leak Surveys, San Francisco. Leak Surveys of the Spring Valley Water Company, V. E. Perry. Am. Water Works Assn.—Jl., vol. 21, no. 8, Aug. 1929, pp. 1010-1012. Results of 1913 and 1924 leak surveys in San Francisco, using aquaphone for testing and following up with visual inspection of all premises where leaks were reported; in 1924 publicity campaign was adopted and proved very effective; table giving number of services in use, surveyed, and found wasting; also amont of work performed per man per hour in both surveys.

WEIRS

Discharge. New Method of Computing Discharge over Weirs from Velocity Distribution in Nappe over Weir Crest (Neues Berechnungsverfahren fuer den Abfluss an Wehren aus der Geschwindigkeitsverteilung des Wassers ueber der Wehrkrone). Bautechnik (Berlin), vol 7, no. 37, Aug. 27, 1929, pp. 575-582, 28 figs. Critical review of accepted formulae; report on experimental studies made at Hydraulic Laboratory of Danzig Institute of Technology, including cases of complete and partial submergence; theoretical conclusions and formulae derived from experimental studies.

Automatic. Automatic Roof Weirs Used for Reservoir Control on Guadalupe River, E. L. Chandler. Eng. News-Rec., vol. 103, no. 18, Oct. 31, 1929, pp. 685-688, 5 figs. Texas Power Corp. uses Huber and Lutz patented crest gates similar to beaf-trap flood gates at three power plants in southern Texas; method of construction, structural details and details of operating mechanism.

Aprons. Bligh's Formula for Computation of Thickness of Aprons at the Foot of Weirs (Zu Blighs Formel fuer die Flutbettstaerke), E. A. Samarin. Bauingenieur (Berlin), vol. 10, no. 27. July 5, 1929, pp. 481-482, 1 fig. Discussion of formula given in W. Bligh's Practical Design of Irrigation Works, pointing out hidden coefficient of safety and suggesting modification of formula for more precise computation.

Flow. Distribution of Velocity in Nappe over Weir Crest (Die Geschwindigkeitsverteilung im Strahle ueber einer Wehrkrone), R. Winkel. Bautechnik (Berlin), vol. 7, no. 28, June 28, 1929, pp. 438-439, 3 figs. Results of experimental study in hydraulic laboratory of Danzig Institute of Technology; flow over rounded weir crests with heads varying from 8.7 cm. to 19.2 cm.

Measurements. Hydraulic Measuring Stick, J. B. Lippincott. West. Construction News, vol. 4, no. 16, Aug. 25, 1929, pp. 424-428, 5 figs. New device is described for measuring water over free-flowing and submerged weirs without necessity for stilling basins, or considering velocity of approach or other variable factors.

WELDING

Electric. *See Electric Welding, Arc.*

WELDING MACHINES

Operations on. Cutting and Welding Steel Parts to Replace Castings. W. J. Buchanan. Am. Welding Soc.—Jl., vol. 8, no. 9, Sept. 1929, pp. 61-70, 14 figs. List of wide variety of production jobs that can be performed on welding machine; operations required for various machinery parts are described.

WELDS

Metallographic Study of. A Metallographic Study of Some Metallic Arc Welds, H. M. Boylston, A. Jenkin, and J. C Carpenter. Am. Welding Soc.—Jl., vol. 8, no. 9, Sept. 1929, pp. 26-47, 27 figs. Experiments described, deal with variables which affect structure of weld; in addition, metallographic examination, physical tests, and bend tests were made from which allowable working stress has been calculated by Kinzel formula; experiments were confined to 6 different welding conditions. Bibliography.

Testing. Welding Society Considers Methods of Testing. Eng. News-Rec., vol. 103, no. 12, Sept. 19, 1929, pp. 463-466, 4 figs. See editorial comment Research and Confidence on p. 441. Stethoscope, X-rays and electric currents considered for non-destructive examinations of welds at annual meeting of American Welding Society; Sperry method of electrical inspection; Union Carbide and Carbon method of inspecting welds with stethoscope and hammer; results of tests for carbonization of welds; new strain-measuring instruments by J. Hammond Smith; pipe-line welding costs.

WIND POWER

Utilization of. Rational Utilization of Wind Power (L'utilisation rationnelle de la puissance du vent), M. Neu. Société Française des Electriciens—Bul. (Paris), vol. 9, no. 94, June 1929, pp. 570-574. Advantages and disadvantages; wind motors manufactured in Germany and France; equipment in existence and planned installation of 6,000 kw. in Leipzig; production of electric power by means of wind power.

WIND TUNNELS

Motor Control for. Motor Control for Wind Tunnel, W. A. Lewis. Am. Inst. Elec. Engrs.—Jl., vol. 48, no. 9, Sept. 1929, pp. 686-691, 8 figs. Wind tunnel for testing model airplanes and their parts requires accurate control of air velocity; describes tunnel having electric drive for producing air movement and explains system of control, which allows wide range of speeds and holds speed very constant at any set value; either hand or automatic regulation may be employed; hand control is used for fairly constant speed while automatic control gives very close regulation.

WIRE ROPE

Lubrication. Selection and Use of Wire Rope Lubricant, C. D. Meals. Can. Machy. (Toronto), vol. 40, no. 21, Oct. 17, 1929, pp. 74-75 and 77-79, 1 fig. Discussion of why lubrication is necessary for wire rope; selection of lubricant; classification of wire ropes into five classes; hoisting ropes for high speed work; application of lubricant; frequency of lubrication.

The Selection and Application of Wire Rope Lubricant, C. D. Meals. Iron and Steel of Canada (Gardenvale, Que.), vol. 12, no. 7, July, 1929, pp. 183-184, 1 fig. Article previously indexed from Eng. and Min. Jl., June 28, 1929.

Strength of. The Strength of Wire Ropes. Metallurgist (Supp. to Engineer, Lond.), Aug. 30, 1929, pp. 120-121. Review of tests by R. Woernle in which various types were compared in regard to their endurance under similar treatment, that is, on basis of number of times they would stand bending operation of specified type before failure; effects investigated were those of radius of pulley-groove, lay of rope, loading diameter of wires, strength of material; measurements were made of elongation of ropes by usage, and data were obtained regarding reduction in carrying capacity of ropes to enable period of useful life to be judged from number of reversals of bending.

WOOD BENDING

Precautions in. Wood Bending, T. R. C. Wilson. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Oct. 16-18, 1929, 7 pp., 9 figs. This paper which is based on studies at Forest Products Laboratory, deals only with requirements of bending apparatus and manipulation, emphasizes their importance, and points out that they must be correct before large breakage losses incurred in bending of wood can be reduced materially.

WOOD PRESERVATION

Bakelizing. New Process for Perfectioning of Wood, Bakelization (La Bakélisation), M. Texier. Société des Ingénieurs Civil de France—Bul. (Paris), vol. 82, no. 34, Mar.-Apr. 1929, pp. 277-281. General properties of wood and various process for its improvement for industrial use; bakelization process and properties of wood so treated compared with original wood is shown in tables and curve; test report of insulator pin of bakelized wood; use of bakelized wood in electric-line construction.

Z

ZINC INDUSTRY

Canada. Zinc in Canada. Metal Industry (Lond.), vol. 35, no. 13, Sept. 27, 1929, pp. 302-303. 1 fig. Rouyn district of western Quebec will be important producer of zinc; Tetreault mine near Notre Dame des Anges; zinc-lead field of central Gaspé; Stirling mine in Nova Scotia; Canadian zinc statistics 1898 to 1928 shown; north-west territories. (Concluded,) Paper presented before Am. Zinc Inst.

ZINC METALLURGY

Tainton Process. Progress in Zinc Electrolysis with Special Reference to the Tainton Process (Ueber Fortschritte auf dem Gebiete der Zinkelektrolyse unter besonderer Beruecksichtigung des Tainton-Verfahrens), G. Eger. Metall und Erz (Berlin), vol. 26, no. 15, Aug. 1, 1929, pp. 373-383, 12 figs. Evolution of zinc electrolysis; features of Tainton process; experimental Tainton plants established in United States; description of large scale plant at Kellogg, Idaho, visited by author; present data practice of Tainton process, its economic value.

ZINC MINES AND MINING

Canada. Zinc in Canada, C. Camsell. Metal Industry (Lond.), vol. 35, no. 9, Aug. 30, 1929, pp. 204-207, 1 fig. Abstract of report prepared for Canadian Department of Mines and presented before Am. Zinc Inst., previously indexed from latter's Journal May and June, 1929. (To be concluded.)

ZINC ORE TREATMENT

Electrolytic. World Developments in Electrolytic Zinc, A Zentner. Min. and Met., vol. 10, no. 275, Nov. 1929, pp. 526-531, 1 map and 2 figs. Historical review; production statistics; development in United States, Canada, Mexico, Peru, England, Norway, Russia, Poland, France, Italy, Germany, Africa, and Australia; electrolytic processes; markets; electrothermic smelting of zinc ores in Norway.

Electrolytic, Montana. Electrolytic Zinc Practice at Great Falls and Anaconda, A. E. Wiggin and R. B. Caples. Eng. and Min. Jl., vol. 128, no. 8, Aug. 24, 1929, pp. 319-324, 6 figs. Great Falls plant described by Laist, Frick, Elton and Caples in Am. Inst. Min. Engrs., Trans., vol. 64, 1921; process and equipment are fundamentally same, with improvements to better recoveries and lower costs; flow sheets and description of present practice at each plant.

ZINC PROPERTIES

Data. Physical Constants of Zinc, E. A. Anderson. Am. Soc. for Steel Treating—Trans., vol. 16, no. 6, Nov. 1929, pp. 811-814. Data on atomic weight; atomic number; electrochemical equivalent; crystal structure; allotropy; melting point; boiling point and vapour pressure; latent heats of fusion and vaporization, specific heat; specific gravity; electrical and thermal conductivities; coefficient of expansion; transmission of sound; optical properties; surface tension; magnetic susceptibility; mechanical properties. Bibliography. Recommended Practice Committee Release.

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A

AIRPLANE PROPELLERS

Testing. Tests of Five Metal Model Propellers With Various Pitch Distributions in a Free Wind Stream and in Combination With a Model Ve-7 Fuselage, E. P. Lesley and E. G. Reid. Nat. Advisory Committee for Aeronautics—Tech. Report, no. 326, 1929, 18 pp., 20 figs.

AIRPLANES

Fuselages, Manufacture of. Chromium-Molybdenum-Steel Tubing Fuselage Construction, J. H. Kindelberger. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 474-477, 6 figs. Reason why pilots, operators, maintenance men, designers, and manufacturers prefer welded steel to stick and wire construction for airplanes; molybdenum steel developed to make stronger struts possible; strength and reliability of welds depends on designing joints that can be welded without overheating any parts; complicated fittings should be made up into subassemblies; jigs for welding airplane assemblies, including fixtures for drilling holes in assembled frame; measures taken to prevent corrosion.

Performance Testing. Efficiency Data of Some Airplanes (Wirtschaftlichkeitszahlen einiger Flugzeuge), P. Rieppel. V. D.I. Zeit. (Berlin), vol. 73, no. 42, Oct. 19, 1929, pp. 1513-1516. Factors experimentally determined under certain condt ions and in straight flying for some German and American airplanes are explained and tabulated.

Wings, Cantilever, Torsion in. Some Aspects of Torsion in Multispar Cantilever Wings. Air Corps information Cir. vol. 7, no. 627, Aug. 1, 1929, 7 pp., 14 figs. Report based on study in connection with investigation of torsional stresses in propeller blades; excentric torsion; torsion in spars of multispar wing; application to Fokker C-2; torsional properties of wing skin; single spar at same weight and strength in bending is considerably stronger and more rigid torsionally than multispar; most favourable location of single spars is at distance from leading edge equal to 25 per cent of chord; most economical cross section is square.

AIRPORT RUNWAYS

Analysis. Airport Surfaces, C. N. Conner. Eng. News-Rec., vol. 103, no. 22, Nov. 28, 1929, pp. 855-858, 6 figs. Analysis of factors affecting selection and design of airport surfaces; airport loading; characteristics of various low-type and high-type airport surfaces; examples from American and European practice. Paper read before Am. Road Bldrs.' Assn. Airport Conference.

AIRPORTS

Camden, N.J. Central Airport, Camden, N.J. Aero Digest, vol. 15, no. 4, Oct. 1929, pp. 118 and 120, 2 figs. Description of Central airport which occupies site of 350 acres, about 200 of which are used in connection with flying operations.

Construction, Chicago. Another Great Airport for Chicago, J. F. Peaslee. Earth Mover, vol. 16, no. 11, Nov. 1929, pp. 7-9, 4 figs. Methods of grading, involving million cubic yards, in construction of new large airport at Glen View near Chicago.

Planning. Underground Hangar Arrangement for Future Airports, H. W. Corbett. Aero Digest, vol. 15: no. 3, Sept. 1929, pp. 96, 352 and 354, 2 figs. Plan is given for landing fields with hangars, repair shops, waiting rooms, pneumatic mail tubes, rail and motor approaches, hotels, and all mechanical necessities underground, so as to be absolutely free of any and all obstacles; conical shaped field proposed; entry into hangar would be made through score or more of trap-door arrangements operated by observer stationed at peak of cone; periscope observation roof; value of pneumatic tubes for air mail between post office and airport; advantages of this design of airport.

AIRSHIP PLANTS

Construction. Weighted Cables Raise 360-Ton Arches in Airship Dock. Eng. News Rec., vol. 103, no. 23, Dec. 5, 1929, pp. 874-878, 10 figs. Editorial comment on p. 872. Framework of Goodyear-Zeppelin airship factory and dock at Akron (Ohio) airport; building is semi-ellipsoid formed by series of 13 arch trusses of 325-ft. span, 198½ ft. high; counterweight and locomotive crane combination used in erecting framework of spherical doors; falls from traveller and fixed stiff-leg derricks were utilized.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Bearing Metals. *See Bearing Metals.*
Brass. *See Brass.*

ALUMINUM ALLOYS

Corrosion. Corrosion of Aluminum Alloys in Superheated Steam (La corrosion des alliages d'aluminium dans la vapeur d'eau surchauffée), L. Guillet and Ballay. Métallurgie et Construction Mécanique (Paris), no. 44, Nov. 2, 1929, p. 17. Study of mechanical effects of corrosion; comparison of corrosion of pure aluminum and of three alloys by superheated steam. Read before Académie des Sciences.

Properties. Service Characteristics of Light Alloys, E. H. Dix, Jr. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 463-468 and (discussion) 468. Discussion of aluminum and magnesium, in their pure and alloyed states, as most suitable for aircraft construction, physical properties; effects of adding small quantities of alloying elements; heat treating for increasing strength per unit weight of alloys; effect of natural aging and artificial aging at elevated temperatures and of quenching in hot and cold water after heat-treating; several types of corrosion; protection afforded to aluminum alloys by surface coating of pure aluminum.

Protective Coatings. Some Recent Developments in Protective Coatings for Aluminum and Its Alloys, H. Sutton. Metal Industry (Lond.), vol. 35, no. 18, Nov. 1, 1929, pp. 411-412 and (discussion) 412-414.

AMMONIA COMPRESSORS

Trouble Location. Locating the Obstruction in a Clogged Line of the Compressor J. Rathbun. Indus. and Eng. Chem., vol. 21, no. 12, Dec. 1929, pp. 1200-1208. Examples of various troubles with refrigeration systems in different plants and means for overcoming difficulties.

ANTI-KNOCK COMPOUNDS

Tetraethyl Lead. Gaseous Explosions, M. Souders and G. G. Brown. Indus. and Eng. Chem., vol. 21, no. 12, Dec. 1929, pp. 1261-1268, 13 figs. Effect of tetraethyl lead, both in vapour phase and thermally decomposed, on flame speeds and rate of rise of pressure following ignition, was determined for explosive mixtures of benzine, pentane, isohexane. and heptane air; tetraethyl lead vapour was ineffective in retarding combustion until decomposed by burning mixture, whereas decomposed tetraethyl lead, introduced befoie firing charge, retarded both flame speed and rate of rise pressure.

ARCHES, FIXED

Design. Design of Doubly Fixed Arches (Calcul de l'arc doublement encastré), L. Legens. Génie Civil (Paris), vol. 95, no. 18, Nov. 2, 1929, pp. 437-439, 9 figs. Theoretical mathematical analysis of stresses in fixed arches of variable cross-section, of any shape.

AUTOMOTIVE ENGINES

Diesel. *See Diesel Engines, Automotive.*

Fuel Distribution. Report on Air-Fuel-Ratio Tests, H. W. Best. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 532-533 and (discussion) 534, and 536-541, 2 figs.

Manufacture. White Iron Edges on Machined Surfaces of Cylinder Heads and Blocks Are Responsible for Economic Losses, G. M. Eaton. Automotive Industries, vol. 61, no. 22, Nov. 30, 1929, pp. 792-794, 3 figs. Results of investigation recently made in causes of white iron edges in several specific epidemics of this trouble; unalloyed iron, chrome-nickel irons, and chrome-molybdenum irons investigated; fundamental reductions of the trouble can be made by modifying foundry design and pattern practice in way that will remove fin on rough casting.

AUTOMOBILE PLANTS

Heat-Treating Furnaces. Automatic Heat-Treating Unit, W. M. Hepburn. Iron Age, vol. 124, no. 20, Nov. 14, 1929, pp. 1304-1306, 4 figs. Description of three interconnected furnaces installed at Studebaker Plant for purpose of normalizing, hardening, quenching, and drawing; these functions may be separated for various heat treatments, according to requirements of production; furnaces are fired with both gas and oil, gas burners being used in soaking-zone; waste-heat recuperator.

AUTOMOBILES

Bearings, Friction of. Automotive Research—Friction Coefficient Research, L. Illmer. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 545-546. Test contributions of J. Goodman to friction research outlined; author's work along analytical research lines toward practical solution of bearing-design problem discussed; journal friction controlled by pressure factor; advantages of tabulated constants of coefficients.

Testing. Performance Evaluation. Automobile Engr. (Lond.), vol. 19, no. 259, Oct. 1929, pp. 387-388, 2 figs. Description of Tapley performance meter for testing general efficiency of motor vehicles; object is to furnish direct reading evaluations of performance, giving measure in pounds per ton that engine is exerting on driving wheels; methods of measuring top gear acceleration, hill-climbing capacity, tractive resistance, actual power output, and engine friction.

AUTOMOTIVE FUELS

Developments in. Developments in Motor Fuels, D. P. Barnard. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 495-498, 2 figs. Progress in improving fuels for carbureter-type internal-combustion engine must be directed toward securing greater efficiency and reliability in operation, and flexibility; for automobiles cost of fuel on basis of useful work realized per dollar expended is more important than weight; for aircraft, increased cost of power cost must be balanced against increased pay-load possibilities; effect of improving distribution and anti-knock characteristics; Federal Specifications restrict improvement; limitation of sulphur content justified.

B

BALANCING MACHINES

Dynamic Type. Mechanization in Dynamic Balancing, G. Gerber. Eng. Progress (Berlin), vol. 10, no. 11, Nov. 1929, pp. 287-289, 5 figs. Principles and types of machine are described; dynamic balancing machine of 2,200 lbs. capacity is described.

BEARING METALS

Bronzes. Wear Tests on Bearing Bronzes, W. M. Corse. Iron Age, vol. 124, no. 22, Nov. 28, 1929, pp. 1431-1434, 2 figs.

BEARINGS

Friction in. Friction in Journal, Roller, and Ball Bearings in Intermittent Operation (Reibung in Gleit,- Rollen- u. Kugellagern bei aussetzendem Betrieb), L. Klein. V.D.I. Zeit. (Berlin), vol. 73, no. 2, Oct. 19, 1929, pp. 1499-1502, 10 figs. Experiments in laboratory for conveying equipment in engineering

University of Hanover have shown that for friction and anti-friction bearings, friction in intermittent operation is higher than in permanent run and is dependent on relative time of throwing in and out; in both cases friction reaches minimum value only after hours of operation; friction coefficients for various cases.

(*See also Automobiles Bearings.*)

JOURNAL. Journal-Bearing Practice, F. Hodgkinson. Engineer (Lond.), vol. 148, no. 3854, Nov. 22, 1929, pp. 559-562, 8 figs.; and (discussion) pp. 543-544, 3 figs.; see also Engineering (Lond.), vol. 128, no. 3332, Nov. 22, 1929, pp. 690-693, 6 figs., and (discussion) pp. 681-684, 8 figs., and editorial comment, pp. 679-680.

BOILER FEEDWATER

ANALYSIS. Rational Measurement Coefficient for Water Analysis (Rationale sszahl fuer die Wasseranalyse), A. Sulfrian. Waerme (Berlin), vol. 52, no. 47, Nov. 23, 1929, pp. 867-869, 1 fig. Instead of coefficient of hardness which, it is claimed, is on arbitrary basis, "milli" standard unit is proposed, which, author states has scientific basis; relations between milli-unit, degrees of German hardness, milligram substance per liter and standard solution are shown in alignment chart.

BOILERS

BAFFLES FIRE-TUBE. Modern Progress in Fire-Tube Baffles (Neuere Fortschritte an Flammrohr-Einbauten), D. Schulz. Glasers Annalen (Berlin), vol. 105, no. 4, Aug. 15, 1929, pp. 67-68, 3 figs. Increase of flue-gas temperature and increased fuel economy have been attained by use of firebrick which frequently destroyed through sudden fluctuations in temperature; this is prevented by newly patented system, called "Stabilsteine," which is described.

CONTROL. Electric Boiler Control (Die elektrische Kesselregelung), W. Jaekel. Elektrizitaet im Bergbau (Munich), vol. 4, no. 11, Nov. 18, 1929, pp. 208-212, 13 figs. Equipment of Siemens and Schuckert, making exclusive use of electric processes; main object is to obtain favourable combustion at highest efficiency; features of system are discussed.

Rouchka System of Automatic Boiler Control (Les Régulateurs automatiques et les Appareils de Contrôle Roucka dans les Chaufferies Modernes). Technique Moderne (Paris), vol. 21, no. 15, Aug. 1, 1929, pp. 17-18, 1 fig. System developed by E. Roucka at his electrical-instrument works in Czechoslovakia during war, provides completely automatic control over flue dampers, air admission, feedwater supply and rate of grate travel thus reducing work of stoker to general supervision and checking regularity of firebed; every important central station in Czechoslovakia is fitted with Roucka apparatus; There are more than 150 installations in Germany.

CORROSION. Decomposition of Efflorescence on Leaking Boilers Due to Flue Gases (Zersetzung von Ausbluehungen an undichten Kesseln durch die Rauchgase). Zeit. des Cayerischen Bevisions-Vereins (Munich), vol. 33, no. 20, Oct. 31, 1929, pp. 279-280. Results of investigation of efflorescence on boiler supplied with feedwater softened according to lime-soda process; it is shown that flue gases have disintegrating effect on such incrustations.

FEED CIRCUITS. Modern Feed Water Circuits, J. Sims. Elec. Times (Lond.), vol. 76, no. 1985, Nov. 7, 1929, pp. 773-775, 22 figs. Layouts for feedwater circuits, de-aerators, feed heaters, etc., are discussed and illustrated by diagrams; binary-fluid cycle is estimated to give overall thermal efficiency of 32.5 per cent.

HIGH PRESSURE (LOEFFLER). Developments of the Loeffler System of Steam Raising. Engineer (Lond.), vol. 148, no. 3853, Nov. 15, 1929, pp. 516-517. Information is taken principally from recent article in Génie Civil, previously indexed; method consists in evaporating water by blowing highly superheated steam through it, steam for this purpose being taken in saturated condition from boiler itself and forced through superheater by means of steam pump; two commercial installations of Loeffler system are described, in addition to short account of its application to locomotive; security of operation is emphasized.

SEAMLESS. Seamless Boilers for Very High Pressure (Somlose kedeltomler for meget joje tryk), A. Hannover. Tekniske Forenings Tidskrift (Copenhagen), vol. 58, no. 5, Apr. 1929, pp. 69-79, 14 figs. Manufacture of seamless boiler 13.5 m. long, 1.5 m. diam. with wall thickness of 114 mm. is described; boiler was tested at 112 atmos.; materials used in boilers for high pressures are pointed out.

WASTE HEAT, DIESEL ENGINES. Clarkson Silencer Boilers to be Built in Canada. Iron and Steel of Canada (Gardenvale, Que.), vol. 12, no. 10, Oct. 1929, pp. 258-259, 4 figs. Description of Clarkson Thimble-Tube-Silencer boilers and heaters which utilize waste heat contained in exhausts of Diesel engines; device combines purpose of being most effective internal-combustion engine exhaust silencer with highly efficient means of recovering from otherwise waste gases abundant supply either of steam or hot water.

WATER CIRCULATION IN. Experiments Concerning Water Circulation in Boilers (Versuche ueber den Wasserunlauf in Dampfkesseln), E. Schmidt. V.D.I. Zeit. (Berlin), vol. 73, no. 33, Aug. 17, 1929, pp. 1151-1155, 9 figs. It is shown by experiment that self-evaporation is cause of frequently observed reversed water circulation; theory of water circulation has to take self-evaporation and relative velocity in boilers into consideration.

BRASS

HARD, PROPERTIES OF. Properties of Hard Brass (Die Eigenschaften des Hartmessings MS 58), O. Bauer and K. Memmler. Mitteilungen der deutschen Materialpruefungsanstalten, no. 8. Berlin, Julius Springer, 1929, 76 figs. tables and diagrams, 13.50 R.M. Properties of different standard brass varieties were investigated at request of German Industrial Standards Committee by Staal, Materialpruefungsamt and Kaiser-Wilhelm Institut fuer Metallforschung in Berlin-Dahlem; material was supplied by different firms made by different processes, and are to some extent of different chemical composition (varying lead content); methods and results of tests are described.

BRIDGE DESIGN

BRIDGE DESIGN. Bridge Architecture at the Limfjord and Lille Belt (Broarkitektur vid Limfjorden och Lille Baelt). Ingenioren (Copenhagen), vol. 38, no. 32, Aug. 10, 1929, pp. 373-382, 4 figs. It is advocated that, besides satisfying statical requirements, bridges should also give general public impression of strength and rigidity.

GREAT BRITAIN. Problem of Roads and Bridges, B. P. Davies. Modern Transport (Lond.), vol. 22, no. 558, Nov. 23, 1929, p. 33. Development of bridge construction during past three decades has been combined use of steel and concrete in form of reinforced concrete to replace structures of masonry and steel; traditions of past; methods for concrete. Abstract of paper presented to Public Works, Roads and Transport Congress.

BRIDGE PIERS

CONSTRUCTION. Caisson Foundations of Unusual Type Used on Bridge Job, A. G. Ashford. Contract Rec. (Toronto), vol. 43, no. 47, Nov. 20, 1929, pp. 1367-1369, 7 figs. Description of foundations of highway viaduct recently built at Sea Mills, on Portway road between Bristol City and Avonmouth, England; bridge, 329 ft. long and 70 ft. wide, comprises six arches of 46-ft. span; caissons of elliptical cross-section consist of steel shoe and concrete blocks measuring 4 ft. by 4 ft. by 2 ft. 3 in.; after reaching bedrock, about 50 ft. below ground level, caissons were filled with 8 to 1 concrete core.

FOUNDATIONS. Pile Foundations in Swampy Regions (Paelefundering i Sumpegne), A. R. Lamm. Ingenioren (Copenhagen), vol. 38, no. 31, Aug. 3, 1929, pp. 370-371, 3 figs. Description of reinforced-concrete bridge 42.5 m. long with 5 spans built over Pontian River in Malay State, Johore; as river bottom was very soft, special concrete piles with mushroom caps were used.

BRIDGES, BASCULE

FAILURE. Discussion and Rebuttal on the Hackensack Bascule Failure. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 783-785, 2 figs. Calculated stresses in counterweight towers, discussed by H. Cross; behaviour of pendulum suspended from rotating shaft, discussed by P. W. Ott; rebuttal by board of engineers consisting of O. E. Hovey, G. E. Beggs and D. B. Steinman.

BRIDGES, CONCRETE ARCH

CALIFORNIA. Concrete Arch of Unusual Design Aids Highway Relocation, D. M. McPhetres. Eng. News-Rec., vol. 103, no. 21, Nov. 21, 1929, pp. 815-816, 3 figs. Concrete-arch bridge of open-spandrel type in which columns have curved alignment and are supported on wide arch ribs made use of to eliminate dangerous traffic condition in Santa Cruz County, Calif.; bridge is 326 ft. long, main span consisting of 123-ft. two-ribbed spandrel arch.

CONSTRUCTION. Movable Towers and Hinged Trusses Aid Concreting of Multiple-Arch Bridge. Construction Methods, vol. 11, no. 11, Nov. 1929, pp. 52-53, 4 figs. Methods of construction of bridge across Raritan River, at New Brunswick, N.J., consisting of six 200-ft. main arch spans and several 40-ft. semicircular barrel approach spans; details of excavation, concreting and centering.

BRIDGES, HIGHWAY

RAILWAYS. Precast Concrete Bridge Railing Design Allows Future Shift. Eng. News-Rec., vol. 103, no. 22, Nov. 28, 1929, p. 847, 2 figs. Features of precast concrete railing that can be shifted to new curb line when future traffic requires wider roadway, designed for new Salinas River bridge at San Ardo, California; anchorage between railing-sections and roadway slab is secured by bolts through side, or curb portion of base and slab.

BRIDGES, RAILROAD

STRESSES. A Study of the Causes of Impact on Railroad Bridges, B. R. Leffler. Am. Ry. Eng. Assn.—Bul., vol. 31, no. 318, Aug. 1929, pp. 1-17, 6 figs. Investigation of causes of impact on bridges, based on recommendation and work of Committee XV, Association adopted formula which has been used as safe expression for percentage of impact to be used in designing new bridges and in rating existing bridges.

BRIDGES, STEEL

SPECIFICATIONS. General Specifications for Steel Railway Bridges. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 10, Dec. 1929, pp. 2641-2676. Full text of specifications prepared by Committe of Am Soc. Civil Engrs. and Am. Railway Eng. Assn., released March, 1929; proposals and drawings; general features of design; loads and stresses; unit stresses; details of design; workmanship; weighing and shipping; materials including; structural steel, silicon steel, nickel steel, cast steel, and cast iron.

BRIDGES, STEEL TRUSS

LAKE CHAMPLAIN. Lake Champlain Bridge, C. M. Spofford. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 10, Dec. 1929, pp. 2535-2539 and (discussion) 2539-2548, 5 figs. Design and construction of continuous steel-truss bridge; more detailed data will be found in number of previously annotated papers; economics; piers; braced coffer-dam; safety measures. Discussion includes erection problems—Lake Champlain Bridge, by H. W. Troelsch; methods for bridge foundations, by J. W. Rollins, etc.

BRIDGES, SUSPENSION

ARGENTINA. Thirty-two-Rope Cable Suspension System on South American Bridge, C. G. Gerstrom. Eng. News Rec., vol. 103, no. 23, Dec. 5, 1929, pp. 881-883, 7 figs. Sixteen ropes independently anchored compose each main suspension member of 492-ft. Rio Quequen crossing between Necochea and Loberia, province of Buenos Aires; continuous stiffening girder, bridges river in three spans, with main span 150 m. and two side spans of 60 m.; rocker type of tower was adopted; testing bridge with loaded trucks; cable erection of side-span stiffening girders on falsework; main tower erection; structural details.

DESIGN. Suspension Bridge Analysis by the Exact Method Simplified by Knowledge of Its Relations to the Approximate Method, A. H. Baker. Rensselaer Polytechnic Inst.—Eng. and Science Series, no. 24, June 1929, 32 pp., 11 figs. Thesis prepared with object of reducing to minimum enormous amount of labour, now necessary in analysis of stiffening trusses of suspension bridges by more accurate theory, by set of correction charts giving directly magnitude of discrepancies in approximate theory for any particular case; accurate values can be obtained by applying proper correction to approximate values.

DETROIT RIVER. Ambassador Bridge between Windsor, Ont. and Detroit, Mich. Completed Last Week. Contract Rec. (Toronto), vol. 43, no. 47, Nov. 20, 1929, pp. 1355-1362, 13 figs. Design and construction of world's longest suspension bridge having 1,850-ft. span, and total length between abutments of 7,400 ft.; details of towers and tower piers, cable anchorages and terminals.

HUDSON RIVER. The First Hudson Bridge in New York City (Die erste Hudson-Bruecke bei New York), R. Bernhard. V.D.I. Zeit. (Berlin), vol. 73, no. 42, Oct. 19, 1929, pp. 1504-1508, 15 figs. Design and construction of Hudson River suspension bridge in New York, having single span of 1.067 km.; properties of cable materials, features of steel towers, model testing of bridge members; construction of tower foundation and cable anchorage.

QUEBEC. The Rope-Strand Suspension Bridge at Grand'Mere, Quebec, D. B. Steinman. Eng. News-Rec., vol. 103, no. 22, Nov. 28, 1929, pp. 841-845, 9 figs. New highway toll suspension bridge over St. Maurice River at Grand'Mere, Quebec, with main span of 949-ft., which makes it longest rope-strand cable bridge in world; cable ropes cut to length and socketed in shop; details of anchorage, steel towers, stiffening trusses, method of cable wrapping, etc.; load tests.

BUILDINGS

BASEMENTS. Basement Walls and Floors. Concrete, vol. 35, no. 6, Dec. 1929, pp. 43-48, 9 figs. Hints for builders of basement walls and floors; watertight concrete is important essential; dimensions of foundations and footings; forms for monolithic foundations; retaining walls; recommended concrete mixtures for foundation walls and basements; watertight method of placing concrete floor on footings; placing and curing concrete; estimating quantities.

BUILDINGS, CONCRETE

FORM WORK. Continuous Shoring Speeds Work on Tall Chicago Structure, C. W. Ellsworth and H. S. Keller. Concrete, vol. 35, no. 6, Dec. 1929, pp. 13-15, 3 figs. Report of form work practice and construction of 30-storey Trustees System Service Building in Chicago; use of continuous shoring speeds up construction operations; joist-layout plan; method of framing beam forms; re-using shores.

BUILDINGS, STEEL

DESIGN. The Design of Tall Building Frames to Resist Wind, C. T. Morris and A. W. Ross. Ohio State Univ. Studies—Eng. Experiment Station—Bul., no. 48, June 1929, 73 pp., 16 figs. Method of design for wind-resisting bents of tall buildings, which approaches accuracy and economy, and which is practical for use; calculations of wind stresses in 48-storey tower of American Insurance Union Bldg., in Columbus, Ohio, by slope deflection method; results tabulated and compared with other methods. See Engineering Index, 1928, p. 303.

WELDED. Gas-Welding Design and Erection on a 300-Ton Mill Building, H. M. Priest and H. H. Moss. Eng. News-Rec., vol. 103, no. 24, Dec. 12, 1929, pp. 928-931, 7 figs. See editorial comment on p. 913-914. In constructing new research laboratory building, 260 by 75 by 42 ft. high, and Carbon Research Laboratories, Inc., in Niagara Falls, oxyacetylene welding was utilized for all connections in steel framing; details of joints; half-trusses were welded together on ground; welding data.

Structural Steel Welding, F. P. McKibben. Gen. Elec. Rev., vol. 32, no. 11, Nov. 1929, pp. 622-625, 10 figs. Welding structural steel by electric arc is progressing rapidly as is shown by recent successful completion of 75 bridges and buildings wholly or partially welded; included in these are steam power plants, hotel buildings, plate girders, bridges; details of construction of buildings enumerated are given. Paper read at World Engineering Congress, Tokyo, Japan.

C

CANALS

WELLAND. The Welland Ship Canal. Engineering (Lond.) vol. 128. no. 3332, Nov. 22, 1929, pp. 668-672, 9 figs. partly on p. 678. Description of Section No. 7; of six bridges on Section, four are higeway brieges and two railway bridges; with one exception all these are of vertical-lift span type giving clear height, when open for shipping, of 120 ft. and over; one exception is swing-bridge; details of bridge construction. (Continuation of serial.)

CARS

REFRIGERATOR. North American Develops Mechanical Refrigerator Car. Ry. Age, vol. 87, no. 20, Nov. 16, 1929, pp. 1155-1157, 4 figs. Advantages claimed for new mechanically refrigerated car include saving of approximately 3,000 lbs. in weight over standard refrigerator with full ice bunkers, elimination of all icing and re-icing en route, maintenance of any predetermined constant temperature required for best conditioning of perishable food products, attainment of this result without sacrifice of load-carrying capacity, and complete absence of salt and brine drippings; power obtained from truck axle; operation of refrigeration system.

CARS, STREET RAILROAD

DESIGN. Car Design, H. H. Adams. Traction Shop and Roadway, vol. 2, no. 10, Oct. 1929, pp. 307-309. Recent developments in car design with particular reference to their application on cars of Chicago surface lines; greatly reduced weight; method of noise reduction; new Chicago cars; increased acceleration and automatic control; trend is toward lower car; tests with new trucks and drives.

CAST IRON

HIGH-TEST, MANUFACTURE OF. High Test Cast Iron, R. S. MacPherran. Am. Foundrymen's Assn.—Trans., vol. 37, 1929, pp. 495-500 and (discussion) 729-733, 5 figs. Methods employed by Allis-Chalmers Mfg. Co. in producing high-test cast iron, are discussed; secret of high-test iron seems to be low carbon and high temperature on melting; silicon from 1.50 to 3.00 per cent has been varied without materially affecting strength of test bar; variation due to low melting point of ferro-silicon, small size of ladle, and some large castings made with silicon below 1.80 per cent.

PROPERTIES. Modern Engineering Cast Irons and their Properties, J. C. Pearce. Engineer (Lond.), vol. 148, no. 3852, Nov. 8, 1929, p. 504. Abstract of paper read at British Cast Iron Association, dealing with relationship between size and strength in cast iron; it is pointed out that bar of gray iron, 0.875 in. in diam., cast in given mixture, is stronger than bars of larger diameter cast from same metal at same time, and that specific strength diminished as section increased; cast iron behaves much better than might be expected when subjected to fatigue tests; resistance of cast iron to wear still remains one of unsolved problems.

Recent Views on the Mechanical Properties of Cast Iron, Thum. Foundry Trade Jl. (Lond.), vol. 41, no. 688, Oct. 24, 1929, p. 302. In order to explain its low strength, cast iron is compared with steel baving same percentage of combined carbon; it is proved experimentally that steel behaves elastically in way similar to cast iron wheu its structure is broken by holes and slits; suggestions are given for utilizing figures obtained for deflection at fracture by transverse test for vibrational strength which is very valuable when investigating suitability of cast iron for manufacture. Paper presented before German Foundry Employers' Federation.

CASTINGS

CLEANING. Tests on a Hydraulic Fettling Plant, U. Lohse. Foundry Trade Jl. (Lond.), vol. 41, no. 685, Oct. 3, 1929, p. 240. Process for cleaning castings with jet of water at high pressure forced through small-diameter nozzles which are placed directly on castings to be fettled; results of tests carried out on machine in foundries of Lanz, Mannheim; castings weighed before and after being fettled in order to ascertain how much sand was removed from casting in given time; wet fettling method is thus suitable for any moulding material. Abstract of paper presented before German Iron Founders Employers, Federation.

X-RAY ANALYSIS. X-Ray Inspection of Castings. Soc. Automotive Engrs.—Jl. vol. 25, no. 5, Nov. 1929, p. 551. Value of X-ray analysis of castings is discussed; its solution to problem of over-zealous and careless inspectors; X-ray inspection used successfully in examination of cast steel, bronze and aluminum as well as other articles.

CEMENT BURNING

REACTIONS. The Reactions in Burning Cement, A. C. Davis. Cement aud Cement Manufacture vol. 2, no. 11, Nov. 1929, pp. 303-314. Review of research work; four distinct methods have been used for determining value of exothermic reaction of clinker formation; these methods are enumerated and discussed.

CEMENT, PORTLAND

FINENESS. Effect of Fineness of Portland Cement on Its Properties (Der Einfluss der Feinheit des Portlandzements auf seine Eigenschaften), P. Filossofow. Tonindustrie-Zeitung (Berlin), vol. 53, no. 72, Sept. 9, 1929, pp. 1302-1304, 6 figs. Cement was separated into two fractions by sieving; test specimens were made with various mixtures and it was found that setting time depended upon fineness; 7-day tensile strength also followed fineness, but 28-day and longer strengths were bigher if initial cement was not quite so fine.

CEMENT TESTING

CEMENT TESTING. Variations in Standard Portland Cements, P. H. Bates. Am. Concrete Inst.—Jl., vol. 1, no. 1, Nov. 1929, pp. 65-95 and (discussion) 95-100, 4 figs. Report of committee 202; no such thing as standard portland cement; variations in early strengths, late strength, permeability, shrinkage and plastic yield; chemical heat of setting in large masses; internal stresses in concrete dams are due to heat evolution during setting and resulting shrinkage during cooling; reactions to curing conditions.

CHROMITE DEPOSITS

CANADA. The Obonga Lake Area, A. R. Graham. Can. Min. Jl. (Gardenvale, Que.), vol. 50, no. 44, Nov. 1, 1929, p. 1038. Brief description of area 26 mi. south of Collin station on Canadian National Railway; geological notes; four veins uncovered, 10 in. to 2 ft. wide, showing average of 34 per cent chrome oxide with favourable ratio of iron chromium; deposits are regarded as uncommercial at present, but of importance as future reserves.

CITIES AND TOWNS

ADMINISTRATION. Administration of the Boston Metropolitan District, D. B. Keniston. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 10, Dec. 1929, pp. 2485-2491. Scope of work of Metropolitan District Commission; methods of organization and operation; financial aspects; proportioning costs; metropolitan planning; Water Supply Commission.

CITY PLANNING

TORONTO. Town Planning Problems in Toronto, T. D. le May. Can. Engr. (Toronto), vol. 57, no. 23, Dec. 3, 1929, pp. 779-781. Planning and Development Act and its operatiou iu Toronto; need for comprehensive zoning scheme in Toronto; City and Suburban Plans Act; advantages of zoning; educating public; technical guidance; compulsory town planning; topographical surveys. Paper presented before Eng. Inst. of Can.

COAL MINES AND MINING

STOWAGE. Application of Pneumatic Stowage in Mining (Die Anwendung des Blasversatzes im Bergbau), F. Prockat. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 22, no. 22, Oct. 25, 1929, pp. 421-425, 4 figs. General discussion of method; mathematical fundamentals of air transmission in pipes; technique of low and high-pressure pneumatic stowage; cost analysis. (To be concluded.)

COAL RESOURCES

UNITED STATES AND CANADA. The Coal Resources of the Northwest, G. W. Evans. Min. Congress Jl., vol. 15, no. 11, Nov. 1929, pp. 898-903, 1 fig. Marketing possibilities are discussed; Crows Nest Pass area has outstanding bituminous deposit; Canada well supplied with everytbing from lignite to anthracite; Washington reserves are largest in Pacific states; Idaho coal of local value only; extensive deposits in Wyoming, Montana, Utah, and Colorado are discussed; oil as competitor with Oregon and California coal.

COLUMNS, CONCRETE

STEEL-CORES. Details of Steel Cores for Reinforced Concrete Columns, F. A. Randall. Concrete, vol. 35, no. 5, Nov. 1929, pp. 13-16, 6 figs. Summary of United States practice as to structural details; column bases; column caps, girder framing; wall columns and corner columns; shop details; column splices. Bibliography.

CONCRETE PRODUCTS

MASONRY, DEVELOPMENTS IN. Recent Architectural Developments in Concrete Masonry, W. D. M. Allan. Concrete Products, vol. 37, no. 4, Oct. 1929, pp. 23-28, 10 figs. Manager of Cement Products Bureau, Portland Cement Assn., discusses standardization and increased use of concrete masonry. portland cement stucco and cast stone; definition of typical American architecture; physical and chemical characteristics of stucco and cementing materials; steps taken by American Concrete Institute to improve quality of portland-cement stucco; characteristics and advantages of cast stone; surfacing of cast stone. Address given before group of Canadian architects.

CONCRETE, READY MIXED

CANADA. Concrete Mixed by the Transit System Now Appear on the Eastern Canada Market. Contract Rec. (Toronto), vol. 43, no. 49, Dec. 4, 1929, pp. 1411-1414, 3 figs. Operation of Toronto Ready-Mix Concrete Ltd.; concrete of any predetermined strength and mixed according to scientific principles can be supplied in any quantity; reaches job heated in freezing weatber; mixing takes place en route to work; details of mixer; merits of system; growing use of system.

COPPER ALLOYS

HARDENED. Hardened Copper for Electrical and Chemical Equipment, W. N. Hibbard. Iron Age, vol. 124, no. 22, Nov. 28, 1929, p. 1434. Uses and properties of hardened coppers known as Everdur and Tempaloy and their welding characteristics are described; table shows composition and physical properties of soft and hardened copper; hardened copper alloys are strong or stronger than medium carbon steels; cold-rolled alloys weld easily and will not season or corrosion crack. Abstract of paper presented before Int. Acetylene Assn.

COPPER MINES AND MINING

BRITISH COLUMBIA. British Columbia's Copper Mines Prospering, F. H. Mason. Eng. and Min. Jl., vol. 128, no. 24, Dec. 14, 1929, pp. 926-927, 4 figs. General review, by special correspondent; with copper price stabilized at $.18, production is expected to show substantial increase over former records; Britannia exploring for orebodies below 2,700 level; Granby puts Bonanza into production and increases reserves at Copper Mountain; Premier Gold developing new properties.

COPPER ORE TREATMENT

BRITISH COLUMBIA. The Allenby Concentrator of the Granby Consolidated Mining, Smelting and Power Company, Limited, H. R. Taylor. Can. Min. and Met. Bul. (Montreal), no. 211, Nov. 1929, pp. 1251-1259, 4 figs. Description of remodeled plants, with capacity of 2,500 tons per day; primary and secondary crushing and fine grinding; specially designed flotation plant, consisting of 28 rougher cells each 18 ft. long, two cleaner cells each 24 ft. long, and two re-cleaner cells each 12 ft. long; flow sheets and data on milling results are given.

CRANES

GEARS AND GEARING. Worm Gears versus Tooth Gears in Modern Crane Design (Schneckengetriebe oder Zahnraduebersetzung in modernen Kranbau), E. Goldberger. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 22, no. 17, Aug. 16, 1929, pp. 309-314, 5 figs. Efficiency of double-geared transmissions; motor capacity; relation of various losses in operation; relative efficiency; current consumption; heat absorption; circumferential force on brake drum; numerical example.

CULVERTS, CONCRETE

MOVING. Concrete Culvert Moved to New Location by Stump Puller and Rollers, J. Calhoun. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, p. 782, 1 fig. In relocating State highway near Heber Springs, Ark., 3-ft. box culvert, 32 ft. long, was removed distance of 41 ft. by stump puller and rollers, at total cost of $149.40; sketch showing arrangement of jacks, rollers and pulling cable.

CUTTING TOOLS

TUNGSTEN CARBIDE. An Appraisal of Carbide Tools, Z. Jeffries. Iron Age, vol. 124, no. 21, Nov. 21, 1929, pp. 1367-1371, 3 figs. Discovery of tungsten carbide, method of manufacturing carbide tools, representative performance in various uses, and future influence of tungsten-carbide cutting tools are discussed; cutting materials which no other metallic material has been able to cut; extraordinary production on metal work; tools for intermittent or jump cuts. Abstract of paper presented before Am. Soc. Mech. Engrs.

D

DAMS, CONCRETE

COAL MINE WATER SUPPLY. Reinforced-Concrete Dam for Coal-Mine Water Supply (Eisenbeton-Stauwerk fuer die Nutzwasserbeschaffung einer Grube), E. Szentkirályi. Glueckauf (Essen), vol. 65, no. 34, Aug. 24, 1929, pp. 1180-1182, 4 figs. Details of dam built specially to impound water for Thommen coal mine and its employees in Vasas establishment at Pecs, Hungary; dam is built across adjoining valley, half mile away, and holds 2¼ million gals.; surface of basin is about 43,000 sq. ft. and maximum depth of water 20 ft.; it is built on Ambursen system; special features of this contruction and its advantages compared with solid, gravity dam are explained.

DAMS, CONCRETE ARCH

CALAVERAS. Calaveras Flood Control Dam, K. L. Parker. West. Construction News, vol. 4, no. 22, Nov. 25, 1929, pp. 611-614, 3 figs. Description of variable radius concrete arch dam with gravity section abutments and gravity wall; 160 ft. high, 1,400 ft. long on crest, 50 ft. thick at base, aud 7 ft. thick at top; built by city of Stockton, Calif.; plans were revised after construction began; details of excavation methods, concrete placing, camp facilities, etc.

DAMS, EARTH

CONSTRUCTION. Construction of Municipal Dam, Melfort, J. G. Schaeffer. Can. Engr. (Toronto), vol. 57, no. 21, Nov. 19, 1929, pp. 723-725, 5 figs. Construction of 100,000,000-gal. water-supply reservoir for Melfort, Sask., having clay core dam, 900 ft. long and of 25 ft. maximum height; unit prices of construction; total cost, exclusive of land, is about $30,000.

SETTLEMENT. Long Period Settlement Records of Two Earth Dams, J. A. Holmes. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 769-772, 6 figs. See editorial comment on p. 755. Data on periodical levels taken for 16 years on Somerset dam (105 ft. high) and for five years on Davis Bridge dam (216 ft. high) in southern Vermont, built by semi-hydraulic process; mechanical analyses of materials; rate of settlement curves; present conditions of dams; well-compacted earth embankment reaches virtual stability in few years.

DAMS

SPECIFICATIONS. Building Code for Dams, F. A. Noetzli. West. Construction News, vol. 4, no. 21, Nov. 10, 1929, pp. 574-576. Discussion by A. Floris, L. Jorgensen and others, taking up; uplift, inclined contraction joints, resistance to earthquakes; lamination of arch dams, sliding factor, testing of models and temperature changes.

DIELECTRICS

MEASUREMENTS. Dielectric Absorption and Dielectric Loss, J. B. Whitehead. Franklin Inst.—Jl., vol. 208, no. 4, Oct. 1929, pp. 453-468, 11 figs. Absorption and loss studies on high-grade impregnated paper condenser; charge and discharge curves are taken; by means of vacuum-tube amplifier and oscillograph to within 0.001 sec. of instant of application of voltage and at values of 500, 1,000 and 1,500 volts, corresponding to those at which alternating loss measurements were made; loss was measured on 60 cycles at Shering bridge; loss as computed from von Schweidler's expressions is compared with measured values.

DIES

FORGING, HEAT TREATMENT OF. American v. British Die-Tool Treatments, J. W. Urguhart. Mech. World (Lond.), vol. 86, nos. 2233 and 2234, Oct. 18 and 25, 1929, pp. 373-374 and 386-387. Oct. 18: Review of compositions and methods of hardening forging dies in England and America; tempering limits of drop-hammer die block; composition; forging-machine die-block requirements; some hot-pressing die steels; chromium-steel die tools difficult to machine; English die steels. Oct. 25: Carburized plain and nickel-steel die blocks; essential carburization condition; hammer work and normalizing; sock-resisting nickel steels; heat-application points of importance.

DIESEL ENGINES

AUTOMOTIVE. F. B. Stearns Develops Two-Cycle Overhead Camshaft Diesel Engine of the Solid Injection Type, A. F. Denham. Automotive Industries, vol. 61, no. 21, Nov. 23, 1929, pp. 748-750, 3 figs.

Widespread Development of Automotive Diesels is Not Anticipated, H. M. Crane and A. L. Clayden. Nat. Petroleum News, vol. 21, no. 48, Nov. 27, 1929, pp. 81, 84, and 91. Abstract and commentary by Clayden, of address by Crane before National Petroleum Assn.; discussion of popular idea that Diesel is fundamentally better than gasoline motor and eventually supplants it; opinion is expressed that, except for certain limited fields, it is highly improbable that automotive Diesels will ever be nearly as suitable as gasoline engines.

CANADA. The Diesel Engine and Canadian Development. Power House, vol. 23, no. 21, Nov. 1929, pp. 66-69, 7 figs. General discussion of increased use of Diesel engine for various services in Canada; local conditions determine power installation; test results on two Diesel engines installed in plant of Robert Simpson Co.; other specific installations; general classifications.

DESIGN. Recent Developments in the Airless Injection of Fuel in Diesel Engines. Sulzer Tech. Rev. (Switzerland), no. 3, 1929, 23 pp., 39 figs. Three main tendencies in development of Diesel engines in recent years have been: (1) increasing size of engine; (2) developing small high-speed type; and (3) means employed to introduce fuel and improved combustion; problems arising when considering introduction of necessary quantity of fuel at right moment; importance of duration of injection; illustrated description of accumulating valves for Diesel engines.

FUEL INJECTORS. Design of Injection System Determines Fuel Consumption, A. Peters. Power, vol. 70, no. 21, Nov. 19, 1929, pp. 789-790, 4 figs. Author claims that tests he has run prove that variable stroke fuel pump is superior to by-pass controlled pump for high-speed solid injection Diesels.

HIGH-PRESSURE. High-Pressure Diesel Engines (Zur Frage der Hochdruckdieselmaschine), C. Commentz. Maschinen-Konstrukteur (Leipzig), vol. 62, no. 20, Oct. 15, 1929, pp. 461-462. Economic factors entering in design of high-pressure Diesel engines, i.e., use of material, and cost of construction in relation to fuel consumption, are discussed; author quotes figures from American practice.

MARINE (RICHARDSONS-WESTGARTH). Development and Performance of the Richardsons-Westgarth Oil Engine, W. S. Burn. Shipbldg. and Sbipg. Rec. (Lond.), vol. 34, no. 20, Nov. 14, 1929, pp. 589-591, 1 fig. Author shows development of design described by him in 1926, as result of intervening three years' work; double-acting two-stroke engine has proved very satisfactory; from time to time trouble was occasioned, mostly from mysterious causes; tendency has been slightly to increase weight and width; crankshaft is now made with cast-steel webs with integral balance weights; fuel-injection experiments. Abstract of paper before North-East Coast Instn. of Engrs. and Shipbldrs.

MARINE—SUPERCHARGING. The Werkspoor Supercharging System. Mar. Engr. and Motorship Bldr. (Lond.), vol. 52, no. 626, Nov. 1929, pp. 448-450, 3 figs. New system of supercharging has been developed in connection with Werkspoor four-stroke crosshead-type engines; system consists in closing in lower sides of working pistons and providing space with automatic air suction and delivery valves; piston displacement serves to compress air to moderate pressure.

DIPHENYL

PROPERTIES OF. Vapour Pressure and Heat of Vaporization of Diphenyl, J. Chipman, and S. B. Peltier. Indus. and Eng. Chem. vol. 21, no. 11, Nov. 1929, pp. 1106-1108, 1 fig. Vapour pressure of diphenyl has been determined between 162 and 322 deg. cent.; equation is derived which should be valid for extrapolation up to 10 to 15 atmospheres; vapour density has been determined and heat of vaporization calculated; properties of diphenyl are shown to be in accord with those of other aromatic hydrocarbons.

DRILLS

POWER REQUIREMENTS OF. Power Required to Drill Cast Iron and Steel, O. W. Boston and C. J. Oxford. Am. Soc. Mech. Engrs.—Advance Paper, no. 4, for mtg. Dec. 2-6, 1929, 22 pp., 55 figs.

E

ECONOMIZERS

GILLED TUBES FOR. Gilled Tubes, G. Tansley and O. Kubalek. Engineer (Lond.), vol. 148, no. 3853, Nov. 15, 1929, p. 532, 2 figs. Account of experiments with gilled tubes for economizers; number of B.t.u.'s transmitted per degree difference was highest with plain tube and lowest with deep gill; outer periphery of deep gill was very much less effective than inner periphery; results from properly designed gill cast on tube will be approximately equal to results from plain tube per square foot of heating surface. Abstract of paper read before Instn. Engrs. and Shipbldrs. in Scotland.

ELECTRIC CIRCUIT BREAKERS

INTERNAL ISOLATION. Internal-Isolation Switchgear. Engineering (Lond.), vol. 128, no. 3332, Nov. 22, 1929, pp. 674-675, 3 figs. It is generally necessary to move whole circuit-breaker structure bodily, if it is required to examine it; in design devised by G. E. Whitehead, and manufactured by Switchgear and Cowans, Ltd., of Old Trafford, Manchester, this disadvantage is overcome by keeping circuit breaker properly fixed and coupling it up to, or disconnecting it from, busbars through moving isolating carriage of light weight and simple design.

ELECTRIC CODES

ELECTRIC CODES. Illumination or Wiring Standard—Which?, J. R. Cravath. Elec. World, vol. 94, no. 21, Nov. 23, 1929, pp. 1028-1029. Franklin specification proposes standard of illumination, whereas California Commercial Red Seal Plan would make adequate wiring basis of approach to problem.

ELECTRIC FURNACES

FOUNDRY. Short-Cycle Malleableizing Improves Product and Saves Time. Elec. World, vol. 94, no. 20, Nov. 16, 1929, p. 989, 2 figs. New short-cycle annealing process for production of malleable iron castings by which it is possible to produce malleable iron in 30 hrs. or less, has been announced by General Electric Co.; furnace and control panel for short-cycle annealing are illustrated.

INDUSTRIAL. Industrial Electric Furnaces. Elec. Rev. (Lond.), vol. 105, no. 2708 and 2710, Oct. 18 and Nov. 1, 1929, pp. 674-676, and 773-774, 9 figs. Illustrations of notes on selected items from manufacturers' products, i.e., Birlec rotating annular-hearth furnace; Metropolitan-Vickers induction furnace at Vickers-Armstrong Works; double-ended furnace for precious metals, Electric Furnace Co.; Lecfur melting pot; 3.2-kw. "Birlec" pusher-type furnace; Wild-Barfield carburizing furnaces; "E.F.C." high-frequency resistance furnaces.

LOSS MEASUREMENT. Open-Door Losses Determined for Electric Furnaces, R. M. Cherry. Elec. World, vol. 94, no. 21, Nov. 23, 1929, p. 1029. Open-door losses for given furnace temperature will depend upon area of door opening, time door remains open; number of openings per hour and design of furnace front and door. Abstract of paper presented before Indus. Elec. Heating School, Case School of Applied Science.

ELECTRIC GENERATORS

ALTERNATING CURRENT. New Alternator of 50,000 Kw. of Generating Plant at Gennevilliers of l'Union d'Electricité (le nouvel alternateur de 50,000 kilowatts de l'usine génératrice de Gennevilliers de l'Union d'Electricité), L. Guyon. Revue Générale de l'Electricté (Paris), vol. 13, no. 18, Nov. 2, 1929, pp. 705-719, 18 figs. Three-phase, 6,000/6,400-volt, 1,500-r.p.m. generator designed and manufactured by Schneider and Co., in such manner that rotor can be replaced by 35,000 and 40,000-kw. rotors of other generators already installed; design data and test results are given in curves and tables.

ELECTRIC INSULATION

FAULTS. Insulation Faults, W. Wilson. World Power (Lond.), vol. 12, no. 71, Nov. 1929, pp. 432-435, 1 fig. Continuity of working can only be secured for electrical equipment by obviation of faults as far as is humanly possible, and by minimizing of their effects when they do occur; these functions require for their efficient fulfilment careful study of fault itself, and more especially of its nature and its life-history; brief discussion will go far towards dispelling mystery surrounding failure of insulation, and to indicate effective means of coping with trouble.

TESTING. The Bridge-Meg Resistance Tester. World Power, vol. 12, no. 70, Oct. 1929, pp. 303-304, 5 figs. New resistance tester for measuring electric insulation resistance, developed by Evershed and Vignoles, Ltd., of Chiswick.

ELECTRIC LAMPS

INCANDESCENT. Theory and Characteristics of Mazda Lamps. Nat. Lamp Works—Gen. Elec. Co.—Bul., no. 56, Oct. 1929, 56 pp., 45 figs. Production of light by incandescence; relative distribution and energy distribution curves; spectral sensitivity of photoelectric cell; efficiency of lamps; filament operating temperature; vacuum and use of gas; filament temperatures, diameters, and lengths; inside frosting; effect of frequency; effects of excessive temperatures on lamps; exponents of lamp characteristics; designed life of lamps; right lamp for service; Steps in manufacture. Bibliography.

ELECTRIC LIGHT AND LIGHTING

DESIGN. Artificial Light in Architecture (Das kuenstliche Licht in der Baukunst), E. Summerer. Licht u. Lampe (Berlin), vol. 18, no. 20, Oct. 3, 1929, pp. 1107-1113, 13 figs. Architect and illuminating engineer discussed problem of interior lighting; determination of intensity required; design of lighting fixtures; table of properties of materials used in lighting; characteristics of various types of lights; economy in mechanical layout.

ELECTRIC LINES

CALCULATION. Overhead Line Nomogram for Inclined Spans (Das Freileitungsnomogramm fuer geneigte Spannfelder), I. Schwarzkopf. Elektrotechnik u. Maschinenbau (Vienna), vol. 47, no. 40, Nov. 10, 1929, pp. 985-988, 3 figs. Mathematical analysis; graphs and curves for calculations.

SAG. Sag Chart for Copper Conductors, W. T. Taylor. Elec. (Lond.), vol. 103, no. 2683, Nov. 1, 1929, pp. 522-523. Series of curves giving sag values for copper conductors (⅜ in. ice loading) in terms of variable span length.

UNDERGROUND. A 100,000-Volt Cable Line, W. Parey. Eng. Progress (Berlin), vol. 10, no. 11, Nov. 1929, pp. 285-286, 3 figs. One year's operating experience on 100-kv. three-phase cable line laid by Grosskraftwerk Franken Co., Numeberg, during 1927 and 1928; cable is designed to transmit 40,000 kva., but at present is loaded with only 16,000 kva.; three single-core cables, supplied by Siemens-Schuckertwerke A.-G., having copper area of 195 sq. mm.; description of this cable has been previously indexed from Elektrizitaetswirtschart, July 1, 1929.

ELECTRIC MANUFACTURING INDUSTRY

CANADA. Power Finance and Imperial Preference, H. Quigley. World Power, vol. 12, no. 70, Oct. 1929, pp. 314-320. Economic discussion concerning electric manufacturing industry; table giving production and consumption of electrical machinery and apparatus for 1920-1928; table giving electricity supply first by water and steam turbine, second by a.c. and d.c. generators; capitalization tables of American controlled companies, Canadian-controlled companies, and independent companies; also table giving generating capacity and output of various companies of Canada.

ELECTRIC MOTORS

INDUCTION. Special Types of Induction Motors. AEG Progress (Berlin), vol. 5, no. 10/11, Oct.-Nov., 1929, pp. 307-311, 13 figs. Types of motors for special purposes described agree in regard to electric characteristics with standard AEG-induction motors type DA, whereas their mechanical features deviate according to duties for which they are determined; drip-proof induction slip-ring motors; externally positioned flame-proof slip-ring enclosure; separately ventilated induction motors; totally enclosed self-ventilated induction motors, etc., are described.

SQUIRREL CAGE, STARTING. Automatic Throw-in Devices for Squirrel-Cage Motors (Les embrayages automatiques appliqués au démarrage des moteurs à cage d'écureuil), M. J. Betbenod. Société Française des Electriciens—Bul. (Paris), vol. 9, no. 97, Sept. 1929, pp. 923-926. Conditions for ideal automatic starting; various French types of throw-in gears applied; energy storage in throw-in equipment during starting.

ELECTRIC NETWORKS

ALTERNATING CURRENT. Solving System Problems by Means of the Power Network Analyser, H. L. Hazen and M. F. Gardner. Power Plant Eng., vol. 33, no. 22, Nov. 15, 1929, pp. 1220-1222, 1 fig. Description of model, constructed at Massachusetts Institute of Technology, applicable to solution of operating problems met with in a.c. networks of various kinds; development of network analyzer; analyzer based on one-line diagram of system.

GROUNDING. The Unsolved Grounding Problem, F. A. Cambridge. Elec. News (Toronto), vol. 35, no. 22, Nov. 15, 1929, pp. 43 and 50. Author ascribes absence of security in present-day grounding practice of electric distribution systems to following factors: lack of appreciation by utility engineers of what constitutes effective grounding; reluctance of utility executives to incur financial outlay necessary; employment of unsuitable system of distribution and methods of conducting current; deficiencies in rules and regulations.

SHORT CIRCUIT CALCULATIONS. The Short Circuit Calculating Table and Its Applications, M. P. Osburn. Hydro-Elec. Power Commission of Ontario—Bul. (Toronto), vol. 16, no. 10, Oct. 1929, pp. 349-358, 8 figs. Short-circuit calculating equipment used for solution of two distinct classes of problems, namely, those involving design and those involving operation of large systems, is described.

ELECTRIC REACTORS

FEEDER REACTORS. Complete Installation of Feeder Reactors, E. G. Burr and S. A. Craig. Elec. News (Toronto), vol. 38, no. 22, Nov. 15, 1929, pp. 37-40, 4 figs. Installation of reactors and regulators is arranged to give phase isolation in enlarged Slater Street substation, Ottawa Electric Co.; reactors are installed on three shelves, one above other and each shelf houses one phase of reactors and also that phase of group bus; two types are employed, reactors constructed with enameled wire rated at 2 per cent (i.e., 46 volts) at 200 amp., 65 deg. cent. rise, and reactors wound with insulated wire rated at 3 per cent (69 volts) at 250 amp., 60 deg. cent. rise.

ELECTRIC SWITCHGEAR

LOW TENSION. The Design of Low Tension Switchgear, W. Wilson. World Power, vol. 12, no. 70, Oct. 1929, pp. 321-327, 9 figs. Functions of switchgear are to carry and interrupt flow of power; maximum power ruptures without arcing of carbon, copper and brass; design of current-carrying surfaces; design of current-breaking elements; mechanical effects.

MANUFACTURE. British Workshops. World Power (Lond.), vol. 12, no. 71, Nov. 1929, pp. 468-471, 6 figs. Discussion of rigid requirements or specifications adhered to in manufacture of electric switchgear at works of W. Lucy and Co., Ltd., Oxford; specific reference to street lighting products.

ELECTRIC TRANSFORMERS

DESIGN. Some Economic Aspects Affecting the Design of Large Power Transformers, F. F. Brand and H. O. Stephens. Gen. Elec. Rev., vol. 32, no. 11, Nov. 1929, pp. 632-637, 9 figs. Increase in kilovolt-ampere rating; growth in system voltages; efficiencies; capitalization of losses; increased complexity of design; lightning; insulation; reliability. Paper read at World Power Conference, Tokyo, Japan.

SURGES. Effect of Surges on Transformer Windings, J. K. Hodnette. Am. Inst. Elec. Engrs.—Jl., vol. 48, no. 11, Nov. 1929, pp. 829-832, 14 figs. Study of reaction of transformer windings in grounded neutral systems when subjected to transient voltage surges such as exist on normally insulated lines; measurements of voltage distribution throughout windings between various elements and to ground were effected by means of cold cathode-ray oscillograph and sphere gaps; stresses due to voltages occurring on transmission systems.

ELECTRIC WELDING

ATOMIC-HYDROGEN. The Welding of Ferrous and Non-Ferrous Metals by the Atomic-Hydrogen Flame, H. A. Weinman. Aviation Eng., vol. 2, no. 11, Nov. 1929, pp. 13-15, 13 figs. Atomic-hydrogen welding process, and equipment used is described; upon entering atomic-hydrogen welding flame, portion of gas is made to pass through an electric arc, remainder merely serving to replenish envelope of molecular hydrogen around arc; welding tungsten, molybdenum, cast-iron alloy steels, aluminum and its alloys, brass and nickel; process is used to weld metals and alloys presenting difficulties to other forms of welding.

ELECTRODES

SODERBERG SELF-BAKING. The Soderberg Self-Baking Electrodes, M. Sem. Can. Chem. and Met. (Toronto), vol. 13, no. 6, June 1929, pp. 177-178, 4 figs. Description of electrode referred to in article by J. Silberstein, indexed from same journal, April 1929; novel principle is that electrode is being built up from green paste in one end, as baked electrode at other end wears away in electric furnace.

ENGINEERING

BIOLOGICAL FACTORS. The Biological Factor in Engineering (Der biologische Faktor in der Technik), W. Ostwald. V.D.I. Zeit. (Berlin), vol. 73, no. 33, Aug. 17, 1929, pp. 1149-1150. Discussion of philosophical character, arguing that engineering, which is defined as study of generation and control of energy, belongs to social sciences and must draw upon physiology and psychology for its fundamental data; nature of engineering control division of labour and co-operation.

ETHICS. Engineering Ethics, E. E. Wall. Engrs. Club of St. Louis—Jl., vol. 9, no. 10, Oct. 1929, pp. 3-5. American Society of Civil Engineers has, through one of its committees, published lengthy reports concerning proper charges for engineering services; reports state that charges or methods of making charges must be based on fixed and stable compliance with established code of ethics; committee also states that outside employment of professors and salaried officials is only permissible when fees are in no case lower than that which would be normally charged by practicing professional engineer.

EXPLOSIVES

PROPERTIES. Explosive Properties of "Chloratite 3" with Varying Content of Petroleum (Die Sprengtechnischen Eigenschaften von Chloratit, etc.), A. Haid and H. Selle. Zeit. fuer das gesamte Schiess-u. Sprengstoffwesen (Munich), vol. 24, no. 7, July 1929, pp. 251-252, 2 figs. Petroleum content of this chlorate explosive was varied from 0 to 16 per cent and effect measured by determinations of sensitiveness to impact, by transmission of detonation through air gap, by rate of detonation, and by effect of lead blocks and copper cylinders; it is concluded that most favourable content of petroleum is 8 to 9 per cent.

F

FLOOD CONTROL

MISSISSIPPI RIVER. Bonnet Carré Spillway Believed to Be at Wrong Location, A. B. B. Harris. Eng. News-Rec., vol. 103, no. 21, Nov. 21, 1929, pp. 818-819, 2 figs. Author attacks location as faulty and wasteful and outlines reasons for his belief that $10,000,000 or more can be saved by more thoroughly studied design. See editoril comment on p. 794.

FLOODLIGHTING

FEATURES OF. Floodlighting. Elec. News (Toronto), vol. 38, no. 21, Nov. 1, 1929, pp. 33-36, 9 figs. Features of this type of lighting, which has many uses, are discussed; in illuminating building exteriors it has created new art which is rapidly gaining in popularity; various Canadian buildings equipped with floodlighting are illustrated.

FLOW METERS

QUANTITY-RATE. Quantity-Rate Fluid Meters, E. S. Smith, Jr. Am. Soc. Mech. Engrs.—Advance Paper, no. 40, for mtg. Dec. 2 to 6, 1929, 21 pp., 11 figs. Study of correlation of coefficients and expansion factors, using Reynolds number and acoustic velocity ratio; venturi tubes and square-edged orifices are placed upon common basis and graphical methods of use are shown; example illustrating relation between flow similarity, Reynolds number, and coefficient; study of factors which cause departure from theoretical flow conditions; fluid metering in practice; basio formula for quantity-rate meters; venturi-tube and orifice analysis. Bibliography.

FLOW OF FLUIDS

SIMILARITY APPLIED TO. Similarity: Limitations in Its Application to Fluid Flow, J. M. Spitzglass. Am. Soc. Mech. Engrs.—Advance Paper, no. 42, for mtg. Dec. 2-6, 1929, 9 pp., 8 figs. General historical review of development of theory of fluid-flow, since Torricelli, in 1643, to most recent studies of 1929, with special reference to geometrical and hydraulic similitude; author concludes that hydraulic similarity being matter of experiment, large sizes may or may now show same results as smaller ones. Bibliography.

FLOW OF GASES

THERMODYNAMICS. Impact Losses in Flow of Gases and Vapours through Sudden Expansions in Pipe Lines (Stossverlust an ploetzlichen Erweiterungen in Rohren beim Durchfluss von Gasen und Daempfen), A. Busemann and W. Nusselt. V.D.I. Zeit. (Berlin), vol. 73, no. 44, Nov. 2, 1929, pp. 1588-1589, 4 figs. Theoretical debate of phenomenon on basis of general thermodynamic principles; entropy diagrams.

FLOW OF WATER

MEASUREMENT. Measurement of Stream Velocity by Air Bubbles, O. Miyagi. Tohoku Imperial Univ.—Tech. Report (Sendai), vol. 8, no. 4, pp. 587-603, 3 figs. Starting with observation that spherical air bubbles of diameter larger than 0.27 cm. arrive to surface with nearly constant velocity of about 24 cm. per sec., author made precise laboratory tests of measuring average current velocities of order of magnitude of 0 to 15 cm. per sec.; mathematical equations for determination of velocity from observations of horizontal displacement of bubbles during this rise from bottom.

FUELS

CALORIFIC VALUE. Gross or Net Calorific Values. World Power, vol. 12, no. 70, Oct. 1929, pp. 370 and 373. It is important to avoid confusion and error which are likely to arise from indiscriminate use of gross and net calorific values of fuel used without clearly specifying which basis is taken; American practice leans toward gross calorific values of fuel, while continental practice is more frequent to use net or lower calorific value; discussion of proximate and ultimate analysis of fuel.

G

GAS ENGINES

BLAST-FURNACE-GAS. Modern Blast Furnace Gas Engines, F. J. Taylor. Gas and Oil Power (Lond.), vol. 25, no. 289, Oct. 3, 1929, pp. 3-5, 4 figs. Practicability of slow-burning properties of blast-furnace gas in large slow-running gas engine; discussion of pistons and valves, governor design; waste-heat recovery and blowing engines.

GAS PIPE LINES

DESIGN. Economical Gas Transmission by Tapered Pipe Lines, L. T. Jones. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, p. 779, 1 fig. Long distance transportation of nearly double usual amount of gas for same cost has been made possible by development of improved form of girth weld, cost of which is independent of diameter of pipe line, provided only that weight is kept constant; effect of increasing number of sections in stepped pipe line; gas pressures in 250-mi. tapered pipe line. Abstract of paper presnted before Pac. Coast Gas Assn.

WELDING. Welded Joints Used in Long Oil Pipe Line. Eng. News-Rec., vol. 103, no. 24, Dec. 12, 1929, p. 927. Bell and spigot joints, sealed by welding process; were used throughout entire 624 mi. length of 12-in. welded-steel oil pipe line, recently completed between Cushing, Okla., and Chicago district; in joining 40-ft. sections of pipe each weld was made in two beads to eliminate pinholes; current was supplied by portable gasoline engine driven welders.

GASES

HEAT-CONDUCTIVITY. Instruments to Measure Heat Conductivity (Varmeledningsinstrumenter), C. A. Robak. Teknisk Ukeblad (Oslo), vol. 76, no. 24, June 14, 1929, pp. 249-251, 6 figs. Method of measuring heat conductivity of several gases are described, also instruments used and results of three tests on reliability of instruments to measure contents of hydrogen in air.

GEARS

CUTTING. Determination of Back Lash with a Given Tooth Profile (Ermittlung der Gegenflanke bei gegebenem Zahnprofil), F. Roetscher. V.D.I. Zeit. (Berlin), vol. 73, no. 41, Oct. 12, 1929, pp. 1469-1471, 9 figs. Simple method is described for determining back lash for given tooth profile which also permits determination of tooth form produced in any cutting machine according to helicoidal system; action of different parts of cutting machine is followed and better conception of phenomena occurring with gear generation of gears is thereby obtained.

PLANETARY. Planetary Gearing Calculations and Design, W. Richards. Machy. (Lond.), vol. 35, no. 889, Oct. 24, 1929, pp. 105-109, 5 figs. Large reductions possible with planetary gear trains are taken up; general arrangement of planetary reduction gear; method of tabulating results of movements; planetary reduction gear with driving and driven members rotating in same direction; law governing direction in which driven gear revolves; centre distances and pitches of planetary gears.

GEOLOGY

ALASKA. Geology and Mineral Deposits of Southeastern Alaska, A. F. Buddington and T. Chapin. U.S. Geol. Survey—Bul. no. 800, 394 pp., 39 figs. on supp. plates. Summary of all available data on general geology of southeastern Alaska. accompanied by reconnaissance geologic map of southern and eastern parts; it is stated that report is not and can not be comprehensive treatise, as information now available is utterly inadequate.

BRITISH COLUMBIA. Britannia Beach Map-Area, British Columbia, H. T. James. Canada Dept. of Mines—Geol. Survey (Ottawa), memoir 158, no. 2193, 1929, 134 pp., 18 figs. Report on field work in area including one of largest copper mines of British Columbia; general geology; historical notes and statistics of mineral production; general classification and mineralogy of deposits; description of individual deposits; summary classification of mineral deposits and theoretical discussion of their relations.

MANITOBA. Geology of Oiseau River Area, Manitoba. Can. Min. Jl. (Gardenvale, Que.), vol. 50, nos. 44, 45 and 46, Nov. 1, 8 and 15, 1929, pp. 1040-1041, 1062-1063, 1069-1076, and 1089-1090, 1098-1099 and 1101. Nov. 1: Metargillite, slate, chert, and tuff; adesite, trachyte, dacite, and chlorite schist; comparison of sedimentary-volcanic complex with similar groups in nearby areas. Nov. 8: General character and distribution. Nov. 15: Mode of occurrence of gabbro; diorite, quartz diorite, and granodiorite; relations between various rocks; econoic geomlogy. (Concluded.)

GOLD MINES AND MINING

BRITISH COLUMBIA. The Hedley Mine and Mill. Can. Min. and Met. Bul. (Montreal), no. 211, Nov. 1929, pp. 1260-1271, 6 figs. General notes on Nickel Plate mine and allied claims, near town of Hedley, B.C.; contact-metamorphic ore body in limestone, with gold-bearing sulphide in gangue of lime-silicate; mine workings; mining methods; diamond drilling; transportation; electric power; stamp mill and cyanidation data.

PLACER, CALIFORNIA. Mining Placer Gravel On Steep Grades, J. W. Neill. Eng. and Min. Jl., vol. 128, no. 20, Nov. 16, 1929, pp. 1-772, 771 fig. Mining machine designed for special problem, but not built; essential units consist of steam shovel to do digging and floating washing plant to handle gravel, recover gold, and stack tailings; outfit equipped with 1 ½-cu. yd. bucket; should be able to dig from 75 to 90 cu. yds. per hr., depending on gravelbank conditions and skill of operators.

ONTARIO. The Pickle Lake—Crow River Area, M. E. Hurst. Can. Min. Jl. (Gardenvale, Que.), vol. 50, no. 46, Nov. 15, 1929, pp. 1080-1081. Area in district of Patricia, about 140 miles northeast of Sioux Lookout station on Canadian National Railway; geological data; quartz veins in greenstones; some veins are gold-bearing, and others carry practically no value; brief notes on exploration and development.

GOVERNORS

CENTRIFUGAL. Critical Valuation of Various Centrifugal Spring Governor Systems (Betrachtungen ueber die kirtische wertung verschiedener Flichkraft-Feder-Regler-Systeme), F. Heinzmann. Maschinen Konstrukteur (Leipzig), vol. 62, no. 20, Oct. 15, 1929, pp. 466-468, 7 figs. Study based on numerical examples for different types of standard equipment, intended to determine how far their efficiency meets requirements of practice.

GRINDING MACHINES

HYDRAULIC DRIVE. High-Speed Grinding Machines with Hydraulic Feed. Engineering (Lond.), vol. 128, no. 3330, Nov. 8, 1929, pp. 589-590, 2 figs. Details of machines made by Karl Jung, Berlin, designed for precision work on small parts; in internal grinding machine, small diameter of grinding wheel necessitates very high shaft speeds to obtain desired peripheral speed; machine under consideration has been designed so that spindle speeds of as high as 30,000 r.p.m. may be safely obtained; surface grinding machine differs in application of hydraulic principle from internal grinding machine in that, in this case, work is traversed by oil gear and grinding wheels by hand.

GUNS

GRINDING. Grinder for Reconditioning Bores of Naval Guns, R. H. Raube. Machy. (N.Y.), vol. 36, no. 3, Nov. 1929, p. 223, 1 fig. Description of gun grinder for reconditioning bores of large naval guns, recently developed by Hutto Engineer-Works, Inc., Detroit, Mich. for reconditioning 12-, 14-, and 16-in. guns; support for spindle used in grinding full length of rifling of these guns in provided by seven centralizing rests; grinding head driven by 7½-hp. d.c. motor.

GYPSUM DEPOSITS

CANADA. Occurrences of Canadian Gypsum Deposits by Provinces. Pit and Quarry, vol. 19, no. 2, Oct. 23, 1929, p. 78. Information issued by Development Branch of Canadian Pacific Railway; greater portion of Canada's production comes from Nova Scotia which Provinces exports most of its production to United States; in New Brunswick, beautiful white gypsum is extensively mined at Hillsborough, Albert County; deposits occur in Niagara peninsula of Ontario; large deposit is worked at Lake St. Matin near Gypsumville, Manitoba; several deposits occur in northern Alberta; gypsum industry of British Columbia is now on producing basis.

H

HARDNESS TESTING

BRINELL. The Hardness of Steel Balls Used for the Determination of Brinell Hardness Numbers of Materials, R. G. Batson and S. A. Wood. Dept. Sci. and Indus. Research—Special Report, no. 16, 1929, 30 pp., 3 figs. Description of research to enable specifications to be prepared for hardness of steel balls used for Brinell hardness testing; hardness tests using diamond indenting tool and by ball flattening method; crushing strength of balls by three-ball method; determination of hardness numbers of steel specimens of high and uniform hardness when made with balls of different hardness; file tests on balls.

HEAT EXCHANGERS

HEAT TRANSMISSION IN. Heat Transfer in Cross-Current Heat Exchangers (Der Waermeuebergang im Kreuzstromwaermeaustauscher), G. Zimmermann. Zeit. Bayerischen Revisions-Vereins (Munich), vol. 33, nos. 19 and 20, Oct. 15 and 31, 1929, pp. 267-270 and 280-283. Oct. 13: Theoretical discussion; calculation of temperature field resulting from heat transfer in cross current according to Nusselt. Oct. 31: Tests were carried out in experimental plant; main purpose was to determine relation of heat transfer and transmission coefficients to velocity; two fans were installed, one for air and one for flue gas.

HEAT-INSULATING MATERIALS

TESTING. Tests of the Properties of Insulating Materials, O. R. Randall. Engineering (Lond.), vol. 128, no. 3331, Nov. 15, 1929, pp. 657-659, 6 figs. Discussion of certain methods which may be used to investigate properties of insulating materials; attempt is made to place testing of such material upon more exact footing than has previously been in use. Paper read before Brit. Assn. at Johannesburg.

HEAT TREATMENT

AIR EFFECTS. Effect of Atmospheres on the Heat Treatment of Metals, E. G. de Coriolis and R. J. Cowan. Indus. and Eng. Chem., vol. 21, no. 12, Dec. 1929, pp. 1164-1168, 1 fig. Effects of various atmospheres on metals during typical heating operations ranging from 350 to 2,500 deg. fahr.; these effects are shown to be essentially of chemical nature; methods for application of heat are considered; account is given of research work of American Gas Assn. in connection with forging; problem of bright annealing is considered; use of steam for bright annealing of copper is discussed.

HIGHWAY ENGINEERING

QUEBEC. A Few Economical and Technical Aspects of the Road Problem of the Province of Quebec, A. Fraser. Eng. Jl. (Montreal), vol. 12, no. 10, Oct. 1929, pp. 527-531. Review of highway development in province of Quebec and discussion of provincial highway policy; transportation facilities as economic factors; highways vs. railways; progressive construction as road policy; study of subsoil conditions; practical results obtained through experiments and studies.

HOUSES

HEAT INSULATING MATERIALS. Experimental Houses at Norges Tekniska Hoeskole, (Forsekshusene ved Norges Tekniske Hoeskole), A Bugge. Teknisk Ukeblad (Oslo), vol. 76, no. 39, Sept. 26, 1929, pp. 400-401, 4 figs. Results of investigation on houses to find value of heat insulation of different building materials.

LIGHTING. Home Lighting. Nat. Elec. Light Assn.—Serial Report 289-119, Sept. 1929, 11 pp., 4 figs. Potential domestic lighting market is discussed and it is shown that this market can be developed by establishment of "service" in home lighting; outline of necessary qualifications of home lighting specialists' functions of lighting service division and their value to electric service company; potential market, its activities, equipment and value to other departments, are discussed.

HYDRAULIC LABORATORIES

MEMPHIS, TENN. Hydraulic Laboratory Planned for Mississippi River Studies, H. D. Vogel. Eng. and Contracting, vol. 68, no. 12, Dec. 1929, pp. 510-512, 5 figs. Foreign experimental installations tabulated and discussed, and proposed new laboratory at Memphis, Tenn., outlined; early work by United States engineers; general characteristics of foreign laboratories; general features of proposed laboratory.

HYDRAULIC TURBINE

BEARINGS. The Development of the Water-Turbine, R. W. Miller. Mech. World (Lond.), vol. 86, no. 2236, Nov. 8, 1929, pp. 442-444, 7 figs. Design of Escher-Wyss and other thrust bearings and method of lubricating bearings explained; method of taking away heat generated so that friction coefficient is maintained within safe limits; upper thrust rings divided into inner and outer rings.

GOVERNORS. Present Tendency in Methods of Hydraulic-Turbine Control (Les tendances actuelles en matière de régulation des turbines hydrauliques), M. Barbillon. Technique Moderne (Paris), vol. 21, no. 15, Aug. 1, 1929, p. 487. Action of several types of governor is mentioned, including mixed indications of tachyometer and accelerometer; double indication of Neyret-Beylier-Picard and Pictet governor, which has been installed on 4,000-kw. unit at Beauffort, Savoy, since 1925; and Ateliers des Charmilles governor.

PRESSURE CONTROL. Mechanics of Hydraulic-Turbine Pressure Regulation, A. Pfau. Am. Soc. Mech. Engrs.—Advance paper no. 34, for mtg. Dec. 2-6, 1929, 17 pp., 20 figs. Paper describes mechanical means whereby desired field results can be obtained under existing conditions of operation and of pipe line characteristics; calculations, formulae, and examples of speed and pressure control take up such points as closing gates, passing through position of static balance of turbine gates, formulae for speed regulation, effect of pressure variations on speed, and calculations of pressure rises in pipe lines.

PROPELLER. Increased Kilowatt Output of Adjustable-Blade Propeller Turbines, C. R. Martin. Am. Soc. Mech. Engrs.—Advance Paper, no. 28, for mtg. Dec. 2-6, 1929, 6 pp. 8 figs.

SPEED CONTROL. Changing Requirements in Hydraulic Turbine Speed Regulation, F. Nagler. Am. Soc. Mech. Engrs.—Advance Paper, no. 32, for mtg. Dec. 2-6, 1929, 6 pp., 8 figs. Hydraulic engineer of Allis-Chalmers Manufacturing Co. discusses design and operation of governing equipment of hydraulic turbines with special reference to flyball control and oil-pressure speed-reducing mechanism; discussion is illustrated with examples from practice of Louisville Hydro-Electric Co., Conowingo power plant, etc.

HYDRO-ELECTRIC POWER DEVELOPMENTS

IRELAND. The Shannon Hydro-Electric Power Development Scheme, B. Cunningham. Nature (Lond.), vol. 124, no. 3133, Nov. 16, 1929, pp. 763-766, 4 figs. Shannon undertaking is now at point of effective operation for partial development; attention is confined in this article to first stage or partial development, which is extent of present undertaking; this consists of works below Killaloe and comprises weir across river bed, artificial channel about 7½ mi. long, and tail race, 1¼ mi. long.

QUEBEC. Second Great Power Development on Saguenay River Begun at Chute-à-Caron. Eng. News Rec., vol. 103, no. 23, Dec. 5, 1929, pp. 889-895, 11 figs. 260,000 hp. generated by part of fall between tailwater of plant at Isle Maligne and tidewater at Chicoutimi to be developed at concrete dam, 200 ft. high, at Chute-à-Caron as first stage of 1,000,000-hp. development, in plant on Shipsaw River; large volume of water in river up to 300,000 cu. ft. interferes with construction.

SWITZERLAND. The Grimsel Hydro-Electric Power Scheme, G. M. Ross. Engineer (Lond.), vol. 148, no. 3854, Nov. 22, 1929, pp. 540-544, 10 figs. partly on p. 552. Scheme comprises main reservoir at Grimsel, connecting to auxiliary reservoir and catchment area at Gelmer, from which three power stations utilize water in turn, stations being sited at gradually descending levels down Haslithal; when first stage is completed in 1932, annual output will amount to 223 million kw. hr. from installed power of 100,000 hp.

HYDRO-ELECTRIC POWER PLANTS

CONOWINGO, MD. The Conowingo Hydro-Electric Development. Engineering (Lond.), vol. 128, no. 3331, Nov. 15, 1929, pp. 613-616, and 13 figs. partly on Supp. Plate. Details of seven combined main and auxiliary alternator sets; four of these were manufactured by General Electric Co. and remainder by Westinghouse Electrical and Manufacturing Co.; each main alternator has output of 40,000 kva., and supplies three-phase current at pressure of 13,800 volts and frequency of 60 cycles, when running at 81.8 r.p.m.; description of switchgear. (Concluded.)

DESIGN. Recent Advances in the Utilization of Low-Head Water Powers, S. Svenningson and E. Brown. Eng. Jl. (Montreal), vol. 12, no. 11, Nov. 1929, pp. 567-580, 19 figs. Review of more important improvements, in design, construction, and operation of water wheels, power-houses, and other elements of hydro-electric plants utilizing heads up to 200 ft.; effects of higher specific speed; high-speed runners; propeller runners with movable and adjustable blades; rubber as lining for water-wheel guide bearings; amount of concrete pe. lineal foot of power house. Paper presented before World Eng. Congress, Tokyo.

NORWAY. West Coast Country Community Power Company—Aavella Power Plant (Vest-Opland kommunale kraftselskap—Aavella kraftanlegg), J. Moelmen. Teknisk Ukeblad (Oslo), vol. 76, no. 40, Oct. 3 1929, pp.407-412. Power plant in Western Norway is described; two Pelton wheels each of 1,960 hp. are installed; head is 308 m.; pipe line is partly of steel and partly of wood; history of progress of work, cost of building, and running expenses are given.

ONTARIO. Adjustable-Blade Runners Increase Hydro Plant Output, J. F. Roberts. Power, vol. 70, no. 21, Nov. 19, 1929, pp. 792-795, 7 figs. Plant designed for ten 12,000-hp. units at 26-ft. head; adjustable-blade propeller runners allow increasing output of each nearly 2,000 hp. during low-head high-water conditions; two units have ejectors in draft tube to increase runners' output during high-water conditions.

Smoky Falls Hydro Station. Power Age, vol. 6, no. 11, Nov. 1929, pp. 69-74 and 88, 8 figs. Discussion of electrical features of Spruce Falls Power and Paper Co. plants at Smoky Falls and Kapuskasing.

PUMPED STORAGE. Extension of High-Pressure Storage Installation at Murg-Schwarzenbach Plant (Erweiterung der Hochdruck-Speicheranlage des Murg-Schwarzenbach-Werkes), E. Treiber. V.D.I. Zeit. (Berlin), vol. 73, no. 33, Aug. 17, 1929, pp. 1156-1158, 4 figs. Hydraulic storage of electric energy has been successful in Murg-Schwarzenbach plant, second storage pump of twice the output of largest present pump; installation of these pumps in places not designed for it, requires special design of water supply and drawings.

Hydraulic Power Plants with Pumped Storage (Kraftwasserpeicheranlagen), R. W. Mueller. Dinglers Polytechnisches Jl. (Berlin), vol. 344, no. 8, Aug. 1929, pp. 153-159, 10 figs. System of water storage by means of Sulzer pumps in times of low loads; increase in application of Sulzer pumps from 1905-1928; combined steam and hydraulic operation with water storage; typical load diagrams for large and small cities; 4,500-hp. two-stage Sulzer pump equipment; description of hydro-electric plants equipped with hydraulic storage.

QUEBEC. Westbury Basin Hydro-Electric Plant Supplying the City of Sherbrooke. Contract Rec. (Toronto), vol. 43, no. 48, Nov. 27, 1929, pp. 1381-1384, 7 figs. Description of recently completed power development on St. Francis River, near East Angus, Que.; equipped with two 2,900-hp. units; growth of generating capacity for Sherbrooke, Que.; list of plants supplying Sherbrooke.

SASKATCHEWAN. Island Falls Hydro Power Development, F. S. Small. Can. Engr. (Toronto), vol. 57, no. 23, Dec. 3, 1929, pp. 765-770, 11 figs. Description of most northerly power development in Canada; geographical and drainage conditions of Churchill River basin; temporary plant supplies power for construction of main development which will have initial capacity of 44,500 hp. and ultimate capacity of 86,000 hp. and will include concrete gravity dam of about 80 ft. maximum height, concrete spillway dam of Ogee profile and 100,000 cu. ft. per sec. in capacity.

WASHINGTON. Nature Makes Settings for Tacoma's Low Cost Water Power, I. F. Montgomery. Universal Engr., vol. 50, no. 5, Nov. 1929, pp. 19-23, 16 figs. Brief history of electricity generation; general statistical review of Nisqually power house and Cushman power plant; electric line system.

I

ICE FORMATION

ST. LAWRENCE. St. Lawrence and Its Ice Problem, H. T. Barnes. Can. Engr. (Toronto), vol. 57, no. 21, Nov. 19, 1929, pp. 738-739. Ice formations and their effect on navigation and power development; formation of anchor ice; chemicals to destroy ice.

ADHESION. The Formation and Adhesion of Ice, H. T. Barnes. Eng. Jl. (Montreal), vol. 12, no. 10, Oct. 1929, pp. 549-551. Results of investigation carried out on formation of anchor ice which throw considerable light on condition under which ice film will adhere to aircraft; formation of snow, hoar frost, hail, sleet, and ice-sand; temperature and humidity; velocity of air currents; terrestrial radiator; comparison with ice in water.

IMPACT TESTING

NOTCHED-BAR. Fractures in Steel and Significance of Transition Region of Notch Toughness (Die Brucharten des Stahles und die Bedeutung des Uebergangsgebietes der Kerbzaehigkeit), F. Fettweis. Stahl und Eisen (Dusseldorf), vol. 49, no. 45, Nov. 7, 1929, pp. 1621-1627, and (discussion) 1627-1628, 11 figs.

INDUSTRIAL ECONOMICS

CANADA. The Movement of the Centres of Population, Industry and Developed Water Power in Canada, H. E. M. Kensit. Eng. Jl. (Montreal), vol. 12, no. 11, Nov. 1929, pp. 605-609, 3 figs. Article previously indexed from Can. Engr., Oct. 29, 1929.

INTERNAL-COMBUSTION ENGINES

DESIGN. Pressures in Combustion-Chamber Engines (Der Druckverlauf im Zuendkammermotor), H. Ruehle. Zeit. fuer Tecknische Physik (Leipzig), no. 10, 1929, pp. 465-472, 7 figs. Graphical mathematical method of solution of differential equations is applied to problem of machine design and it is shown how difficult calculations can be made clear by systematic treatment.

THERMODYNAMICS. The Thermodynamics of Heat Transference, A. A. Herzfeld. Automobile Engr. (Lond.), vol. 19, no. 259, Oct. 1929, pp. 374-376, 3 figs. Calculations affecting output of internal-combustion engines are given; only turbulent flow considered is developing formulae for heat transference during combustion and expansion in high speed engine; formulae of von Karman and Latzko; flow conditions in cylinder analyzed; border gas layer for various piston positions; calculation of duration and rate of propagation of combustion; mass rate of combustion; influence of dissociation on combustion.

(*See also Diesel Engines; Gas Engines; Motor Buses; Oil Engines.*)

IRON AND STEEL INDUSTRY

PRODUCTION, CANADA. Production of Iron and Steel in Canada. Iron and Steel of Canada (Gardenvale, Que.), vol. 12, no. 10, Oct. 1929, pp. 260-261. Statistics are given for production of pig iron, ferro-alloys, steel ingots and castings, and prices. during August, 1929 and eight months preceding August as well as 1928.

IRON AND STEEL PLANTS

HAMILTON, ONTARIO. Improvements at Hamilton Steel Plant. Iron and Steel of Canada (Gardenvale, Que.), vol. 12, no. 10, Oct. 1929, pp. 253-255, and 259, 5 figs. Description of new open-hearth furnaces, merchant mill, gas holder and other additions made by Steel Co. of Canada, Ltd., to their Hamilton works.

L

LEAD SMELTING

BLAST FURNACE. Smelting in the Lead Blast Furnace, G. L. Oldright and V. Miller. U.S. Bur. of Mines—Reports of Investigations, no. 2966, Nov. 1929, 7 pp. Supplement to U.S. Bur. of Mines—Report of Investigations, nos. 2954, 2957, 2963 and 2965; effect of conditions at various tuyeres on form of lead and composition of slag. Conclusion of series of 5 papers based on data collected from one furnace of Int. Smelting Co. at Tooele, Utah.

LEAD-ZINC MINES AND MINING

AUSTRALIA. Mount Isa's Plans for Mining, Milling, and Smelting Outlined, E. C. B. Heden. Eng. and Min. Jl., vol. 128, no. 20, No. 16, 1929, p. 778. Glory holes will be used in mining oxidized ore at Mount Isa; this part of orebody extends to depth of 200 ft.; shrinkage stoping will be used in extracting sulphide ore; first production plans call for 1,500 tons of oxidized ore daily to be treated by gravity concentration and flotation, and for 500 tons of sulphide ore daily, to be treated by flotation only; flow sheet is given.

LIGHTING

INDUSTRIAL. The Elements of Good Factory Lighting, D. W. Thorpe. World Power, vol. 12, no. 70, Oct. 1929, pp. 337-342, 9 figs. Illustrated description of good and efficient factory lighting; consideration of lighting-points to be adopted in general lighting; article considers aspect of good factory lighting with relation to efficiency.

LIGHTNING ARRESTERS

ZIGZAG. Unshackling the Lightning Arrester, B. E. Ellsworth. Elec. World, vol. 94, no. 19, Nov. 9, 1929, pp. 935-936, 1 fig. Elimination of lightning troubles is apparently result of Zigzag arrester connection in use by Iowa-Nebraska Light and Power Co. operating approximately 1,800 mi. of transmission line and serving 200 towns and villages.

LIGNITE DEPOSITS

ONTARIO. The Ontario Lignite Field, A. R. R. Jones. Can. Min. Jl. (Gardenvale, Que.), vol. 50, no. 45, Nov. 8, 1929, pp. 1056-1057. Notes of interview with T. F. Sutherland, acting deputy minister of mines of Ontario; area known as Onakawana, near Blacksmith Rapids on Aabitibi River, about 130 mi. north of Cochrane; drilling results indicates yield of 20,000,000 tons per sq. mi.; analysis of char before briquetting and of briquettes with 10 per cent asphalt binder.

LOCOMOTIVES

DIESEL. Requirements of Locomotive Design for Diesel-Engine Drive (Die Anforderungen des Lokomotivbaues an den Dieselmotor), F. Meineke. V.D.I. Zeit. (Berlin), vol. 73, no. 42, Oct. 19, 1929, pp. 1509-1512, 9 figs. Until now Diesel engines have been too expensive and complicated in construction to be efficient; this especially concerns drive between motor and driving wheels as Diesel engines of common design have been used; railroad practice requires suitable engine of constant performance in large range of speeds; requirements concerning design and performance of such engines are discussed.

PASSENGER. Great Northern Buys Six 4-8-4 Type Passenger Locomotives. Ry. Age, vol. 87, no. 19, Nov. 9, 1929, pp. 1097-1098, 1 fig. Locomotives built by Baldwin for operation over mountain territory between Havre, Mont., and Whitefish; cylinders, diameter and stroke 28 in. by 30 in.; total engine weight 472,120 lbs.; total engine wheelbase 45 ft. 6 in.; driving wheels 73 in.; maximum rated tractive force 67,000 lbs.

SUPERHEATER. A Note on Superheating and Locomotive Cylinder Efficiency, E. L. Diamond. Engineer (Lond.), vol. 148, no. 3854, Nov. 22. 1929, pp. 541-543, 4 figs. There appears to be no information of detailed character as to exact behaviour of steam in locomotive cylinder under varying running conditions; writer reconstructed quantitatively two series of indicator diagrams taken at Pennsylvania Railroad Co.'s locomotive testing plant at Altoona; these relate to E6S 4-4-2 and K4S 4-6-2 superheater locomotives; he suggests that it would be worth while to discover just how locomotive efficiency varies with superheat.

WHEELS, PRESSURE OF. Dynamic Pressure of Locomotive Wheels (Ueber den dynamischen Druck der Lokomotivraeder), G. Lomonossoff. Glasers Annalen (Berlin), vol. 53, nos. 5 and 6, Sept. 1 and 15, 1929, pp. 80-84 and 92-98, 12 figs. Mathematical analysis regarding dynamic effect of vibrations and forces of locomotive mechanism and of stresses upon springs, rails, and bridges.

LUBRICANTS

GREASES, ZINC OXIDE. An Electroplating Lubricant. Indus. Chem. (Lond.), vol. 5, no. 57, Oct. 1929, p. 412, 1 fig. As result of corrosion in Keenok friction gears when using ordinary lubricants and due to electrolytic action set up by differences in electric potential, firm of Keenok Gears Limited have introduced new lubricant; zinc oxide was chosen as most suitable material for lubricant; results from practical point of view has been to eliminate wear of parts.

OIL VISCOSITY. More Recent Results Concerning Viscosity of Lubricants Under Pressure (Neuere Ergebnisse ueber die Druckzaehigkeit bon Oelen), S. Kiesskalt. V.D.I. Zeit. (Berlin), vol. 73, no. 42, Oct. 19, 1929, pp. 1592-1903, 1 fig. Former experiments of author are completed on basis of later American experience; exponential equation for increase of viscosity under pressure is confirmed and more simple relation between sensitivity for temperatures and for pressure, are indicated with aid of curves. See reference to earlier work in Engineering Index, 1928, p. 504.

M

MACHINERY

DESIGN. A Revolution in Machinery Design, W. S. Kelley. Iron Age, vol. 124, no. 19, Nov. 7, 1929, pp. 1229-1231. In design of machinery revolution affecting industrial machinery, particularly represents breaking with tradition, being economical rather than technical; factors in imitating design; inhibitions in providing for power; habit of restricting application of power to one point of machine is heritage of older days; few designers making use of great flexibility of electric motors. (To be continued.)

FOUNDATIONS, VIBRATIONS OF. Vibration of Foundations (Ueber Fundamentschwingungen), H. Kayser. V.D.I. Zeit. (Berlin), vol. 73, no. 37, Sept. 14, 1929, pp. 1305-1310. Principles of new methods for computing resonance by means of energy equations; report on observations and measurements of vibrations of turbine foundations; comparison of calculated and observed results; effect of nature of foundation site; deadload compensation for dynamic stresses.

MALLEABLE-IRON CASTINGS

BRIDGE RAILS. Making Large Malleable Castings, E. F. Cone. Iron Age, vol. 124, no. 21, Nov. 21, 1929, pp. 1364-1366, 5 figs. Employment of large malleable-iron castings as railings for new Liberty Bridge which span Monongahela River in downtown district of Pittsburgh is discussed; posts and railings stand severe tests.

MARBLE QUARRIES AND QUARRYING

OHIO. Marble Cliff Quarries Company Manufactures Hydrate and Quicklime in Modern Plant, T. L. Collins. Pit and Quarry, vol. 19, no. 2, Oct. 23, 1929, pp. 67-70, 9 figs. Output of this plant is approximately 30,000 tons year, about one-half quicklime and one-half hydrate; operated in connection with this plant is pulverizing plant, manufacturing pulverized raw limestone; also ready-mix mortar plant.

MASONRY

STANDARDIZATION. A Standard Unit of Dimension for Masonry, F. T. Heath. Clay-Worker, vol. 92, no. 5, Nov. 1929, pp. 354-363, 16 figs. Construction problems due to lack of coordination in sizes of masonry materials; difficulties can be overcome by adoption of standard unit of dimension by architects, engineers, and masonry material manufacturers; unit should approximate one brick length plus one mortar joint, two brick widths plus two joints, or three brick thicknesses plus three joints; application of unit plan is given for face brick paving block, firebrick, etc.

MATERIALS

GRANULAR, HEAT CONDUCTIVITY OF. Method for Determination of Thermal Conductivity of Pulverulent Substances at High Temperatures (Ueber ein Verfahren zur Bestimmung der Waermeleitfachigkeit pulverfoermiger Koerper hohen Temperaturen), M. Pirani and Wangenheim. Zeit. fuer Technische Physik (Leipzig), no. 10, 1929, pp. 413-424, 7 figs. Method, experimental arrangements and equipment for determination at high temperatures and for different materials; measured values of various materials are given in tables and curves, and discussed.

METALS

FATIGUE OF. The Fatigue of Metals. Engineer (Lond.), vol. 148, no. 3855, Nov. 29, 1929, p. 584. According to Gough, in whole experience of National Physical Laboratory, no case has been encountered in which slip bands indicative of plastic yielding have not been apparent at stresses which would never fatigue material; surface defects have considerable influence on lowering fatigue strength; this, taken in conjunction with demonstration that fatigue strength is reduced by contact with liquids which produce chemical effect on metal, leaves little room for doubt that fatigue failure commences at surface of metal.

RARE. Metals of the Tungsten and Tantalum Groups, C. W. Balke. Indus. and Eng. Chem., vol. 21, no. 11, Nov. 1929, pp. 1002-1007, 14 figs. Chemical and physical properties of four metals, columbium and tantalum on one hand, and molybdenum and tungsten on other; in all cases minerals containing these elements are essentially salts of acid radical containing metal, for chemically these four elements are more acid in character than basic; preparation of metallic tungsten is considered typical case.

SOLIDIFICATION. Volume Changes During the Solidification of Metals and Alloys, W. E. Goodrich. Engineering (Lond.), vol. 128, no. 3331, Nov. 15, 1929, p. 659. Results of measurements made on behalf of Die Casting Committee of British Non-Ferrous Metals Research Association, on metals of low fusibility, viz., tin, lead, bismuth, antimony, and their alloys. Brief abstract of paper read before Faraday Soc.

TESTING, TENSILE. Tension and Compression. Metallurgist (Supp. to Engineer, Lond.), Oct. 25, 1929, pp. 146-147. Experience shows that in many ways different mechanical properties of engineering metals are closely linked together; close correlation exists between tensile strength and Brinell hardness, at all events in steel, while fatigue range also seems to be closely related to ultimate tensile strength; closer study of relation between tensile and compression properties of more important structural materials is essential.

X-RAY ANALYSIS. X-Ray Methods for Determining of Flaws in Construction Materials (Roentgenverfahren zur raeumlichen Ausmessung von Fehlstellen in Werkstoffen), C. Kantner and A. Herr. V.D.I. Zeit. (Berlin), vol. 73, no. 24, June 15, 1929, pp. 811-816, 24 figs. Principles of densographic and stereometrometric processes giving results of great precision far exceeding that of usual methods; description of special apparatus and method of using it, with special reference to study of flaws in castings and welds.

MINES AND MINING

CONTROL MAPS. A Well-Planned Numbering and Sketching System Facilitates Control of Underground Operations, A. Kwiecinski. Eng. and Min. Jl., vol. 128, no. 22, Nov. 30, 1929, pp. 848-850, 4 figs. Basis of system is division of entire mining area into rectangular blocks with 100 m. sides; each block is numbered and letters of different types are used to indicate different types of mine work; description of details of sketching system and conventional signs.

DEEP, VENTILATION. The Engineering Aspect of Dealing With Temperature and Humidity Conditions of Mine Atmospheres at the Great Depths Associated with some of the Gold Mines of the Witwatersrand, J. H. Dobson. Chem., Met. and Min. Soc. of S. Africa (Johannesburg), vol. 30, no. 2, Aug. 1929, pp. 58-62 and (discussion) 69-74. Mathematical study of heat exchange in mine air, rock and rock surface, and bodies of miners; refrigeration of mine air; economic limit of quantity of air for ventilation; refrigeration of air supply at surface; cooling effect of compressed air; use of liquid air; use of ice; direct cooling of workers.

MINING EXPLORATION

QUEBEC. A Review of Exploration Work in the Rouyn Camp, J. G. MacGregor. Can. Min. and Met. Bul. (Montreal), no. 211, Nov. 1929, pp. 1280-1289. General remarks, including discussion of geological problems, review of past and present exploration methods, and prediction as to type of exploration campaign that will be largely adopted in future search for ore.

MOTOR BUSES

ENGINES, HEAVY-OIL. Surveys the Present State of Progress of Heavy Fuel Engines and Their Possibilities, G. J. Shave. Bus and Coach (Lond.), vol. 1, no. 10, Oct. 1929, pp. 380-386, 5 figs. Possibilities which compression-ignition motor offers of utilizing wide field of cheap fuel; expenditure necessary for comprehensive research is sound investment; advantages and disadvantages of heavy-oil fuel; fuels available; combustion problems; heavy-oil vaporizers; vaporizer limitations; compression-ignition engines; fuel injection; constant-stroke pumps; heavy-fuel engines; fuel injectors; Diesel engines types; starting; maintenance and repair.

MOTOR TRUCKS

DESIGN. Motor Vehicle Design, J. B. Osler. Modern Transport (Lond.), vol. 22, no. 557, Nov. 16, 1929, (Supp. Sec.), pp. xxi and xxiii, 1 fig. Discussion of proper vehicle design and effect on motor-fleet operation; diagram showing operating cost per mile at various vehicle speeds; maintenance expenditure.

MOTORSHIPS

DIESEL (GRAINMOTOR). A Canadian Motorfreighter for Canal and Lake Service. Motorship, vol. 14, no. 11, Nov. 1929, p. 795, 1 fig. Grainmotor is 260 ft. in length o.a., with loaded displacement of 3,605 tons; on draft of 14 ft. she has capacity of 100,000 bu. of grain; equipped with 8-cylinder 4-cycle Bessemer Diesel engine delivering 800 s.hp. at 200 r.p.m.

N

NICKEL DEPOSITS

WORLD DEPOSITS. World Deposits of Nickel (Vaerldens nickelmalmstillgangar), H. Carlborg. Jernkontorets Annaler (Stockholm), no. 10, 1929, pp. 493-494. Brief history of nickel; description of nickel ore minerals, nickel-mining and refining processes; use of nickel and nickel alloys; geology of nickel deposits; mine production statistics are given for years 1913 to 1927; present yearly consumption is 40,000 tons. Bibliography.

NICKEL SMELTERS

ONTARIO. Where Frood Ore Will be Milled and Smelted. Eng. and Min. Jl., vol. 128, no. 20, Nov. 16, 1929, p. 773, 3 figs. Illustrations and brief notes describing construction work of International Nickel Co. at Copper Cliff, Ont.; initial output will be about 120,000 tons of blister copper yearly and probably 40,000 or 50,000 tons of nickel.

NOISE

MEASUREMENT OF. Measurement of Machine Noises, B. A. G. Churcher and A. J. King. Elec. Times, vol. 76, no. 1986, Nov. 14, 1929, p. 816, and (discussion). Comprehensive investigation carried out by Metropolitan-Vickers Electrical Co.; work was initiated with object of attacking in thorough and comprehensive manner problem of noise emitted by motors, but technique and measuring apparatus developed in connection with sound tests on motors are also directly applicable to other classes of apparatus. Paper read before Instn. Elec. Engrs.

O

OIL ENGINES

COMBUSTION IN. Ratio of Mixture and Combustion Processes in Oil Engines (Mischungsverhaeltnis u. Verbrennungsvorgaenge im Oelmotor), P. Meyer. V.D.I. Zeit. (Berlin), vol. 73, no. 24, June 15, 1929, pp. 824-826, 3 figs. Reference to earlier suggestions for determination of mixture ratio from exhaust-gas analysis; exact determination of constituents of combustion gases in self-mixing and injection engines in case of lack of air; combustion tests in bomb showed deviations in self-mixing engines; attempt to explain this phenomenon is made.

OPEN-HEARTH FURNACE PRACTICE

STEEL QUALITY. Getting Open-Hearth Steel Quality. Iron Age, vol. 124, no. 21, Nov. 21, 1929, pp. 1382-1384, 1 fig. Further review of round table discussion taking place at Open-Hearth Committee meeting of American Institute of Mining and Metallurgical Engineers; report of one of two Quality Control Committees for rimmed steel; quality in killed steel; progress on open-hearth investigation; pouring practice; use of purifiers for iron and steel; manganese vs. aluminum as deoxidizer; soaking pit heating and chipping costs; atomizing oil fuel with superheated steam. (To be concluded.)

ORE TREATMENT

CLASSIFICATION. The Importance of Classification in Fine Grinding, J. V. N. Dorr and A. D. Marriott. Eng. and Min. Jl., vol. 128, no. 23, Dec. 7, 1929, pp. 880-887, 26 figs. Discussion of wet fine grinding with mechanical classifiers, particularly as carried on at nine large copper milling plants in Western part of North America; paper is limited to information obtained from contact with machine with which authors are familiar, namely Dorr classifier and bowl classifier; flow sheets of some of larger mills are given, with tabular data on milling results.

P

PAINT

PLASTICITY OF. The Plasticity of Paint, F. H. Rhodes and J. H. Wells. Indus. and Eng. Chem., vol. 21, no. 12, Dec. 1929, pp. 1273-1277, 7 figs. Yield point of paint increases with concentration by volume of pigment in paint; in paints containing equal concentrations by volume of pigment yield point varies inversely with average particle size; this relationship is qualitative only and is affected by specific character of pigment; extent to which plastic characteristics of paint are altered by addition of given amount of thinner depend to some extent upon specific character of thinner; turpentine produces relatively less change in plastic characteristics than does either petroleum thinner or xylene.

PAVEMENTS

ASPHALT. Asphalt Pavements of Rough Texture, F. J. Leduc. Can. Engr. (Toronto), vol. 57, no. 22, Nov. 26, 1929, pp. 749-750. Construction of anti-skid pavements in Europe; definition of skidding; seal coats; sheet asphalt; application of rock asphalt; producing asphalt coule. Paper read at Asphalt Paving Conference.

BRICK. Brick Manufacturers Discuss Paving Practices at Annual Meeting. Eng. News-Rec., vol. 103, no. 24, Dec. 12, 1929, pp. 939-941, 1 fig. Abstracts of papers on losses in power-shovel grading, brick-laying by roller conveyors, improvements in brick-road construction, repairing and salvaging old pavements, fillers, bituminated sand as cushion material, asphalt and grout-filled sections and regional highway planning.

Flexible Bases for Vitrified Brick Pavements, H. F. Harris. Nat. Paving Brick Mfrs. Assn.—Proc. of mtg. Feb. 13-15, 1929, pp. 77-80 and (discussion) 81-83, 2 figs. Author discusses merits of flexible bases in light of experience of city of Trenton, N.J., mechanical analysis of black base mixtures; cost data.

TESTING. Field Testing for Transverse Strength of Pavement Slabs, W. C. Hammatt. Pub. Works, vol. 60, no. 12, Dec. 1929, pp. 471-472, 3 figs. Method of obtaining test beams and slabs which have been placed and cured under same conditions as pavement.

PHOTOELASTICITY

PHOTOELASTICITY. Some Experimental Methods and Apparatus for Determining the Stresses in Bridges and Framed Structures, E. G. Coker. Instn. Civ. Engrs.—Proc. (Lond.), pt. 1, no. 4733, 1929, 23 pp., 9 figs. Author reports on application of photoelastic methods to study of stresses in nitrocellulose models of arches; concludes that complete stress distribution in member can be found by mechanical measurements made on member itself combined with optical measurements obtained from transparent model, thus eliminating laborious calculations, especially in complicated structures of indeterminate type. Bibliography.

POTASH DEPOSITS

RUSSIA. Potash Deposits in the Urals, W. P. Kotchetkoff. Eng. and Min. Jl., vol. 128, no. 22, Nov. 30, 1929, pp. 842-845, 2 figs. Review of exploration work near Solikamsk and Ust Borovaya, in province of Perm; since 1917; potash mineral sylvite or potassium chloride occurs in rock salt; layers of primary mineral carnallite, magnesium-potassium chloride are also found; explored area of 60 sq. km. is estimated to contain total of 600,000,000 tons of potassium oxide; analysis and comparison with Stassfurt and Alsace salts are given.

POWER PLANTS

STEAM ACCUMULATORS FOR. Ruth's Accumulator for Peak Loads and for Standby Service in Electric Power Plants (Ruthsspeicher zur Spitzendeckung und als Momentanreserve in Elektrizitaetswerken), E. Praetorius. Elektrizitaetswirtschaft (Berlin), vol. 28, no. 490, Aug. 2, 1929, pp. 432-435, 4 figs. Momentary standby service as applied in plant in Malmo, Sweden, connected with municipal heating systems; systems of Munich, Elberfeld, Leipzig, Charlottenburg, etc.; savings and cost of energy; equipment load and wiring diagram of Charlottenburg plant are illustrated.

PRESSURE VESSELS

WALL THICKNESS. Non-Ferrous Metal Walls for Pressure Vessels (Die Wandungen der Dampffaesser aus Nichteisenmetallen), G. Hoennicke. Waerme (Berlin), vol. 52, no. 45, Nov. 9, 1929, pp. 835-841, 7 figs. Two examples are given of results obtained with cylinder plates of non-ferrous metal, described in Feb. 16 and 23, 1929, issues of this journal; riveted joint of cylinder exposed to internal pressure and its influence on thickness of plate; calculation of all parts of pressure-vessel walls with uniform degree of safety is recommended.

PUMPING STATIONS, ELECTRIC

DAYTON, OHIO. Economy Result of Electric Drive in Pumping Station, C. G. Tarkington. Water Works Eng., vol. 82, no. 25, Dec. 4, 1929, pp. 1755 and 1758. Synchronous motor driven centrifugal pumps furnish water for city of Dayton; methods of control; speed regulation; records show 75 per cent overall efficiency; power factor; efficiency; speed regulation; dependability of operation.

PUMPS, CENTRIFUGAL

PERFORMANCE. Characteristics of Centrifugal Pumps, E. L. Maag. Power House, vol. 23, no. 21, Nov. 5, 1929, pp. 17-21, 5 figs. Diagrams illustrating characteristic curves of 6- and 16-in. single-stage pump; importance of curves for designing engineer; diagram illustrating characteristic curves of 8- and 10-in. two stage pumps.

R

RADIATORS, HEATING

STEAM. Correct Methods for Venting Steam Radiators, T. N. Thomson. Plumbers Trade Jl., vol. 87, no. 10, Nov. 15, 1929, pp. 24-25, and 74, 4 figs. Description of method of overcoming venting troubles that occur when modern water-pattern radiators are used in one-pipe steam heating systems.

RAIL MOTOR CARS

FUELS. Distillate as Rail-Car Fuel, E. Wanamaker. Soc. Automotive Engrs.—Jl., vol. 25, no. 5, Nov. 1929, pp. 499-501, and 514.

GASOLINE-ELECTRIC. Gas-Electric Motor Car Transportation on Steam Railroads, P. M. Gillilan. South. and Southwest Ry. Club—Proc., vol. 20, no. 5, Sept. 1929, pp. 15-52 and (discussion) 53-61, 16 figs.

RAILROAD CROSSINGS

SIGNALS. Traffic Light Protects Crossing, B. L. Smith. Traction Shop and Roadway, vol. 2, no. 10, Oct. 1929, pp. 313-314, 2 figs. Chicago South Shore and South Bend Railroad protects Michigan City, Ind., crossing with city "stop and go" light; operation of signal; layout of electrical circuit.

RAILROAD SIGNALS

AUTOMATIC BLOCK. Automatic Block Signals Protect Train Movements. Ry. Signaling, vol. 22, no. 11, Nov. 1929, pp. 410-411, 3 figs. Either-direction signals on double-track line controlled automatically by approach of train through Canadian Pacific Connaught Tunnel; track and signaling layout; train establishes direction for signal control; auxiliary equipment.

RAILROAD SIGNALS AND SIGNALING

NEW METHOD. New Method of Train Describing. Modern Transport (Lond.), vol. 22, no. 558, Nov. 23, 1929, pp. 5-6, 4 figs. Apparatus just completed by Relay Automatic Telephone Co., in association with British Power Railway Signal Co.; installation of this nature has recently been put into service on British railway; features of new system are use of two wires only between cabins and ability of receiving cabin to pass on descriptions selectively to one or more boxes.

AUTOMATIC BLOCK. Normal and Reverse Direction Signals Solve Operating Problem for D. & R. G. W. on Mountain Grade. Ry. Age, vol. 87, no. 23, Dec. 7, 1929, pp. 1322-1324, 6 figs.; see also Ry. Signaling, vol. 22, no. 12, Dec. 1929, pp. 452-453, 5 figs. Description of signal installation, with control arranged for either-direction operation on either track, which has improved safety of train operation and increased track capacity; illustration of track and signal plan; zones used for control.

INTERLOCKING. Automatic Interlocker Saves over 8,000 Train Stops Annually. Ry. Signaling, vol. 22, no. 11, Nov. 1929, pp. 407-409, 8 figs. Simplified control system used at C. and A. N.Y.C. crossing at Streator Junction, Ill.; brief description of colour-light signals and emergency release switch, also relay box at crossing.

RAILROAD TERMINALS

MONTREAL. Economic Aspects of the Montreal Terminal, S. W. Fairweather. Can. Ry. Club—Official Proc., vol. 28, no. 6, Sept. 1929, pp. 25-59. Chart showing present rate of growth of greater Montreal in comparison with that of other metropolitan districts; brief description of proposed terminal facilities; tables showing transportation increase in last 40 years; diagrams illustrating growth of Canadian National Railways, Montreal Terminal; construction of Montreal Terminal will involve expenditure of $50,000,000; synopsis is given of tangible benefits.

RAILROAD TERMINALS, FREIGHT

LOUISVILLE, KY. Freight Terminal is Model of Efficiency, L. M. Brown. Elec Traction, vol. 25, no. 11, Nov. 1929, pp. 571-572, 4 figs. Interstate Public Service Co. constructs new freight terminal in Louisville, Ky., for efficient handling of its growing freight business; 22 cars loaded at one time; interchange with electric and steam lines.

RAILROADS

CANADA. Colonization and Development as Affecting Railway Construction and Operation, J. S. Dennis. Can. Ry. Club—Official Proc., vol. 28, no. 7, Oct. 1929, pp. 25-33. Brief history of work performed by Colonization and Development Dept. of Canadian Pacific Railway for past 57 years; results of activities undertaken for purpose of producing traffic; system a necessity in development of Canada as whole.

MOUNTAIN. Rack Railroads and Their Importance for Mountainous Countries (Los ferrocarriles de cremallera y su importancia para paises montanyosos), C. R. Mathaler. Anales de Ingenieria (Bogota), vol. 47, no. 433, April 1929, pp. 91-108, 12 figs. General discussion, with tabular data on maximum grades of steam railroads in Switzerland, France, and Austria; historical and descriptive notes on rack systems; switches and turnouts; steam locomotives; electric locomotive and cars; combined rack and adhesion railroads; comparison between adhesion and combined types, with corresponding tabular technical data.

RAILS

Flaw Detection. About 800,000 Rails Tested Electrically for Flaws, E. A. Sperry. Iron Age, vol. 124, no. 21, Nov. 21, 1929, p. 1366. Considerable success attained in non-destructive internal testing of steel rails for detection of flaws, particularly transverse fissures; two detector cars have made permanent records of about 800,000 rails showing condition of their internal structure. Abstract of paper presented before Nat. Metal Congress.

REFRIGERATION

Research. Methods of Obtaining Extremely Low Temperatures (Sur la manière dont on obtient les températures très basses), W. H. Keesom. Revue Universelle des Mines (Liége), vol. 72, no. 8, Oct. 15, 1929, pp. 225-233, 13 figs. Description of method developed in cryogenic laboratorory at Leyden; historical reference to liquefaction of ammonia gas in 1798, and helium in 1908, both accomplished in Holland; description of refrigeration research work of Kamerlingh Onnes; description of apparatus and practice in obtaining temperature of 2.3 deg. Kelvin, at which liquid helium exhibits properties differing from liquid helium at higher temperature.

REFUSE DISPOSAL

United States and Europe. Review of Question of Refuse Disposal (En oversigt over dagrenovationsporgsmaalet), S. Sorensen. Ingenioren (Copenhagen), vol. 38, no. 22, June 1, 1929. pp. 257-263, 16 figs. Mode of removal of waste in different cities in United States and Europe are described and compared as to costs and efficiency of systems.

REMOTE CONTROL

Optical Indicator. Remote Control with Pictorial Indication (Sinnbildliche Fernanzeige), Ahrens. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 22, no. 23, Nov. 8, 1929, pp. 439-440, 5 figs. Special type of electric position indicator developed by Siemens and Halske, to be used for movable bridges, sluices, ship control, etc., and which gives plastic pictorial idea of position of moving parts remotely operated.

ROLLING MILLS

Billet Mills, Design of. Improvement of Billet Mills (Die Entwicklung des Platinenwalzwerkes), W. Kraemer. Stahl und Eisen (Dusseldorf), vol. 49, no. 46, Nov. 14, 1929, pp. 1653-1654, 1 fig. Recommendations are made to improve efficiency of billet mills and reduce costs; plan of suggested mill for production of billets is shown as continuous mill is too costly, improved universal mill with Lauth three-high mill is proposed.

Journal Bearings. New Types of Journal Bearings in Rolling Mills (Neue Gleitlagerformen in Walzwerken), H. Weinlig. Stahl u. Eisen (Dusseldorf), vol. 49, no. 44, Oct. 31, 1929, pp. 1573-1579, 19 figs. Further development of bearings at Roechling iron and steel work in Woelklingen; bearings with linked chambers; pressure lubrication; testing of different kinds of wood to determine their adaptability; comparative experimental results; wood-frame bearing has been used successfully in different mills.

RESERVOIRS

Surveying. Levelling for Tunnels and Reservoirs for the Boston Metropolitan District Water Supply, L. G. Harris. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 10, Dec. 1929, pp. 2597-2607 and (discussion) 2601-2603. Details of method of running series of precise or first order levels from established Government bench-mark at Springfield, Mass., along railroads, to Boston via Oakdale, Mass. Discussion includes: Comparison with Cascade Tunnel, by H. B. Alvord; Cooperation of the United States Coast and Geodetic Survey, by J. B. Babcock, 3rd; Inaccuracy of Levelling Rods, by H. G. Avers; Coastal Surveys in Rhode Island, by L. L. Holland; Proper Monumentation, by C. H. Birdseye.

RESERVOIRS, CONCRETE

Construction. Reinforced Concrete Reservoir at Barnet. Concrete and Constr. Eng. (Lond.), vol. 24, no. 11, Nov. 1929, pp. 643-646, 3 figs. Methods of construction of 5,000,000-gal. water reservoir having depth of 12 ft.

Pittsburgh, Pa. Construction of Concrete Reservoirs with Special Reference to Foundation Work in Abandoned Mines, R. M. Riegel and G. L. Hendrickson. Engrs. Soc. West. Penn.—Proc., vol. 45, no. 8, Nov. 1929, pp. 343-366 and (discussion) 367-378, 11 figs. Design and construction of Brashear and McNaugher concrete distribution reservoirs for water works of Pittsburgh, Pa., 23,000,000 gals. and 5,500,000 gals. in capacity, respectively; maximum depth of water is 25 ft.; details of retaining walls, grouting operations, etc.; partly worked coal veins were found at both reservoir sites.

RETAINING WALLS

Halifax. Interesting Retaining Wall at Halifax. Surveyor (Lond.), vol. 76, no. 1972, Nov. 8, 1929, p. 429, 2 figs. Construction of masonry retaining wall of 27-ft. maximum height; details of reinforced-concrete beams used to bond wall.

RIVERS

Improvement, Models. Benefits of Proposed River Cutoffs Determined by Model. Eng. News Rec., vol. 103, no. 23, Dec. 5, 1929, pp. 886-888, 4 figs., editorial on p. 871. Des Moines River at Ottumwa, Iowa, reproduced in hydraulic laboratory of University of Iowa for determination of benefits of proposed cutoffs; construction of model; test procedure; effect of cut-off channels across bends; effect of channel enlargement.

ROAD CONSTRUCTION

Blasting. Blasting on Highway Construction Projects, H. M. Hamilton. Dupont Explosives Service Bul., Nov. 1929, 8 pp. 4 figs. Blasting as key to shovel efficiency; spacing, depth and diameter of holes as factors in blasting results; kinds and grades of dynamite best suited for blasting sand rock and limestone; circuit tester as saver of time and money; underloading blasting machine as precaution for avoiding misfires; steps for safeguarding property and traffic against damage from blasting.

Detours. Road Reconstruction without Detouring, W. A. Van Duzer. Eng. News Rec., vol. 103, no. 23, Dec. 5, 1929, pp. 884-885, 2 figs. Improvements of Lincoln Highway in Westmoreland County, Pa., between Greensburg and Ligonier where 3 mi. section traverses narrow creek valley and no parallel roads were available; plan necessitated carrying of traffic over right-of-way; alternating files of one-way traffic were maintained around steam-shovel operations and sections of concrete pavement during curing periods; with delays not exceeding 10-minutes to section.

ROAD MATERIALS

Bituminous. An Asphalt Emulsion for Road Surfaces. Can. Engr. (Toronto), vol. 57, no. 21, Nov. 19, 1929, pp. 733-734, 6 figs. Properties and uses of British road emulsion Colas in construction; successful tests on Ontario highways, airport runways, etc.

The Application of the Bituminous Sands of Alberta to Road Construction, K. A. Clark. Contract Rec. (Toronto), vol. 43, no. 48, Nov. 27, 1929, pp. 1398-1400. Scientific and Industrial Research Council of Alberta discusses effect of fine materials; kerosene; emulsion formation during bituminous sand separation operations; oil-in-water emulsions.

ROADS

Low Cost. Asphalt Paving Conference Deals with Improvement of Secondary Roads. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 776-778. Producers, Technologists and Contractors' Association discuss series of closely related papers on low-cost road construction, utilizing bituminous materials of all kinds at annual Asphalt Paving Conference at West Baden, Ind.; résumé of papers on cooperative research; methods of low-cost road construction; re-tread construction; oiling; subgrade treatment; non-skid surfaces; emulsions; airport runways.

ROCK DRILLS

Sharpening. Centralization and Electrification of Drill-Steel Shops Effects Savings in Labour, Fuel and Material, H. I. Altshuler and J. T. Lewis, Jr. Eng. and Min. Jl., vol. 128, no. 20, Nov. 16, 1929, pp. 766-769, 8 figs. Description of drill-sharpening equipment and practice of Companyia de Real del Monte y Pachuca, at Pachuca Hidalgo, Mexico; sharpening, formerly done at each of eight separate mines, is now concentrated at two central shops.

ROOFS

Design. Hangars Carry Expansion Ends of Long Roof Trusses, W. S. Wolfe. Eng. News-Rec., vol. 103, no. 21, Nov. 21, 1929, pp. 801-802, 2 figs. Roof details of new auditorium for industrial Mutual Association at Flint, Mich.; with one end of trusses free to swing on 6-in. pin at top of column, possible movement of 4 in. is provided for.

S

SAND AND GRAVEL PLANTS

Electric Drive. Gravel Plant Operation by Hydro Power, W. W. Southam. Can. Engr. (Toronto), vol. 57, no. 22, Nov. 26, 1929, pp. 745-746, 5 figs. Modern plant having capacity of 1,200 tons per hr. is operated entirely by electricity except two steam locomotives; electrically operated drag lines, motor-driven screens and washing plant.

SEAPLANES

Design. Large Flying Boats (Die Gross-Flugboote), Schuster. Glasers Annalen (Berlin), vol. 105, no. 7, Oct. 1, 1929, pp. 105-111, 8 figs. Problems to be solved in designs of seaworthy seaplanes, i.e., resistance and power requirements of flying boat at starting, and increase in weight when type of boat is enlarged; most important German and foreign flying boats are summarized; typical design of Rohrbach and Dornier flying boats.

SEPTIC TANKS

Data on. Data on Cesspools, Septic Tanks and Sewage Disposal Fields, W. A. Hardenbergh. Plumbers Trade Jl., vol. 87, no. 10, Nov. 15, 1929, pp. 12-14, 5 figs. Abstracts from bulletin issued by Connecticut Board of Health for regulation of sewage-disposal systems.

SEWAGE DISPOSAL

Sludge Utilization. Sludge Disposal at Marion, Ohio, F. G. Browne. Pub. Works, vol. 60, no. 12, Dec. 1929, pp. 449-453, 3 figs. Description of sewage disposal plant serving population of 25,000; five years experience with sludge disposal; operating details; costs.

SEWAGE DISPOSAL PLANTS

Design. Basing Sewage-Works Requirements on Stream Pollution Studies, A. C. Purdy. Eng. News-Rec., vol. 103, no. 21, Nov. 21, 1929, pp. 813-815, 4 figs. In Middletown, N.Y., defeat of first proposed bond issue, was followed by adoption of second and simpler plan after analytic work, which demonstrated necessity of proposed plan and offers satisfactory provisions against stream pollution at one-third cost of first project.

Japan. First Two Activated-Sludge Plants in Japan, T. Kawahara. Eng. News-Rec., vol. 103, no. 24, Dec. 12, 1929, p. 938, 1 fig. Features of Horidome plant of Nagoya, capacity 11,000,000 gals. daily, which will be roofed over and provided with ventilation shaft 100 ft. above level of adjacent roadway; also features of Atsuta plant, designed for capacity of 4,700,000 gals. per day in dry weather, serving population of 130,000.

SEWAGE PUMPING STATIONS

Hamilton, Ont. The Hamilton Intercepting Sewer and Main Pumping Station, H. S. Philips. Eng. Jl. (Montreal), vol. 12, no. 10, Oct. 1929, pp. 532-535, 6 figs. General description of system and equipment consisting of five 14- to 16-in. vertical centrifugal wood trash pumps with electric motors automatically operated by master controller.

SEWERAGE

Canada. Sewage Treatment for Grand Marais. Can. Engr. (Toronto), vol. 57, no. 20, Nov. 12, 1929, pp. 719-720. Abstract of report by Gore, Nasmith and Storrie, consulting engineers, Toronto, accompanying previously indexed report by J. C. Keith; single plant for population of 10,000, estimated to cost $415,000 with annual capital and operation charges amounting to $46,500 is recommended.

SEWERS

Outfall, Construction. Divers Place Pipe in 60-ft. of Water on Seattle Sewer Job. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 782-783. Method of placing 700-ft. length of cast-iron outfall sewer pipe, 4 ft. in diam., on piles which were driven in trench; pipe was lowered in 36-ft. lengths consisting of three 12-ft. sections that had been fastened together on shore.

Ventilation. Chlorine and Sewer Ventilation, H. C. H. Shenton. Can. Engr. (Toronto), vol. 57, no. 21, Nov. 19, 1929, pp. 731-732. Sewer ventilation and prevention of odours in sewage by use of chlorine; practice in London and America.

SHORE PROTECTION

Chicago. Lake Levels and Damage to Shore Property at Chicago, W. G. Potter. Eng. News-Rec., vol. 103. no. 20, Nov. 14, 1929, pp. 767-768, 1 fig. See editorial comment, p. 757. Waterfront development and disregard of highwater stages contribute to damage by recent storms; elevation of Lake Michigan 1860 to 1929; shore protection has become necessity; protection should be mainly by bulkheads or breakwaters parallel to shore; property owners should combine and thus get uniform and better construction at lower cost. Abstract of paper read before West. Soc. Engrs.

SHOVELS

Road Grading. Power-Shovel Production Grading Highway Roadbed, A. P. Anderson. Eng. News-Rec., vol. 103, no. 22, Nov. 28, 1929, pp. 860-861. Study of actual average rates at which power shovels were found to be operating and at which pay yardage was being handled on more than 120 going projects in various sections of United States; study includes analysis of 48,000 complete shovel cycles and compilation of records giving complete data on movement of more than 400,000 cu. yds. of excavation; effect of kind and character of material on power-shovel production in highway grading work.

SIPHONS

Concrete. Building High-Head Siphons on the Yakima Project. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 763-765, 4 figs. Description of 25 reinforced-concrete and joint pipe siphons of main and branch canals of Kittitas division; siphons are up to 13-ft. in diam., and concrete carries pressure heads up to 153 ft.; construction joints and details of reinforced-concrete siphons showing eccentric shoulder and copper water stop; leakage tests on ten concrete siphons show average loss of 0.0192 gal. per min. per linear foot of barrel.

SNOW REMOVAL

Railroads. The Operation and Maintenance of Railway Track in Districts of Heavy Snowfall, G. B. Brown. Eng. Jl. (Montreal), vol. 12, no. 11, Nov. 1929, pp. 588-590, 3 figs. Chief operation engineer of Canadian National Railway reports on practice of his company in using wedge-and-wing plows, rotary plows, and flanger cars. Paper presented before World Eng. Congress, Tokyo.

SOILS

Bearing Capacity. A Practical Method for the Selection of Foundations Based on Fundamental Research in Soil Mechanics, W. S. Housel. Univ. of Mich.—Dept. of Eng. Research, no. 13, Oct. 1929, 117 pp., 44 figs. Method is developed, in light of experiments with loaded round and square plates bearing on clays only; theory of pressure distribution on bearing areas, quite contrary to usual principles is developed; straight-line relation of bearing capacity to relative size of bearing area; characterization of soils by coefficients determined by tests.

SOLIDS

Viscosity in. Viscosity in Solids, R. L. Wegel. Bell Laboratories Rec., vol. 8, no. 3, Nov. 1929, pp. 94-99, 5 figs. Distortion of piece of solid matter is generally accompanied by two kinds of energy losses: thermodynamic losses due to changes of volume, and losses due to shearing between layers of material: these shearing viscous losses are discussed.

SPEED REDUCERS

Variable Speed. An Infinitely Variable Speed Gear. Gas and Oil Power (Lond.), vol. 25, no. 289, Oct. 3, 1929, p. 18, 1 fig. Description of infinitely variable-speed gear manufactured by Crofts, Ltd.; speed ranges from zero to 1,000 r.p.m. and above, also reverse; great advantage is of bringing machinery to rest or at any desired speed.

SPRINGS

Coil. Oscillations of Compound Springs, A. S. Langsdorf. Wash. Univ.—Sci. and Technology, no. 3, Oct. 1929, 17 pp., 4 figs. In order that springs of compound type may be designed to minimize oscillations under given operating conditions, it is necessary to analyze their performance by mathematical methods, so as to derive formulae in terms of spring constants; accordingly, analysis has been worked out to cover any general case.

STEAM-ELECTRIC POWER PLANTS

Deepwater, N. J. Deepwater—A New Idea in Central Stations. Power Plant Eng., vol. 33, no. 22, Nov. 15, 1929, pp. 1204-1214, 11 figs. Deepwater is one of first large central stations to go into operation utilizing 1,200 lbs. pressure exclusively and is also one of first to supply large quantities of high pressure exhaust steam to industrial plant; coal delivered both by rail and water; boilers to be operated at 1,350 lbs. drum pressure; forced and induced draft; heat balance diagram of deepwater; feedwater system; make-up feedwater is evaporated; list of principal equipment is given; turbine generators; condensing equipment; electrical features; instruments and metering.

England. The Hams Hall Generating Station of The Birmingham Corporation. Engineering (Lond.), vol. 128, nos. 3329, and 3332, Nov. 1 and 22, 1929, pp. 545-547 and 663-666, 18 figs. partly on supp. plate. Nov. 1: First section, now finished, comprises 60,000 kw., total cost of construction being 1,336,400 pounds; it contains two 30,000-kw. units, but there is room for a third set of same output, which it is proposed to erect in 1933-1934; details of coal-handling plant. Nov. 22: Boiler plant; ash-handling and water-softening plant.

The Portishead Generating Station of the British Corporation. Engineering (Lond.), vol. 128, no. 3331, Nov. 15, 1929, pp. 654-655, 3 figs. partly on p. 624. Station consists of four main sections, viz., boiler house, turbine house, and low-tension and high-tension switch houses, which are built in tiers on hill side; steam-raising equipment consists of four Vickers header straight-tube boilers, supplied by Vickers Boiler Co.; two main turbines were manufactured by Metropolitan-Vickers Electrical Co.; each main generating unit is solidly connected to bank of three 8,333-kva. transformers, whereby pressure is stepped up to 33,000 volts for transmission to Bristol.

STEAM HEATING PLANTS

District, Toronto, Ont. The Toronto Terminals Central Steam Generating Station, J. Breakey. Power House, vol. 23, no. 21, Nov. 1929, pp. 70 and 74-80, 17 figs. Illustrated description of power plant which will be used as supply steam for various purposes in Toronto; boiler equipment; ash handling steam for various purposes in Toronto; boiler equipment; ash handling; draft indicator; layout of boiler room, showing position of boilers, forced-draft fans, water-softening tank, etc.; electric winch; steam flow records; water measurement; feed pumps and generator set.

STEAM POWER PLANTS

Developments in. Scientific Developments in Steam-Driven Power Station Practice, D. Brownlie. Elecn. (Lond.), vol. 103, no. 2683, Nov. 1, 1929, pp. 525-526. Notes on pulverized-fuel firing; high-pressure boilers; substitutes for water in boilers; low-temperature carbonization; sulphur problem (To be concluded.) Extracts from paper read before Instn. Mech. Engrs.

Germany. Large Thermal Power Stations in Germany (Les grandes centrales thermiques allemandes), P. Jarrier. Technique Moderne (Paris), vol. 21, no. 16, Aug. 15, 1929, pp. 497-500, 3 figs. Review of present practice is concluded; cheapening of peak-load supply by utilization of water-power storage (natural or pumped) and by means of Ruths' thermal storages; particulars of large turbo-alternator sets and relative merits of alternative arrangements of high- and low-pressure and back-pressure units; back-pressure working is specially advantageous in district heating systems; appendix gives information dealing with high-pressure installations.

Heating and Power. Steam Stand-By and Central Steam Heating Plant of the City of Winnipeg, G. W. Oliver. Engineering (Lond.), vol. 128, no. 3331, Nov. 15, 1929, pp. 609-612, 7 figs. Details of stand-by plant of 11,000 kw. capacity combined with central heating division, utilizing boilers of stand-by plant during winter months; building is divided into four sections, comprising (1) coal-handling and preparation plant; (2) boiler room; (3) turbine room; (4) electric substation, each of which is described.

Power and Process. Power and Process Steam Supplied From Central Station to Paper Mill, W. G. Allen. Power, vol. 70, no. 20, Nov. 12, 1929, pp. 748-752, 4 figs.

STEEL

Annealing. Testing of Tempered Steel (Provning av hardat stal), A. Lundgren. Jernkontorets Annaler (Stockholm), no. 8, 1929, pp. 367-374. Communication from State Testing Laboratory on investigation of influence of speed of cooling after annealing on properties of tempered steel and influence of speed of annealing on properties of tempered steel; it is shown that increasing time of annealing increases resistance to bending and impact, but decreases hardness.

Creep. Creep of Steel Under Simple and Compound Stresses, R. W. Bailey. Engineer (Lond.), vol. 148, no. 3853, Nov. 15, 1929, pp. 528-529, 8 figs. Two series of tests are recorded; one was made upon steel tubes strained separately at same temperature by tension and torsion producing equal maximum shear stress; other was made upon lead pipes under internal pressure with superimposed axial loading. Paper read before World Power Conference, Tokio.

High-Speed, Cutting Qualities. Influence of Composition and Heat Treatment on Properties of High-Speed Steel Used as Cutting Tool (Om sammansattningens och varmebehandlingens inverkan pa snabbstalens egenskaper som skarande), G. Wallquist. Jernkontorets Annaler (Stockholm), no. 7, 1929, pp. 305-350, 41 figs. Results of American, German, and Swedish investigations show that vanadium is best alloy for improving cutting qualities of steel and that difference of 25 deg. cent. from ideal hardening temperature lowers cutting quality 65-86 per cent; ideal annealing temperatures for chromium-tungsten-vanadium high-speed steels and for cobalt steel are given.

Manufacture, Electric Process of. High Quality Steel Is Produced in Electric Furnaces, H. D. Phillips. Foundry, vol. 57, no. 23, Dec. 1, 1929, pp. 997-998. Practice at plant of Empire Steel Casting Co., Reading, Pa. for manufacture of acid steel in electric furnaces is discussed; general method used in manipulation of heats, with special emphasis on deoxidation of slag and removal of practically all of ferrous oxide from slag; 1-in. diameter round gate off green sand casting was bent 90 deg. with sledge hammer.

Working Stresses for Steel at High Temperatures, D. S. Jacobux. Am. Soc. Mech. Engrs.—Advance Paper, no. 22, for mtg. Dec. 2 to 6, 1929, 5 pp., 7 figs. Results of practical experience used for setting maximum working stresses up to temperatures of 800 deg. fahr.; above this, working stresses are scaled down in proportion to falling off of stresses producing creep; first curve of creep points published by J. J. French used and working stresses for given temperature are taken at ⅔ creep-point stress; effect on stress of piercing boiler shell with holes and of transmitting heat through equalization of stress through extension of most-strained fiber.

STREET LIGHTING

Winnipeg, Manitoba. Trends in Street Lighting, R. M. Love. Elec. News (Toronto), vol. 38, no. 21, Nov. 1, 1929, pp. 29-32, 7 figs. Features of street-lighting equipment in Winnipeg are discussed; principal street is lighted by 10,000 lumen lamps and asymmetric dome refractors; various types of lamp posts are illustrated.

STRUCTURAL STEEL

Inspection. Inferior Structural Steelwork, A. W. A. Eden. Eng. News-Rec., vol. 103, no. 20, Nov. 14, 1929, pp. 773-774, 5 figs. Author discusses objectionable practices in erection of steelwork of buildings, such as use of second-hand steel members, etc.; specific recommendations for prevention of abuses.

T

TOLERANCES

Skoda vs. D. I. N. System. German and Skoda Tolerances Compared—Discussion, G. Schlesinger and N. N. Sawin. Am. Mach., vol. 71, no. 22, Nov. 28, 1929, pp. 887-889, 3 figs. Reply to discussion of author's article published in Mar. 7 issue of magazine; proof is given that N. N. Sawin's proposal, based rather on point of view that workman should not be trained, than on requirements of interchangeable manufacture, cannot be applied in practice; workman, in applying new medium grade tolerances proposed to three most important classes of fits, may get so many rejections that it must be strongly recommended not to introduce such fits into workshops; data is given on press tests.

TUNNELS, RAILROAD

Construction. Tunnel Driving in the Cumberland Mountains. Construction Methods, vol. 11, no. 11, Nov. 1929, pp. 34-37, 9 figs. Report on excavation of more than 2,000,000 cu. yds. of material and driving of about 9,000 ft. of tunnel on 13.6 mi. of single-track construction for Louisville and Nashville Railroad; details of drilling and mucking, and bench excavation; heavy timbering was required; description of concreting plant.

TUNNELS, SERVICE MAIN

London. Damage to Post Office Cables by Fires in London Subways. Post Office Elec. Engrs. Jl., vol. 22, Oct. 1929, pp. 213-219, 4 figs. General description of London underground ducts for gas, water and electric mains, telephone cables, etc., covering about 7 mi. under city's main thoroughfares; flooding and fire in ducts in January and June 1928, respectively; restoration of lines and service.

TUNNELS, VEHICULAR

Detroit. Pressed Steel Plates Reduce Tunnel Lining Cost. Construction Methods, vol. 11, no. 11, Nov. 1929, pp. 50-51, 5 figs. Report on use of steel liners in construction of Detroit-Canada tunnel under Detroit River; liners are 2 ft. 6 in. wide and lining of tunnel is made up of rings each ring being composed of 11 segments and key section.

Liverpool. The Mersey Tunnel. Iron and Coal Trades Rev. (Lond.), vol. 119, no. 3217, Oct. 25, 1929, p. 622. History of project; principal features; contracts; tunnel shield is probably largest of type so far built, being 46 ft. 8 in. diameter.

V

VIADUCTS, CONCRETE

Construction. Concrete Handling on 4,800-Ft. Viaduct. Contractors and Engrs. Monthly, vol. 19, no. 4, Oct. 1929, pp. 72-75, 11 figs. Construction of new concrete structure and earth embankment, which replaces old wooden Harahan viaduct in Arkansas, opposite Memphis, including bridge across railroad tracks and 3,498-ft. viaduct with maximum height of 65 ft.; layout of materials-handling plant; pouring footings and columns; concrete railing cast on job.

W

WASHERS

Lock. A New Type of Lock Washer. Mech. World (Lond.), vol. 86, no. 2233, Oct. 18, 1929, pp. 366-367, 7 figs. Description of new locking principle applied to shakeproof washer manufactured by Barber and Colman, Ltd., Manchester; in two models positive locking action is obtained by twisted teeth that surround external or internal edge of washer; another type particularly used with countersunk-head screws; another type combines locking device with terminal.

WATER PIPE LINES

Materials. Large Water Pipe. Eng. News-Rec., vol. 103, no. 24, Dec. 12, 1929, pp. 922-927, 1 fig. Editorial comment on p. 914. Symposium on materials, joints coatings and cause of breaks and other factors in design and construction including following articles; Reliable Pipe for Main Arteries in Large Cities Needed, C. B. Burdick; Steel Chosen for 54 in. Water Intake at East Chicago, P. Hansen; One Firm's Practice as to Choice of Materials for Pipe Over 30 in. Diameter, D. W. Howes; Earlier Conclusions on Value of C. for Various Materials after Use Confirmed, D. H. Maury.

Railroad Crossings. Pipe Tunnels for Water Mains under Railroad Tracks, L. G. Lenhardt. Eng. News-Rec., vol. 103, no. 21, Nov. 21, 1929, p. 816, 1 fig. Pipe in tunnel generally preferable to pipe buried in trench; cost of supporting tracks; practice at Detroit. Abstract of paper read before Am. Water Works Assn.

WATER WORKS

Calgary, Alberta. Extensions to Water Works, Calgary, Gore, Nasmith and Storrie. Can. Engr. (Toronto), vol. 57, no. 20, Nov. 12, 1929, pp. 707-710, 1 fig. Abstract of consulting engineers' report covering present water-supply system and proposals for extensions; recommended supply from Elbow River to cost $3,770,000; areas, population, and density of population in various cities in Canada; Chinook reservoir proposed.

WEIRS

Discharge of. Measuring Flow of Water with Sharp-Edged Weirs (Wassermessung mit scharfkantigen Ueberfallwehren), T. Rehbock. V. D. I. Zeit. (Berlin), vol. 73, no. 24, June 15, 1929, pp. 817-823, 5 figs. General review of weir-discharge theories; effect of temperature on velocity distribution in weir nappes; critical review of weir-discharge formulas beginning with Poleni's formula, published in 1767; justification of author's original formula published in 1911 on basis of 280 recent weir-discharge determinations by various investigators; author presents new simplified and more usable form of his original 1911 equation expressing discharge of weirs.

Fully Contracted Weirs, J. G. Burnell. Instn. Engrs. of Australia—Jl. (Sydney), vol. 1, no. 10, Oct. 1929, pp. 361-369, 2 figs. Available experimental data are summarized; subject of end contractions is discussed and conclusions reached as to true values of same for rectangular weirs; comparison is made of discharges given by modified formula of Hamilton Smith, Jr., with all available data, very satisfactory agreement being shown for rectangular suppressed weirs of any proportions; results obtained with short weirs by Steward and Longwell at Boise, in 1911; work of Schoder and Turner on suppressed weirs.

WELDING

Electric. *See Electric Welding.*

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

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A

ABRASIVE MATERIALS

TESTING. Determination of Breaking Strength of Granular Abrasives (Bestimmung der Bruchеigenschaften gekoernter Schleifmittel), C. Krug. V.D.I. Zeit. (Berlin), vol. 73, no. 48, Nov. 30, 1929, pp. 1707-1709, 6 figs. Testing of corundum and silicon carbide; resistance against rapidly changing loads; curves for analyzing qualities from breaks, allowing for making of specifications for grinding wheels.

AERIAL TRANSPORTATION

CANADA. Canadian Aviation in 1929, H. A. Somerville. Airway Age, vol. 11, no. 1, Jan. 1930, pp. 58-60, 2 figs. Increases registered in all phases of Dominion aeronautics; 24 accidents which cost lives of 29 individuals; 89 commercial operators and 27 private owners; Western Canada Airways operating 33 aircraft; Government air service; winter flying; new airports; Indian treaty made; transatlantic route; air mail; number of flights.

AERODYNAMICS

AIR RESISTANCE. Air Resistance at Very High Velocities (Der Luftwiderstand bei sehr grossen Geschwindigkeiten), J. Ackeret. Schweizerische Bauzeitung (Zurich), vol. 94, no. 15, Oct. 12, 1929, pp. 179-183, 18 figs. Discussion of laws of resistance of air to bodies moving with very high velocities on basis of theoretical studies and experimental results obtained at Kaiser Wilhelm Institute of Aerodynamic Research; streamline photographs of projectiles; applications of these laws to ballistics, design of high-speed steam turbines and aeronautics.

AERONAUTICS

PROGRESS IN. Progress in Aeronautics. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 3-13, 6 figs. Progress report prepared by Aeronautic Division of American Society of Mech. Engineers covering following subjects: power plants; airplane design and construction; aerodynamics; air transport and other civil flying; progress of naval aviation; military aircraft progress in 1929; airships; airports.

AIRPLANE ENGINES

DIESEL. Diesel Airplane Engines (Les moteurs diesel d'aviation), A. Frachet. Nature (Paris), no. 2815, Aug. 15, 1929, pp. 166-170, 7 figs. Problem of adaptation of Diesel engine to aviation as solved in Germany with Junkers engine and in England with Beardmore is discussed; of Diesel in safety from fire on board airplane; reliability in operation and simplicity of construction; possibilities realized in high-speed Diesel; Packard Diesel constructed in series; results of work of Junkers; test of Beardmore.

MANUFACTURE. Layout of a Manufacturing Plant, F. L. Faurote. Iron Age, vol. 124, no. 26, Dec. 26, 1929, pp. 1730-1731. Description of layout of plant Wright Aeronautical Corp., for manufacture of airplane engines; foundations laid for system of mass production and unit assembly; engines mounted on special assembly frames equipped with wheels so that power unit may be moved along tracks as weight grows.

TESTING. Developing a New Type of Motor. U.S. Aviation Quarterly, vol. 1, 1929, p. 43. Discussion of various tests made at Aeronautical Engine Laboratory, Naval Aircraft factory, Philadelphia, which may affect profoundly design of internal combustion engines; tests on Prestone cooling liquid which would permit smaller radiator; possibilities of closed system.

AIRPLANE PROPELLERS

VARIABLE-PITCH. Variable-Pitch Propellers, F. W. Caldwell. Soc. Automotive Engrs. Jl., vol. 25, no. 6, Dec. 1929, pp. 656-664 and (discussion) 664-666, 16 figs. Effect of camber ratio and of angle of attack on speed at which burble occurs; efficiency of propellers as static-thrust producers; method of momentum to compute thrust and application of adjustable-pitch propellers to supercharged engines; causes of forces required to operate control adjustments; method of elastic-stress analysis; with increase of propeller-tip speeds and engine horsepower, aerodynamic advantages of controllable-pitch propeller become more important.

AIRPLANES

GLIDERS, USE OF. On Motorless Flying. Aeroplane (Lond.), vol. 37, no. 19, Nov. 6, 1929, pp. 1089-1090, 1092, 1094 and 1096, 9 figs. Use of gliders for sport and also for purpose of scientific research is discussed; comparison with bird flight; opinions of C. Lougheed considered; it has been shown in Germany that serious gliding experiments, expecially in study of gliding angles, can be made with help of ordinary airplane.

SPEED. The Economic Speed-Weight Relation in Air Transportation, E. P. Warner. Soc. Automotive Engrs. Jl., vol. 25, no. 6, Dec. 1929, pp. 635-640, 6 figs. Relations of payload to engine horsepower, initial cost of airplane and engine, costs per pound of payload and per passenger-mile, and value of time saved by greater speed; five means for securing higher cruising speed; seeking to operate at cruising speeds of more than 1.8 times minimum flight speed does not appear economically advisable at present; increasing cruising speed depends on use of engines, engine combinations, maintenance methods and large smooth airports.

STABILITY. Balancing and Stability of Airplanes (Centrage et stabilité des avions), M. Guibert, Aéronautique (Paris), vol. 11, no. 125, Oct. 1929, pp. 339-346, 10 figs.

Longitudinal Stability for Very Large Airplanes, A. Kelmin. Aviation Eng., vol. 2, no. 12, Dec. 1929, pp. 9-11, 1 fig. Problem of longitudinal stability of airplane is discussed taking damping into consideration; suggestion is made that large machines can be short coupled, have their weight concentrated along longitudinal axis, and have large static stability secured mainly by constant centre of pressure, or other methods independent of product of tail area.

AIRSHIPS

R 100. H. M. Airship R 100. Engineer (Lond.), vol. 148, no. 3856, Dec. 6, 1929, pp. 604-605, 4 figs., partly on p. 608. R 100, built at Howden, Yorkshire, is fitted with gasoline engines which is likely to result in flights being confined to cool climates, including Transatlantic voyages; equipment consists of six Rolls-Royce "Condor" III B engines, each developing 660 hp.; passengers and crew are accommodated in three-decked compartment slung inside hull at point forward of its maximum diameter; length 709 ft.: max. diam. 133 ft., over-all height, 135 ft.; gas capacity is over 5,000,000 cu. ft.

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

ANTI-CORROSIVE. Properties of Corrosion-Resisting Alloys, P. S. Menough. Blast Furnace and Steel Plant, vol. 17, no. 11, Nov. 1929, pp. 1648-1651 and 1655, 3 figs.; see also Heat Treating and Forging, vol. 15, no. 11, Nov. 1929, pp. 1437-1440, and 1450, 3 figs.

BEARING METALS. *See Bearing Metals.*

MAGNESIUM. *See Magnesium Alloys.*

ALUMINUM ALLOYS

CASTINGS. Cast Aluminum Alloy That Compares With Die Castings, L. H. Fawcett. Iron Age, vol. 124, no. 26, Dec. 26, 1929, pp. 1722-1724, 4 figs. Description of unusual practice at United States Naval Gun Factory for casting aluminum alloys; castings are made in sand and require minimum machining; metal and wooden patterns used; moulding of chute casting; typical case; closing mould and pouring; machining and assembling; casting made with tolerances approaching die castings.

PROPERTIES. Brinell Hardness, Elastic Limits, and Tensile Strength of Commercial Aluminum Alloys (Brinelhaerte, Elastizitaetsgrenze und Zugfestigkeit verguetbarer Aluminium legierungen), H. Bohner. Zeit. fuer Metallkunde (Berlin), vol. 21, no. 11, Nov. 1929, pp. 387-389, 1 fig. Influence of different stresses and duration of stress on Brinell hardness; formula is proposed for calculation of Brinell hardness of aluminum-copper alloys from tensile strength and elastic limits; further tests are deemed necessary.

ARMOUR PLATE

MACHINING. An Armour Plate Ordeal for Tungsten-Carbide, H. A. Ingram. Am. Mach., vol 72, no. 2, Jan. 9, 1930, pp. 39-42, 6 figs. Description of difficult and unusual job recently completed by Hull Construction Department at United States Navy Yard, Puget Sound; machining face-hardened nickel-steel armour plate by utilizing peculiar cutting properties of tungsten-carbide after ordinary cutting tools had repeatedly failed; comparison of methods for cutting armoured tube shown.

B

BEARING METALS

THERMIT. A New Product of Bearing-Metal Research. Metal Industry (Lond.), vol. 35, no. 19, Nov. 8, 1929, pp. 441-442. Description of alloy bearing metal known as Thermit of Universal Bearing Metal, which had been produced by T. Goldschmidt, A.G., Essen, in connection with G. von Hanffstengel: structure of Thermit comprises uniformly distributed hardening bodies bedded in plastic eutectic ground-mass which is rich in lead; through high softening point of Thermit alloys, favourable hardness conditions are maintained; slipperiness of Thermit investigated by process of von. Hanffstengel; casting of Thermit. Abstracted from Technische Blaetter, Aug. 4.

BLAST FURNACES

GERMANY. Blast-Furnace Plant of Fried. Krupp Company at Essen-Borbeck (Das Hockhofenwerk der Fried. Krupp Aktiengesellschaft in Essen-Borbeck), R. Dietrich. Kruppsche-Monatschefte (Essen), vol. 10, no. 139, Oct. 1929, pp. 139-159, 29 figs. Plant and auxiliary machinery are fully described and illustrated, in addition to numerous photographs in text, map of layout of works, plans and elevations of various machines, and elevation of one of blast-furnaces are given.

PRACTICE. Modern Blast Furnace Theory and Practice, R. H. Sweetser and S. P. Kinney. Iron and Steel Eng., vol. 6, no. 11, Nov. 1929, pp. 575-579, 2 figs. Adoption of measure of performance of blast furnace has indirectly resulted in almost doubling daily output of pig iron in stacks of given height and bosh diameter; cleaning blast-furnace gas; movement of hot metal; adoption of three-shift day; merchant blast furnaces.

BOILER CODES

A.S.M.E. Revisions and Addenda to the Boiler Construction Code. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 77-78. Boiler Code Committee has received and acted upon number of suggested revisions which have been approved for publication as addenda to code; these are published with corresponding paragraph numbers to identify their location in various sections of code and are submitted for criticism and comment.

BOILER FURNACES

WATER-COOLED. Determination of Circulating Speed in Cooling-Wall Tubes (Bestimmung der Umlaufgeschwindigkeit in Kuehlwandrohren), W. Boie. Feuerungstechnik (Leipzig), vol. 17, no. 21-22, Nov. 15, 1929, pp. 232-235, 9 figs. Increase in efficiency of boilers demands water-cooled combustion chamber walls; their increasing use necessitates paying of greater attention to circulation in cooling tubes; method of determining steam-water mixture and velocity is described.

BOILER TUBES

HEAT TRANSMISSION IN. Determination of Heat-Transfer Coefficients by Means of Diffusion Tests (Bestimmung von waermeuebergangszahlen durch Diffusionsversuche), W. Lohrisch. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 322, 1929, p. 46-49. Heat transfer of flowing gases in tubes arranged perpendicularly to direction of flow was investigated by Thoma's method of determining heat-transfer coefficients from diffusion phenomena; heat-absorption tests were carried out on rotating single tubes (atmos boilers); heat-transmission coefficient is established as function of air velocity and suggestions are made for improving heat transfer.

Heat Transfer in Water Tubes (Waermeuebergang in Wasserrohren), F. Jaklitsch. Waerme (Berlin), vol. 52, no. 46, Nov. 16, 1929, pp. 851-854. As results of tests carried out by Soennecke, it is shown that transmission in water tubes can be determined by formula already developed for air and steam; this fact suggests possibility of existence of single heat-transfer law, independent of substance or its aggregate state.

BOILERS

DESIGN. Utilization of Heat Radiation as Means of Reducing Cost of Boiler Plants (Die Ausnutzung der Waermestrahlung als Mittel zur Verbilligung von Kesselanlagen), W. Schultes. Waerme (Berlin), vol. 52, no. 49, Dec. 7, 1929, pp. 939-944, 12 figs. Theory of radiation boiler is discussed and diagrams are presented to illustrate heat transfer by radiation, and contact; examples are given of two kinds of boilers utilizing heat radiation, namely water-tube with cooled furnace and fire-tube boiler with pulverized-coal furnace and no ignition chamber.

MANUFACTURE—WELDING. Welding of Boilers, Pressure Vessels and Steam Lines, C. W. Obert. Power, vol. 70, no. 23, Dec. 3, 1929, pp. 904-905. Outline of present status of fusion welding and attitude of A.S.M.E. Boiler Code Committee and other authorities. Abstract of paper read before Int. Acetylene Assn.

OPERATION, LOAD DISTRIBUTION IN. A Method of Loading Boilers for Maximum Fuel Economy, B. M. Thornton. Engineering (Lond.), vol. 128, no. 3336, Dec. 20, 1929, pp. 796-797, 5 figs.

WATER-TUBE. High-Capacity Boilers at Low Cost (Der billige Hochleistungskessel), O. Wirmer. Waerme (Berlin), vol. 52, no. 48, Nov. 30, 1929, pp. 904-908, 4 figs. In view of unfavourable business conditions in Germany, and present lack of funds, possibilities of developing cheaper design of water-tube boilers were studied with result that new type of vertical-tube boiler with two drums has been developed which is capable of maximum loads.

Model Tests on Water Circulation in Vertical-Tube and Inclined-Tube Boilers (Modellversuche ueber den Wasserumlauf in Steil- und Schraegrohrkesseln), K. Cleve. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 322, 1929, p. 1. Water-circulation theory of Muenzinger was experimentally examined and influence of heating, tube diameter, incline, and length of tube, etc., on water circulation was investigated; flow resistance of water during passage through tube was determined and calibrating curves developed for instruments used in measuring velocity of flow in boiler tubes.

BORING AND TURNING MACHINES

GIANT. A Giant Boring and Turning Mill, H. Vogler. Eng. Progress (Berlin), vol. 10, no. 12, Dec. 1929, pp. 309-312, 3 figs. See also Machy. (Lond.), vol. 35, no. 894, Nov. 28, 1929, pp. 275-276, 1 fig. Large boring and turning mill with 39 ft. diam. of table, length of cross rail 72 ft., for machining of rotors and stators, etc. of large turbine units, made by Schiess-Defries for J. M. Voith, machine builders of Heidenheim, Germany; pieces of 200 tons can be machined; capacity of main motor is 250 hp.; travelling speed of tools 8.2 ft.

VERTICAL. Vertical Boring and Turning Machine with Table of 12 m. Diameter (Tourcarrousel vertical à pleateau de 12 mètres de diamètre). Génie Civil (Paris), vol. 95, no. 20, Nov. 16, 1929, pp. 477-480, 6 figs. Machine is built by Schiess-Defries in Duesseldorf for Voith in Heidenheim and will be used for working large hydraulic turbine parts, such as rotors, stators, etc.; pieces up to 18 m. diam. and weighing 700 tons can be machined on lathe, of which constructional details are given.

BOREHOLES, EXPLORATORY

CANADA. Deep Borings in British Columbia and Yukon, D. C. Maddox. Can. Dept. of Mines—Geol. Survey (Ottawa), no. 2202, 1929, pp. 194A-195A. Brief notes on 1928 work of Borings Division of Geological Survey of Canada; information is collected from various sources and laboratory tests are made on samples submitted.

BRIDGE CONSTRUCTION

GREAT BRITAIN. The Forth Bridge, E. W. Moir. Engineer (Lond.), vol. 148, no. 3859, Dec. 27, 1929, pp. 684-685, 1 fig. Construction details of bridge built in 1882; author was one of supervising engineers; building and launching of large caissons for foundations; cantilever movements by sun; setting-out of Forth bridge. Abstract of presidential address to Junior Inst. of Engr., Dec. 13, 1929.

BRIDGE DESIGN

BRIDGE DESIGN. Some Bridges of 1929. Engineer (London), vol. 149, no. 3860, Jan. 3, 1930, p. 22, 3 figs. on supp. plate. Among notable bridges briefly described are Ambassador bridge over Detroit River, Khartoum Omdurman bridge across White Nile; and Royal Albert bridge, Saltash.

HISTORICAL REVIEW. Progress Review of Bridge Engineering, D. B. Steinman. Can. Engrg. (Toronto), vol. 57, no. 27, Dec. 31, 1929, pp. 849-854. Historical review of improvements in bridge design and construction during past 50 years; theory of bridge design; different types of steel-bridge construction. Article previously indexed from various sources in 1929.

BRIDGES

FLOORS. Development Tests on a Light Floor for Bridges, L. S. Moisseiff. Eng. News-Rec., vol. 104, no. 2, Jan. 9, 1930, pp. 71-74, 8 figs. Slab weighing only 57 lbs. per sq. ft., armoured and reinforced by system of T's and flats, carries equivalent highway loads on 4-ft. span; deflection contours produced by concentrated loads at centre of span; stress-strain relation; tests made for Tri-Lock Co. of Pittsburgh, Pa., has shown that properly armoured surface of slab will require no additional pavement and that omission of pavement will save weight of 30 lbs. per sq. ft.

STRENGTHENING. The Strengthening of Bridges by Electric Welding. Ry. Engr. (Lond.), vol. 50, no. 599, Dec. 1929, pp. 464-466, 8 figs. Discussion of economics in bridge maintenance secured by electric welding.

WIDENING. The Widening of Highway Bridges, C. S. Chettoe. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 56, no 13, Dec. 24, 1929, pp. 725-749 and (discussion) 752-763, 34 figs. Review of principles and practical methods employed in Great Britain in widening of masonry or brick bridges, cast iron, wrought iron or steel arches, iron or steel truss or girder bridges, suspension bridges.

BRIDGES, BASCULE

ROTTERDAM. The New Bascule Bridge of the Queen over Koningshaven in Rotterdam (Le nouveau pont Basculant de la Reine sur le Koningshaven, à Rotterdam), L. Dalton. Génie Civil (Paris)), vol. 95, no 24, Dec. 14, 1929, pp. 581-586, 12 figs. Design and construction of two-leaf bridge spanning navigable passage 50 m. wide and 27 m. wide; non-movable approaches, of reinforced concrete, are 17.3 m. in span and 32.5 m. wide; structural details of bascule leaves; also details of operating mechanism.

BRIDGES, CONCRETE

DESIGN. Some Points on Reinforced Concrete Bridge Design, C. S. Chettoe. Surveyor (Lond.), vol. 76, no. 1978, Dec. 20, 1929, pp. 621-624, 17 figs. General principles of design of elements of concrete bridges, such as reinforced-concrete slabs, beams, portal frames, abutments, wing and spandrel walls, arches, etc.; skew-arch bridges.

BRIDGES, RAILROAD

RECONSTRUCTION. The Regirdering of the Railway-Bridge over the Krishna River Madras and Southern Mahratta Railway, India, N. N. Colam. Instn. Civil Engrs.—Min. of Proc., vol. 227, 1928-1929, 1st, pt., pp. 245-256 and (discussion) 257-263, 1 fig. Method of regirdering single-track meter-gauge bridge without interruption to traffic, is believed to be new and capable of modification to meet most cases; essential feature of scheme was service span to carry traffic over gap between any two piers while old permanent span was being removed and new one put in its place.

BRIDGES, STEEL

DESIGN. Bridges, D. B. Steinman. Brooklyn Engrs.' Club—Proc., vol. 28, part 1, Oct. 1929, pp. 52-84, 20 figs. Elaboration of paper entitled "Fifty Years of Progress in Bridge Engineering, from Brooklyn Bridge to Liberty Bridge," printed in Oct. 1926 issue of same journal; review of 50 years progress in different types of steel-bridge construction; Eads bridge; Hell Gate arch bridge; Forth Bridge; Carquinez Straits Bridge; Florianoplis Bridge; Liberty Bridge; beauty in steel.

BUILDING MATERIALS

CANADA. Nineteen-Twenty-Nine was Record Year for Production of Structural Materials. Contract Rec. (Toronto), vol. 44, no. 4, Jan. 22. 1930, pp. 88-89. Official estimate of minerals, fuels and construction materials produced last year totals $303,876,000; cement, lime, sand, stone, brick, tile, etc. all show increases.

BUILDINGS

VIBRATIONS. On the Diffraction on Artificial Shocks Caused by a Small Building, S. Nakamura. Tohoku Imperial Univ.—Science Report (Sendai), vol. 18, no. 3, Oct. 1929, pp. 401-407, 5 figs. Geophysical laboratory of Tohoku Imperial University was disturbed by artificial shocks which were caused by hammering in nearby factory; shocks were observed at several points in and near building; as period of shock was about 0.07 sec., their wave-length of several meters was comparable in length to dimensions of building; results of observation show slight diffraction of shocks.

BUILDINGS, CONCRETE

CONSTRUCTION. Cableway Removes Debris and Forms on Concrete Building Job, Z. Witkin. Eng. News-Rec., vol. 104, no. 1, Jan. 2, 1930, pp. 37-38, 1 fig. Operating experience and diagram of cableway used in handling forms and debris on concrete building job.

C

CAMS

DESIGN. Cam Design from the Standpoint of Stress Analysis. J. Flodin. Machine Design, vol. 1, no. 4, Dec. 1929, pp. 18-23, 10 figs. Force to be transmitted is important consideration in design in addition to movement of follower; force factors to consider are discussed.

CANALS

WELLAND. Engineering Features of the Welland Ship Canal, F. E. Sterns. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 8, Oct. 1929, pp. 2063-2072, 6 figs. Dimensions, number and location of locks; filling culverts; lock-gates; safety horns; gate operation; inspection; fenders; regulating works; bridges.

CARBON DIOXIDE

THERMAL PROPERTIES. Thermal Characteristics of Carbon Dioxide in Gaseous, Liquid, and Solid Condition (Die thermischen Eigenschaften der Kohlensaeure im gasfoermigen fluessigen und festen Zustand), R. Plank and J. Kuprianoff. Zeit. fuer die gesamte Kaelte-Industrie (Munich), vol. 1, no. 1, 1929, 64 pp., 17 figs. partly on supp. plates. Recapitulation of previous works; analysis of equilibrium curves, specific volume; latent heat, enthralpy and entropy; gas tables and diagrams are given. Bibliography.

CAST IRON

HIGH-TEST. Production of High-Strength Cast Iron. Machy, (N. Y.), vol. 36, no. 4, Dec. 1929, p. 302. Description of Meehanite, which is produced by refinement of ordinary process employed in making semi-steel; ultimate strength and yield point of ordinary cupola Meehanite metal said to be 46,000 lbs. per sq. in.; effect of heat treatment on Meehanite; methods of adding nickel to cast iron; Gunite, wear-resisting iron.

PROPERTIES. New Theories of the Mechanical Properties of Cast Iron (Neuere Anschauungen ueber die mechanischen Eigenschaften des Gusseisens), A. Thum. Giesserei (Duesseldorf), vol. 16, no. 50, Dec. 13, 1929, pp. 1164-1173 and (discussion) 1173-1174. Notch effect of graphite veins and its influence on strength and elasticity of cast iron; evaluation of coefficients of deflection in bending test; ductility and durability; comparison of cast iron and steel.

CEMENT PLANTS

NEW YORK. Glens Falls Modernizes to Make High Early Strength Cement, H. A. Schaffer. Concrete, vol. 36, no. 1, Jan. 1930, pp. 101-108, 15 figs. History of plant and its gradual modernization; introduction of rotary kilns, switching from dry process to wet process of manufacture, equipment for production of ironclad Velo cement; company now has grinding capacity of 6,000 barrels standard portland or 4,000 barrels of Velo; plant is interchangeable; tests of Velo cement.

CEMENT, PORTLAND

TESTING. Durability of Portland Cement, T. Merriman. Eng. News-Rec., vol. 104, no. 2, Jan. 9, 1930, pp. 62-64. Solubility of cement lime in 15 per cent sugar solution serves as durability test of portland cement; 32 cements compared by Committee C-I of American Society for Testing Materials were tested by author; difference in cements as shown by tests; modifying effect of lime; relation to alumina content; index of disintegration; action of sugar-lime solution is criterion of completeness with which cement has been manufactured.

CIVIL ENGINEERING

UNITED STATES. A Survey of Engineering Progress, 1929-1930. Eng. News-Rec., vol. 104, no. 6, Feb. 1930, pp. 211-226, 37 figs. Editorial survey of business conditions, construction industry of United States; structural developments; materials of construction; new construction technique; progress on new engineering projects and notable structures including Mississippi Flood Control, Kill van Kull bridge, Chrysler Building, etc.; new railroad construction; highway trends; city and regional engineering; water and interstate controversies; air transport; four pages of pictorial survey of construction projects of 1929.

COAL CARBONIZATION

LOW-TEMPERATURE. Low-Temperature Carbonization in Germany, D. Brownlie. Iron and Coal Trades Rev. (Lond.), vol. 119, no. 3225, Dec. 20, 1929, pp. 939-940. Description of Tormin process for making hard, dense, smokeless fuel from coking bituminous coal dust and fines, by heating under low-temperature conditions, 430 to 650 deg. cent., subjecting charge at same time to strong mechanical compression.

Scientific Developments in Steam-Driven Power Station Practice. D. Brownlie. Machy. Market (Lond.), nos. 1513, 1514, 1515, and 1516, Nov. 1, 8, 15, and 22, 1929, pp. 1005-1006, 1029-1030, 1051-1052, 1073-1074, and 1076, 6 figs. Nov. 1: Combined low-temperature carbonization, gasification, and combustion discussed; one aspect of future development of power-station practice according to entirely different methods; valuable by-products of coal; sulphur problems. Nov. 8: Details of Babcock, Pintsch, Hanl, and Hereng processes. Nov. 15: KSG process. Nov. 22: Kwollaston process; gas-fuel system; MacLaurin and other processes. Paper presented before Instn. Mech. Engrs.

COAL MINES AND MINING

MECHANIZATION. Method and Cost of Mining in a 100 per cent Mechanized Mine, W. F. Hazen and E. J. Christy. Min. Congress Jl., vol. 16, no. 1, Jan. 1930, pp. 32-41, 7 figs. Mining practice, methods and costs in 100 per cent mechanized mine; detailed description of mining method employed, equipment used and results obtained; mine operates two eight-hour shifts each day, with time between for servicing mechanical equipment and taking in supplies.

CONCRETE AGGREGATES

TESTING. Tests of Longitudinal and Structural Changes of Concrete Aggregates and Cement Mortars at Temperatures up to 1,200 Deg. (Versuche ueber Laengen- und Gefuegeaenderung von Betonsuschlagstoffen und Zementmoerteln unter Einwirkung von Temperaturen bis 1,200 Deg.), K. Endell. Stahl. und. Eisen (Duesseldorf), vol. 50, no. 1, Jan. 2, 1930 pp. 21-22, 1 fig. Results of investigations are shown in diagram giving linear thermal expansion when heating up to 1,200 deg. cent. of different aggregates and pure portland cement. Abstract of report No. 60 of German Committee for Reinforced Concrete.

CONCRETE DESIGN

SIMPLIFIED. Reinforced Concrete Design Simplified, J. R. Griffith. Concrete, vol. 36, no. 1, Jan. 1930, pp. 40-42, 4 figs. Method of construction and use of alignment chart for computation of stirrup spacing in accordance with American Concrete Institute code requirements.

CONCRETE MIXING

TRIAL METHOD. A Scientific Trial Method for Designing Concrete Mixtures, R. E. Robb. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 281-289, and (discussion) 290-291, 6 figs. Device for determining percentage of moisture in aggregates; steps to be followed in making scientific trial design.

WATER TABLES, ETC. Water Tables and Curves for Use in Designing and Estimating Concrete Mixtures, H. J. Gilkey. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 292-298, 4 figs. Tables and graphs covering water-cement ratio by loose or bulk volume, gallons of water per bag of cement, pounds of water per bag of cement, water-cement ratio by absolute volume and ratio of water to cement by weight; strength ratios based upon Abrams curves.

CONSTRUCTION INDUSTRY

CANADA. Complete Construction Figures for 1929. Contract Rec., (Toronto), vol. 43, no. 3, Jan. 15, 1930, pp. 49-51. Revised figures show that contracts amounted to $576,651,800; analysis by provinces and classes of work; statistical tables.

COOLING TOWERS

CHARACTERISTICS OF. Characteristics of Water Coolers (Quelques Propriétés des Refrigérants d'Eau), M. Bonnemort. Chaleur et Industrie (Paris), vol. 10, no. 113, Sept. 1929, pp. 428-432, 5 figs. General discussion; curves showing temperature differences and presentation of general characteristics in graphs.

DIESEL PLANTS. Cooling Towers for Diesel Plants, L. A. Pease. Power, vol. 70, no. 23, Dec. 3, 1929, pp. 886-887, 2 figs. Discussion of types of water-cooling towers; atmospheric towers used in majority of cases; diagrammatic layout of commonly used atmospheric cooling tower.

COPPER

ANNEALING. Anomalies of Annealing After Cold Hardening of Copper and Brass (Anomalies du recuit après écrouissage du cuivre et des laitons), F. Eugene. Société d'Encouragement pour l'Industrie Nationale—Bul. (Paris), vol. 128, no. 5, May 1929, pp. 361-379, 20 figs. Study of anomaly described by P. Nicolau which affects not only hardness but fitness for swaging characterized by deflection before rupture in Erichsen test, and, in less degree, elongation; dilatometric tests effected by differential dilatometer of Chevenard show that phenomena of annealing copper and brass is sufficiently different.

COUPLINGS

FLEXIBLE. The Steel-Shaw Flexible Coupling. Engineering (Lond.), vol. 128, no. 3332, Nov. 22, 1929, p. 68?, 2 figs. It has been designed to allow for amount of misalignment which appears to be inevitable in even most accurate of erection operations, flexible elements of coupling are enclosed in split casing, which contains oil, and rotates with them.

CRANES

CONTROL. Easy Crane Control by Push Buttons. Iron Age, vol. 124, no. 26, Dec. 26, 1929, pp. 1740-1741, 1 fig. Description of 40-ton riveting crane in plant of Lasker Iron Works, Chicago; accurate sporting for riveting work, saving in labour increase in production reported; independent push-button control station one at control point of each poll riveter are interlocked so that only one set of push buttons can be used at one time.

CUPOLAS

MIXERS. Some Notes on Cupola Receivers, M. G. Woods. Foundry Trade Jl. (Lond.), vol. 41, no. 691, Nov. 14, 1929, pp. 353-354 and 356, 6 figs. Various types of receivers for cupolas are described, including Whiting cupola and receiver, jolting receivers, Hurst's oil-fired receiver, outside and inside receivers; advantages and disadvantages of receivers outlined.

REFRACTORIES FOR. Cupola Refractories, C. Presswood. Foundry Trade Jl. (Lond.), vol. 41, nos. 692 and 693, Nov. 21 and 28, 1929, pp. 369-371, 376 and (discussion) 389-390. Nov. 21: Cost of cupola operation reflected in finished materials; temperature conditions; temperature fluctuations; influence of fluxes; neutral linings; destruction by abrasion; influence of furnace gases; brick linings; materials available; spalling; siliceous bricks; neutral bricks; rammed linings; patching materials. Nov. 28: Cupola refractories and cost of castings; glazing of refractories; effect of continuous working.

CUTTING TOOLS

TUNGSTEN CARBIDE. An Armour Plate Ordeal for Tungsten-Carbide, H. A. Ingram. Am. Mach., vol. 72, no. 2, Jan. 9, 1930, pp. 39-42, 6 figs. Description of difficult and unusual job recently completed by Hull Construction Department at United States Navy Yard, Puget Sound; machining face-hardened nickel-steel armour plate by utilizing peculiar cutting properties of tungsten-carbide after ordinary cutting tools had repeatedly failed; comparison of methods for cutting armoured tube shown.

D

DAMS

GOVERNMENT SUPERVISION. State Supervision of Dams. Power, vol. 7, no. 3, Jan. 21, 1930, p. 112. It is generally recognized that design, construction and maintenance of dams for power development and other projects should be under state supervision; some such control is already exercised; how to make this supervision most effective without placing unnecessary burden on owners of projects, and how to insure safe structures were considered during Power Division session at American Society of Civil Engineers' recent annual convention in New York City.

DAMS, CONCRETE

CONSTRUCTION. Thomson Dam and Reservoir, H. C. Ash. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 29-38 and (discussion) 39-46, 16 figs. Description of early construction methods with particular attention given to such details as selection of materials, and mixing, placing and curing of concrete.

DIE CASTING

ALUMINUM-ALLOYS. Effect of Pores on Strength of Die Castings (Der Einfluss von Poren auf die Festigkeit von Spritzguss), L. Frommer, W. Kuntze, and G. Sachs. V.D.I. Zeit. (Berlin), vol. 73, no. 45, Nov. 9, 1929, pp. 1609-1612, 4 figs. Report on X-ray study and mechanical tests of aluminum die castings, made at German Bureau for Materials Testing and Kaiser Wilhelm Institute for Physical Chemistry and Metallurgical Research; authors estimate effect of blow-holes in reducing specific strength of casting at not much over 10 per cent.

ZINC-BASE. Strength of Zinc Base Die Castings, R. M. Curts. Iron Age, vol. 124, no. 25, Dec. 19, 1929, pp. 1655-1658, 13 figs. Remarkable improvement which has been made to physical properties of zinc-base die-casting alloys; improvement has been large recently; gravity and pressure methods compared; types and relative merits of alloys available.

DIES

STAMPING. Metal Stamping Dies, E. E. Clark. Metal Stampings, vol. 2, no. 11, Nov. 1929, pp. 865-870, 9 figs. Typical die layout; planning sequence of stamping and forming operations; comparative estimating die costs.

DIESEL-ELECTRIC POWER PLANTS

ALBERTA. Electrical Development in Northern Alberta, A. J. Cantin. Elec. News, vol. 39, no. 2, Jan. 15, 1930, pp. 51-52, 4 figs. Modern plant has one 200-hp. Atlas Diesel engine direct-connected to 160-kw. 2,200-volt 60-cycle 3-phase generator with 8½-kw. 120-volt exciter, and one 300-hp. Atlas Diesel engine direct-connected to 250-kw. 300-r.p.m. generator, also with direct-connected exciter.

HOTELS. Hotel New Yorker Diesel Generator Now Operating. Oil Engine Power, vol. 7, no. 12, Dec. 1929, pp. 682-686, 8 figs. Use of Diesel engines in Hotel New Yorker power plant is based on ability to improve balance between electric power load and heating load; Diesel engine able to carry summer electric load; charts illustrating heat saving creditable to Diesel; brief description of Davis heater which contributes to Diesel economy.

DIESEL ENGINES

AUTOMOTIVE. History of Light Diesel Engines, E. C. Magdeburger. Soc. Automotive Engrs. Jl., vol. 25, no. 6, Dec. 1929, p. 698. Development of high-speed oil-engines is discussed; fluid injection saves weight. Diesels on motor-coaches; peculiarity of Packard engine is that single valve serves both for exhaust and inlet.

MARINE. The Large Diesel Engine, H. Becker. Brit. Motor Ship (Lond.), vol. 10, no. 117, Dec. 1929, pp. 353-355, 8 figs. Special types of Diesel engines suitable for marine purposes are discussed; airless-injection, fuel consumption, gearing and comparative weights and sizes with special reference to M.A.N. engines. Supplement to article published in July 1929 issue of same journal.

The Marine Diesel Engine, H. Blache. Brit. Motor Ship (Lond.), vol. 10, no. 115, Oct. 1929, pp. 247-251, 11 figs. Details of new Burmeister and Wain double-acting two-stroke type; advantage of design is that main piston does not cut off and uncover exhaust ports, subjecting piston surface to great heat from rebounding of exhaust gases from remainder of cylinders, as is case with other types of two-stroke engines. Extract from paper read on occasion of Centenary of Royal Technical University, Copenhagen.

PULVERIZED-FUEL. The Use of Pulverized Coal in Internal-Combustion Engines (Kohlenstaub als Triebmittel fuer Brennkraftmaschinen), H. Jentzsch. Werft-Reederei-Hafen (Berlin), vol. 10, no. 20, Oct. 22, 1929, pp. 409-411, 3 figs.; see also brief translated abstract in Mar. Engr. and Motorship Bldr., vol. 52, no. 627, Dec. 1929, p. 504. Original work of Diesel has been continued by Pawlikowski and fairly successful pulverized-coal engine developed; author emphasizes necessity for greater investigation of pulverized-fuel motor and points out that its ultimate development will admit of cost of running Diesel engine as against oil to be reduced to one quarter.

E

ELECTRIC CONDENSERS

SYNCHRONOUS. Automatic Regulation of Synchronous Condensers Equipped with Super-Speed Excitation, L. W. Thompson and P. J. Walton. Am. Inst. Elec. Engrs.—Paper for mtg. Dec. 2-4, 1929, 4 pp., 8 figs. Extensive field tests made on super-high-speed excitation equipment used with 30,000-kva. synchronous condensers at Plymouth Meeting Substation of Philadelphia Electric Co. is described; oscillograms and calculated curves showing performance of equipment are included together with discussion of results obtained.

ELECTRIC FURNACES

INDUCTION. Induction Furnaces. Engineer (Lond.), vol. 148, nos. 3858 and 3859, Dec. 20 and 27, 1929, pp. 652-654 and 680-682, 17 figs. Furnaces are of two kinds, standard frequency induction and those which employ high-frequency currents; while former is limited by metallurgical considerations and problems of electrical design high-frequency furnace removes these limitations and gives wider field to metallurgical research, and to melting of metals having high melting points; details of Ajax Northrup and Ajax Wyatt furnaces; review of research on coreless induction furnaces; examples of furnaces and auxiliary equipment are illustrated.

ELECTRIC HEATING

THERMAL STORAGE. The Heating of Buildings Electrically by Means of Thermal Storage, S. E. Monkhouse and L. C. Grant. Instn. Elec. Engrs.—Advance Papers, Sept. 19, 1929, 9 pp., 5 figs. Authors advocate more extended use of electrical heating by adopting thermal storage, thus enabling energy to be used during off-peak hours; they contend that such a system is economical to operate and they show that, for large buildings, electric heating can compete with systems employing other forms of fuel.

ELEVATORS, CONSTRUCTION

SAFETY GATES. Simple Elevator Safety Gate, G. E. Peachey. Eng. News-Rec., vol. 104, no. 1, Jan. 2, 1930, p. 34, 1 fig. Description of gate consisting of single cross-bar and hinged brace, for building construction elevators.

ELECTRIC GENERATORS

DIRECT CURRENT, THREE-WIRE. Operation of Three-Wire Generators, C. Lynn. Power, vol. 71, no. 4, Jan. 28, 1930, pp. 135-137, 9 figs. Difference between two and three-wire d.c. generators is outlined; it is shown how neutral is produced and how three-wire generators are operated in parallel; elementary diagrams of 3-wire generators and their connections; simplified diagram of two 3-wire generators connected in parallel.

ELECTRIC INSULATING MATERIALS

MOULDED. Trends in Radio and Their Bearing on Moulded Tube Bases, E. B. Saul. Plastics, vol. 6, no. 2, Feb. 1930, pp. 101-102, 2 figs. High-frequency transmission and broadcasting bring up insulation problems which may force tube manufacturers to seek other materials than moulded resinoids for tube bases.

ELECTRIC LINES

POLES, CONCRETE. Graphical Determination of Deflections of Armoured Concrete Poles (Détermination graphiques des flèches des poteaux en béton armé), P. Gully. Revue Générale de l'Electricité (Paris), vol. 26, no. 22, Nov. 30, 1929, pp. 887-890, 4 figs. Mathematical graphical analysis; calculation of deflection of concrete poles with load at top; experimental results are in accordance with theoretical calculations.

HIGH TENSION, PROTECTION. The Protective Relay Installation at the Toronto-Leaside Transformer Station of the Hydro-Electric Power Commission of Ontario, E. M. Wood. Power Age, vol. 6, no. 12, Dec. 1929, pp. 79-84, 4 figs. Outline of transmission problem and adopted system diagram and application of relaying to system and transformer station; general requirements; types of relays used.

ELECTRIC MACHINERY

SYNCHRONOUS. Stability of Synchronous Machines—Effect of Armature Circuit Resistance, C. A. Nickle and C. A. Pierce. Am. Inst. Elec. Engrs.— Paper, for mtg. Dec. 2-4, 1929, 13 pp., 12 figs. Theory of synchronous machines as developed by Doherty and Nickle has been extended to include determination of effect of armature-circuit resistance on damping torque; equations are developed for damping torque of synchronous machines in general, i.e., both salient-pole and round rotor types; mathematical analysis is checked with laboratory experiments.

ELECTRIC MANUFACTURING INDUSTRY

CANADA. The Electrical Trade Position in Canada, A. S. L. Barnes. Elec. Rev. (Lond.), vol. 106, no. 2719, Jan. 3, 1930, pp. 3-6. Canadian correspondent summarizes present position of affairs in electric manufacturing industry; opinions, criticism, and suggestions offered by various authorities are quoted and view is expressed that concerted attack on market by British companies and firms would be well-timed.

ELECTRIC MOTORS

INDUCTION. Quiet Induction Motors, L. E. Hildebrand. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 1, Jan. 1930, pp. 7-11, 4 figs. Magnetic noise in induction motors is caused by vibration of magnetic parts produced by varying forces associated with changing flux density in adjacent air parts of magnetic circuit; torsional vibration of motor is caused by unbalanced windings or applied voltages; causes of vibration of rotor and stator; magnetic noise can be predicted from qualitative analysis of air-gap field supplemented by analysis of stiffness of parts.

ELECTRIC NETWORKS

DESIGN. Recent Trends in Power System Development, W. F. Sims. Elec. Light and Power, vol. 8, no. 1, Jan. 1930, pp. 36-39, 7 figs. Changes in trend of substation design; growing use of mercury-arc rectifiers; notes on trends in distribution, interconnection, transmission, load building, and rehabilitation.

ELECTRIC POWER INDUSTRY

CANADA. Canadian Electrical Industry is Prosperous, D. C. Durland. Can. Engr. (Toronto), vol. 58, no. 2, Jan. 14, 1930, pp. 131-132. Business of Canadian General Electric Co., Ltd., showed increase for 1929 of 20 per cent. over preceding year; steady increase in demand for electricity; equipment installed in hydro power plants during year.

ELECTRIC POWER SUPPLY

ECONOMICS. Power Plant Economics, H. Quigley. World Power (Lond.), vol. 13, no. 55, Jan. 1930, pp. 36-44, 16 figs. Survey of progress achieved; capital expenditure on generating plant; capital expenditure of transmission and distribution; average costs of typical stations in Great Britain; overall thermal efficiency; electricity supply costs; generating stations in Great Britain and United States compared; table giving production costs in electricity supply.

ELECTRIC SUBSTATIONS

DESIGN. Modern Trends in Sub-Station Design, J. B. Kitchen. Power House (Toronto), vol. 24, no. 1, Jan. 1930, pp. 63-68, 5 figs. Discussion of two leading factors which influence substation design; description of station construction with respect to Toronto system; advances in control, relay protection, transformers, mercury-arc rectifiers.

ELECTRIC TRANSFORMERS

CURRENT. Current Transformers for Protective Devices, A. M. Wiggins. Elec. Jl., vol. 27, no. 1, Jan. 1930, pp. 39-41, 8 figs. Current transformers must be selected with care or incorrect operation will result; action of relay or other protective device depends to large extent on this operation; applications to protective schemes should be based upon consideration of kind of protection used, and upon characteristics of current transformer under abnormal conditions which are to be guarded against.

F

FLOOD CONTROL

MISSISSIPPI RIVER. What Is Being Done for Flood Control on the Mississippi. Pub. Works, vol. 61, no. 1, Jan. 1930, pp. 8-11, 3 figs. Brief outline of work in progress on Bonnet Carre floodway, Birds Point and New Madrid floodways; development of construction methods; contractors' problems; Mississippi River Commission organization and personnel.

Mississippi Flood Control. L. Brown. Eng. News-Rec., vol. 104, no. 6, Feb. 6, 1930, pp. 227-231, 6 figs. Chief of Engineers of United States Army discusses origin of plan of flood control, major elements of this plan and principles conceived to govern its development and prosecution, with suggestion of prospective changes; criticism of Bonnet Carre spillway; flood magnitude and safety margins; new levee sections; floodway flowage and control; representative levee-building equipment.

FLOORS

CONCRETE SLABS. One Way Concrete Slab Floors Widely Used in Northwest, G. Runciman and H. L. Worthington. Eng. News-Rec., vol. 104, no. 2, Jan. 9, 1930, pp. 68-70, 4 figs. The type of design is favoured on account of simplicity, and savings in storey height and in cost of forms and plastering; typical floor systems using one-way reinforcing; list of buildings in State of Washington baving one-way concrete slab floors.

FLOW OF AIR

MEASUREMENT. Measurement of Air Flow, E. Ower. Instruments, vol. 2, nos. 10 and 12, Oct. and Dec., 1929, pp. 347-358 and 443-454, 7 figs. Theoretical mathematical discussion regarding general principles of pressure-tube anemometer; flow of air in pipes; resistance of pipe to motion of fluid along it; characteristics of flow in pipes; turbulent flow in pipes.

FLOW OF FLUIDS

ROTATING TUBES. Flow Phenomena in Revolving. Tubes (Stroemungserscheinungen in rotierenden Rohren). F. Levy. Forschungsarbeiten auf den Gebiete des Ingenieurwesens (Berlin), no. 322, 1929, pp. 18-45, 22 figs; see also abstract in V.D.I. Zeit. (Berlin), vol. 73, no. 42, Oct. 19, 1929, p. 1512. Purpose of investigations was to find means of improving efficiency of diffusers; tests were carried out on rotating cylindrical tubes such as are used in atmos boilers and rotating diffusers; most important result is fact that pressure drop in straight tubes is greatly reduced by influence of wall rotation; transformation of flow energy into kinetic energy in diffuser is studied.

THEORY. New Theory of Flow (Neue Wege in der Stroemungslehre), J. Maercks. Glueckauf (Essen), vol. 65, no. 36, Sept. 7, 1929, pp. 1234-1241, 11 figs. According to new theory described, friction resistance is in all flow phenomena a function of Reynolds coefficient; elementary explanation and derivation of this coefficient is given and its application to flow in tubes, nozzles, and orifices is explained.

FLOW OF STEAM

MEASUREMENTS. Precision of Nozzle Measurements of Steam Flow in Acceptance Testing (Ueber die Genauigkeit von Dampfmessungen mittels Duesen bei Abnahmversuchen), M. Ten Bosch. Schweizerische Bauzeitung (Zurich), vol. 94, no. 17, Oct. 26, 1929, pp. 209-212, 7 figs. Discussion of precision based on experimental study by Witte; precise measurements of pressure differences and temperatures; nozzles can be calibrated by using cold water; author concludes that in practice allowance should be made for errors up to 2 per cent.

FORGINGS

STEEL, HEAT TREATMENT OF. A Microscopic Study of Improperly Heated Forgings. A. S. Jameson. Am. Soc. Steel Treating—Trans., vol. 17, no. 1, Jan. 1930, pp. 81-89, 20 figs. It is purpose of paper to illustrate few of defects which result from uncontrolled heating of steel prior to hot working or forging, and in doing this show how valuable a tool microscope is in determining exact occurrence of these flaws.

UPSET. Development of Upset Forgings, W. E. Crocombe. Iron Age, vol. 124, no 23, Dec. 5, 1929, pp. 1513-1515, 2 figs. Many advantages of upset method of forging are discussed and its development traced; saving of one-fifth in weight and great improvement in output; uniform grain conditions give higher strength; much greater production obtained; upset method eliminates tong holds; plea for adequate cost analysis.

FREIGHT TRANSPORTATION

CANADA. Steam Railway Traffic in Canada. Can Ry. and Mar. World (Toronto), no. 383, Jan. 1930, pp. 14-16, 1 fig. Chart illustrating revenue freight forwarded on Canadian railways, 1921-1928 inclusive, arranged by provinces; statistics of freight transportation are given.

FUEL ENGINEERING

PROGRESS REPORT. Progress in Fuel Utilization in 1929. Mech Eng., vol. 52, no. 1, Jan. 1930, pp. 13-19. Progress report submitted by Fuels Division of American Society Mechanical Engineers, dealing with following subjects: solid fuels, liquid fuels, natural gas, manufactured gas, low temperature carbonization, boilers, boiler furnaces, stokers, pulverized fuel, fuel oil, diesel engines, locomotives, industrial furnaces and power plants, domestic heating, refractories and research.

FURNACES

MELTING, PULVERIZED COAL. Uses Rotary Foundry Melting Furnace. Iron Age, vol. 124, no. 24, Dec. 12, 1929, p. 1586. Description of furnace of unique design called Brackelsburg which has recently been put into operation in Germany in production of high-quality gray and malleable castings; furnace is horizontal cylindrical shell, rotating during melting and super-heating and fired with powdered coal; rate of revolution slow during melting. From Publication no. 131 of Kaiser Wilhelm Institute fuer Eisenforschung.

G

GAUGES

ELECTRIC. The Electric Gauge, A. V. Mershon, J. W. Matthews and B. C. Waite, Jr. Gen. Elec. Rev., vol. 32, no. 12, Dec. 1929, pp. 674-675, 3 figs. Instrument is independent of human sense of touch; simple and rapid to manipulate; amplification factor is 10,000; electric gauge has been developed to meet for accurate gauging device that has but minimum of moving parts and that will permit routine gauging operations to be conducted with great rapidity.

GEAR CUTTERS

CROWN-GEAR HOBBING. Crown Gear Hobbing Fixture for Turret Lathe, O. S. Marshall. Machy, (N. Y.), vol. 36, no. 4, Dec. 1929, pp. 297-298, 5 figs. Description of fixture of unusual design applied to Hartness flat turret lathe for hobbing teeth on crown-tangent-tooth gear; basically fixture is application of Hartness chasing attachment to driving of hob.

GEARS

NON-METALLIC, MANUFACTURE OF. Design of Textolite Gears, H. D. Randall. Am. Mach., vol. 71, no. 26, Dec. 26, 1929, pp. 1033-1035, 7 figs. Methods employed in manufacturing Textolite gears are described; gears fabricated out of non-metallic materials present problems somewaht different from ordinary practice; blanks may be moulded for plain pinions or may be die formed with or without moulded in steel hubs and webbed wheels; tables show allowable horsepowers for Textolite gears.

GEOLOGY

SASKATCHEWAN. Southern Saskatchewan, F. H. McLearn. Can. Dept. of Mines—Geol. Survey (Ottawa), no. 2206, 1929, pp. 30B-44B, and (appendix) 45. Discussion of stratigraphy and structure; oil and gas possibilities are mentioned but not discussed; brief notes on clays and mention of report by J. G. Phillips on tests of samples collected in 1928; notes on petrography of sediments, by F. J. Fraser.

BRITISH COLUMBIA. Mineral Deposits of Alice Arm District, British Columbia, G. Hanson. Can. Dept. of Mines—Geol. Survey (Ottawa), no. 2202, part A, 1929, 27A-49A, 3 figs. Report on field work of July and August 1928; general description; mineral deposits are classed as molybdenite deposits; high grade silver-bearing veins in argillite, silver-lead deposits in volcanic rocks, sphalerite deposits and chalcopyrite deposits; notes on individual mining properties.

ONTARIO. Preliminary Report on Woman River and Ridout Map-Areas, Sudbury District, Ontario, R. C. Emmons and E. Thomson. Can. Dept. Mines—Geol. Survey (Ottawa), no. 2191, 1929, 28 pp. and index, 2 maps in pocket. Report on fieldwork in areas in Sudbury district; topography; general geology; main feature of economic interest is iron formation and associated sulphide deposits; pyrrhotite, pyrite, chalcopyrite, sphalerite, and galena occurrences, by townships.

H

HANGARS

DOORS, ELECTRIC DRIVE FOR. Designing Drive and Control for 600-Ton Hangar Doors, W. J. Watson. Machine Design, vol. 1, no. 3, Nov. 1929, pp. 9-12, 7 figs. Description of door-moving mechanism designed for airship hangar of Goodyear Zeppelin Corp., at Akron, Ohio. Each wheel has individual axle; worm gear also prevents swinging; electric cutout switches mounted on runway adjacent to driving unit so that projections for door operate them, door coming to slow down, increasing speed.

HEADING MACHINES

COLD-HEADING RIVETS. An Accurate Cold Heading Machine. Engineer (Lond.), vol. 148, no 3856, Dec. 6, 1929, pp. 616-617, 6 figs. Details of machine brought out by E. White, of Windsor, Works, Redditch, for making such objects as rivets, screw blanks, etc. with exceptional degree of accuracy; it will, in fact, work to nearest 0.002 in.

HEAT EXCHANGERS

CHARACTERISTIC CURVES. Heat-Exchanger Characteristic Curves (Eschangeurs de chaleur semblables courbes caracteristiques), M. Véron. Chaleur et Industrie (Paris), vol. 10, nos. 114 and 115, Oct. and Nov. 1929, pp. 469-478, and 549-556, 5 figs. Mathematical analysis of heat exchange between fluids through separating partition; equations for thermal efficiency developed; formulae and characteristic curves giving efficiency and losses in reheaters.

HEAT TRANSMISSION IN. Heat Transmission in Cross-Current Heat Exchangers (Der Waermeuebergang im Kreuzstromwaermeastauscher), G. Zimmermann. Zeit. Bayerischen Revisions-Vereins (Munich), vol. 33, nos. 21, 22 and 24, Nov. 15 and 30, and Dec. 31, 1929, pp. 297-302, 315-317, and 343-350, 24 figs. Nov. 15: Temperature measurement of air and flue gases; preliminary tests; dimensioning of ducts. Nov. 30: Conducting and evaluation of tests; calculation of heat volume discharged from flue gases and heat absorbed from air. Dec. 31: Determination of temperatures of plates; heat-transfer coefficient; comparison of theoretical discharge-temperature curve with practical results.

HEAT PUMPS

PRINCIPLE OF. The Heat Pump—An Economical Method of Producing Low-Grade Heat from Electricity, T. G. N. Haldane. Inst. Elec. Engrs.—Advance Paper, Sept. 7, 1929, 10 pp., 7 figs. Method of converting electrical energy into heat energy is based on general principle that efficiency of heat engine working in normal cycle is given by difference between high and low temperature multiplied by high temperature; application of this principle to heating of buildings and for such purposes as heating of public baths is discussed, and estimated figures for installation are given; experiments by author demonstrated soundness of principles on which pump is based.

HIGH BUILDINGS

CONSTRUCTION. Getting Materials to the Right Place at the Right Time. Am. Contractor, vol. 50, no. 52, Dec. 28, 1929, pp. 11-13, 4 figs. Details of Pittsburgh contractor's system of expediting material delivery and distribution; material delivery reports; distribution dispatches; material routings; application of this system to construction of 27-storey addition to William Penn Hotel, Pittsburgh, within period of twelve months.

HOT-AIR HEATING

FANS. Friction Losses and Observed Static Pressures in a Domestic Fan Furnace Heating System, A. C. Willard and A. P. Kratz. Heating, Piping, and Air Conditioning, vol. 1, no. 8, Dec. 1929, pp. 683-687, 6 figs. With increasing tendency to apply various types of small disc and propeller fans as well as small centrifugal fans to warm-air furnace-heating system of gravity circulating types has developed without proper attention to heads or resistances; description of apparatus, test procedure, and discussion of results are given. To be presented before Am. Soc. Heat. and Vent. Engrs.

HOT-WATER HEATING

PUMPING VS. GRAVITY SYSTEMS. Pumping vs. Gravity Heating Systems (Schwerkraft oder Pumpenheizung), M. Hottinger. Gesundheits-Ingenieur (Munich), vol. 52, no. 38, Sept. 21, 1929, pp. 657-660, 1 fig. Advantages of pumping over gravity heating systems; limiting cases; determination of pump capacity; safety provisions; comparative cost data.

HYDRAULIC MACHINERY

Design. Calculation and Design of Hydraulic Machines and Presses (Calcul et construction des presses et machines hydrauliques), A. Lambrette. Technique Moderne (Paris), vol. 21, nos. 18 and 20, Sept 15, and Oct. 15, 1929, pp. 572-576 and 646-652, 13 figs. Practical design data and tables; description of different types of presses; choice of construction materials; installation of presses.

HYDRAULIC TURBINES

Draft Tubes. Contribution to the Theory of the Vertical and Cylindrical Draft Tubes (Bidrag till den vertikala och cirkulara sugtrummans teori), H. Berglund. Teknisk Tidskrift (Stockholm), vol. 59, nos. 42 and 46, Oct. 19 and Nov. 16, 1929, (Mekanik), pp. 132-140 and 151-152, 4 figs. Through gradual widening of suction line from turbine, author contends that higher efficiency may be reached; he develops formulae for construction of suction lines based on this theory and applies them to examples.

Propeller-Type. Hydraulic Turbines of the Propeller Type (Le turbine idrauliche ad elica), G. Buchi. Energia Elettrica (Milan), vol. 6, no. 10; Oct. 1929, pp. 1002-1023, 48 figs. Compilation on developments of design, construction and operation of Kaplan turbines and their appurtenances; description of propeller turbine installations of Lilla Edet plant in Sweden and of Mori plant in Italy; development of propeller turbines in America with special reference to Moody turbine; high- and low-speed types of Bell propeller turbine.

Regulation. Present Tendencies in Regulation of Hydraulic Turbines (Tendances actuelles en matière de regulation des turbines hydrauliques), L. Barmillion. Société des Ingénieurs Civils de France—Mémoires et Compte Rendu des Travaux (Paris), vol. 82, no. 5/6, May/June, 1929, pp. 688-715, 38 figs. General review of theory and practice of hydraulic-turbine regulation, with special reference to accelerometric and tachymetric criteria and special devices and in French practice.

Testing. Measurement of Turbine Efficiency (Sur une nouvelle méthode de mésure du rendement des turbines hydrauliques), L. Barbillion. Chaleur et Industrie (Paris), vol. 10, no. 113, Sept. 1929, pp. 423-427, 1 fig. Study of new means of measuring turbine efficiency, termed by author "thermometrical method," based on difference in temperature between water before and after passing turbines, this difference being proportional to losses of energy by friction, leakage, etc.; principles of method are disclosed with calculations worked out.

HYDRAULICS

Progress in. Progress in Hydraulics. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 19-23. Progress report submitted by Hydraulic Division of American Society Mechanical Engineers, dealing with following subjects: factors affecting economics of hydro-electric power development; governmental regulation and supervision of utilities and structures; governmentally owned hydro plants and projects; model testing; dams and accessories; measurement of water; adjustable-vane turbines; high-speed propeller-type turbines impulse; reaction turbines; generation; frequency and load control; penstocks; pumps; fish screens and fishways and hydrology.

HYDRO-ELECTRIC POWER DEVELOPMENTS

St. Lawrence River. Another Chapter in St. Lawrence River Power Development. Power, vol. 71, no. 4, Jan. 28, 1930, pp. 128-129, 1 fig. If New York State's Governor and Legislature agree upon water-power policy, there remain national and international questions to be settled regarding St. Lawrence River before power can be developed on its international section.

British Columbia. Developing Northern B.C. Power, D. Anderson. Contract Rec. (Toronto), vol. 44, no. 4, Jan. 22, 1930, pp. 79-83, 8 figs. Subsidiary of Power Corporation of Canada developing power resources in Prince Rupert region; new plant at Falls River to have ultimate capacity of 32,000 hp.; proposed development takes advantage of fall of about 160 ft.; power-house is being designed for two 6,000- and two 10,000-hp. units.

Canada. Water Power Development in Canada During the Past Year. Contract Rec. (Toronto), vol. 43, no. 3, Jan. 15, 1930, pp. 45-47, 4 figs. Review of development in Quebec, New Brunswick, and Nova Scotia. (Concluded.)

Hydro-Electric Power Progress in Canada. Can. Engr. (Toronto), vol. 58, no. f2, Jan. 14, 1930, pp. 133-136. Review prepared by Dominion Water Power and Reclamation Service of Department of Interior discloses that capacity brought into operation during year was 378,400 hp., bringing total for Dominion to 5,727,600 hp.; over $75,000,000 expended during year on construction.

Hydro-Electric Power Development in Canada. Engineering (Lond.), vol. 129, no. 3339, Jan. 10, 1930, pp. 62-63. Brief review of some outstanding developments; fact that Canada has at present hydro-electric installations amounting to 5,500,000 hp. does not appear to exercise any influence in arresting pace of new construction, and plans are under consideration, and in some cases actually in execution, for number of projects which will reach 1,000,000-hp. stage.

Water Power Development in Canada During the Past Year. Contract Rec. (Toronto), vol. 43, no. 1, Jan. 1, 1930, pp. 31-34, 4 figs. General statistical review; year's outlay $69,000,000; $292,000,000 will be required to complete undertakings planned for next three years; over 378,000 hp. placed in operation in 1929, making Canada's total 5,727,600 hp. (To be continued.)

Ontario. Hydro Power Development at Smoky Falls. Can. Engr. (Toronto), vol. 58, no. 2, Jan. 14, 1930, pp. 121-124, 5 figs. Spruce Falls Power and Paper Co. build power development at Smoky Falls on Mattagami River to supply power to pulp and paper mill at Kapuskasing; initial installation of three turbines gives total output of 56,000 hp.; provision for additional unit; concrete dam at Smoky Falls has maximum height of 65 ft.; operating head is 114 ft.; description of railway and transmission lines.

HYDRO-ELECTRIC POWER PLANTS

Gate Control. Automatic Gate Control Maintains Normal River Flow, D. P. Dinapoli. Elec. World, vol. 94, no. 25, Dec. 21, 1929, pp. 1220, 1 fig. On Pit River development of Pacific Gas and Electric Co., gate operation must fulfill two requirements: first, to maintain given river flow and second, to vary flow to follow slight seasonal variations which accompany normal river flow; device for this purpose consists of three main elements, float mechanism, relays, and sluice gate with its motor and contactor; wiring diagram of automatic sluice-gate control equipment is given.

Pumped Storage. Two 8,100 hp. Pumps Supply Water for Power Generation. Power, vol. 70, no. 25, Dec. 24, 1929, pp. 1006-1008, 7 figs. Illustrated description of vertical-shaft, single-inlet, single-stage, bottom-suction, volute-type pumps rated at 162,000,000 gals. per day, against 240-ft. gross head used in Rodky River hydro-electric plant of Connecticut Light and Power Co.; cross-section of one of two pumps; curves obtained from test made on model pump, and on pump in actual operation.

Automatic. Large Automatic Hydro Plant Has High Reliability, C. W. Colvin. Elec. World, vol. 95, no. 2, Jan. 11, 1930, p. 112. Operating experiences with 10,000-kva. fully automatic Alouette hydro-electric plant of British Columbia Electric Railway Co. during first year's operation has shown full justification for extra expense incurred in providing additional equipment required for full automatic operation.

Niagara Falls. Niagara Power, N. R. Gibson. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 1, Jan. 1930, pp. 139-140. Discussion by F. P. Williams of paper previously indexed from issue of Sept. 1929, limitation of diversion of water under existing treaty; economic benefits; ultimate diversion.

Saskatchewan. Churchill River Now Harnessed at Island Falls, F. S. Small. Power Age, vol. 6, no. 12, Dec. 1929, pp. 69-75, 8 figs. Description of early progress of Island Falls development; power plant being built will have initial capacity of 44,500 hp., with provision for future expansion to total of 86,500 hp.; temporary power plant; general layout of main dam and power house at Island Falls; section through main units.

Remote Control. Trethewey Falls Hydro-Electric Plant, S. W. Black. Contract Rec. (Toronto), vol. 43, no. 1, Jan. 1, 1930, pp. 6-8, 4 figs. Remote-control development at 35 ft. head 2,300 hp. power house, constructed by Hydro-electric Power Commission of Ontario. on Muskoka River.

Quebec. Montreal's New Station Has Special Features. Elec. News (Toronto), vol. 39, no. 2, Jan. 15, 1930, pp. 41-47, 13 figs. Movable blade turbines for variable flow and head and twelve sided welded stator frames are used in plant of Montreal Island Power Co.; feature of this development is that as flow increases from 35,000 to 90,000 cu. ft. per sec., head on plant decreases from 26 to 18 ft.; ultimate continuous output of new plant is estimated at 65,000 hp., but turbines installed will be capable of delivering 120,000 hp.; notes on head works, hydraulic and electric equipment are given.

I

IMHOFF TANKS

Design. Improvements in the Imhoff Settling Tank, O. Mohr. Surveyor (Lond.), vol. 77, no. 1980, Jan. 3, 1930, p. 15, 2 figs. Submerged settling compartments for elimination of foaming with steeper slopes for sides of sedimentation compartment walls are self cleansing; details of Imhoff tanks of Schwerin, Germany.

INDUSTRIAL TRUCKS

Electric. Materials Handling Problems Solved by Use of Electric Truck, H. E. Stocker. Iron Trade Rev., vol. 85, no. 24, Dec. 12, 1929, pp. 1502-1503, 3 figs. Description of new electric industrial truck used in plant of Driver-Harris Co., Harrison, N.J., in manufacture of nickel-chrome wire; time and costs are cut by use of electric lift truck and platforms in moving product through various operations; four-wheel drive and four-wheel steering, sensibility and flexibility of controls, and ability to operate equally well in either direction obtained.

INLAND WATERWAYS

St. Lawrence River. St. Lawrence Project Condemned. Ry. Age, vol. 88, no. 2, Jan. 11, 1930, pp. 147-150, 1 fig. Engineers report to Montreal Trade Board says present waterway not used to capacity; cost estimates too low; rate saving only two cents per bushel; Welland's cents exceed estimates 140 per cent; mariners condemn St. Lawrence project; westward grain movement increases; statement showing relation of annual costs in transport to capital investment, based on present and assumed future volume of through freight.

INTERNAL-COMBUSTION ENGINES

Compression Limits. Limit of Compression in Internal-Combustion Engines (Sur la limite de compression dans les moteurs à explosion), P. Dumanois. Bul. Technique du Bureau Veritas (Paris), vol. 11, no. 10, Oct. 1929, pp. 215-220, 1 fig. Importance of even very slight variations in time on combustion process is pointed out; investigation of what takes place when compression in engine is increased; tests were carried to confirm, if possible, assumption that oxidation takes place during compression.

Crankshafts. Critical Speeds of Crankshafts, A. Gorfinkel. Engineering (Lond.), vol. 128, no. 3337, Dec. 27, 1929, pp. 827-829, 3 figs. Author explains how calculation may be simplified and results, sufficiently exact for practical requirements, attained with reasonable ease and rapidity; methods described originated in connection with design of Diesel engines constructed by Carels Brothers in Ghent but are applicable to all multi-throw crankshafts.

Indicators. New Compression Indicator, G. L. Holzapfel. Instruments, vol. 2, no. 11, Nov. 1929, pp. 418-419. Holzapek indicator designed to fill need for accurate and reliable instrument; is screwed into spark-plug orifice and engine cranked, owing to action of check valve, pressure of gas pumped into space communicating with pressure gauge soon reaches maximum pressure reached in engine cylinder during compression stroke, this being registered on pressure gauge; check valve is so designed that it is absolutely gas-tight so that compressed gas trapped in upper part of body is held there, recording maximum compression pressure.

Thermodynamics of. The Thermodynamics of Heat Transference, A. A. Herzfeld. Automobile Engr., (Lond.), vol. 19, no. 261, Nov. 1929, pp. 441-444, 3 figs. Propagation of combustion in direction of flow of gas is given with accuracy sufficient for practical purposes; calculation of linear rates of combustion at right angles and opposite to direction of flow of gas; formulae for L-head engine; method for determining volumetric efficiency of existing engine; determining heat developed by each combustion; by these formulae, places of highest heat transference can be determined.

Vibration. The Effect of the Damping of the Throws on the Torsional Vibration of the Crankshaft system of an Internal Combustion Engine, J. Morris. Roy. Aeronautical Soc. (Lond.), vol. 33, no. 227, Nov. 1929, pp. 1086-1087, 2 figs. Formulae for frequencies in torsional vibrations of crankshaft of direct-drive engine having equal throws and equal journals; in view of considerable moment of inertia of airscrew compared with that of throw, author finds that its damping will not appreciably affect above result, which again is exact having ragard to conditions assumed.

(*See also Airplane Engines; Diesel Engines; Oil Engines.*)

IRON AND STEEL RESEARCH

Progress in. Progress in Metallurgical Research, H. C. H. Carpenter. Iron and Coal Trades Rev. (Lond.), vol. 120, no. 3230, Jan. 24, 1930, pp. 152-153. Most important event of year 1929 is formation of Iron and Steel Industrial Research Council composed of members of Iron and Steel Institute, National Federation of Iron and Steel Manufacturers, and of research associations of industries connected with iron and steel; policy is encouragement of definitely technical investigations designed to overcome immediate and pressing difficulties, and to explore must obvious lines of development by suitable means; research in United States; other researches.

J

JIGS AND FIXTURES

Design. The Planning and Design of Stand Type Jigs, J. A. Potter. Am. Mach., vol. 72, no. 2, Jan. 9, 1930, pp. 62-63, 4 figs. Standards of quality and tolerance, as well as available machines, dictate type of fixture and number of operations; exposition of various factors governing type of jig to be used on particular production job.

L

LATHES

Cutting Tools. Cutting Capabilities of Lathe Tools, D. Smith. North-East Coast Instn. of Engrs. and Shipbldrs.—Advance Paper (Newcastle-upon-Tyne), Dec. 6, 1929, 26 pp., 13 figs. Brief outline of development of cutting metals, their chemical composition and functions; Stellite, Cooperite, Widia, and Perdurum; heat treatment of tool steels and some of their properties; difficulty experienced in obtaining rational law between cuts of different dimensions and cutting speed; work done by Manchester Lathe Tool Committee on effect of depth of cut and traverse, shape of tool, and speed on durability of ordinary high-speed tools; also on forces exerted on tool when cutting iron and steel.

LIGHTING

Industrial. Cost of Lighting Industrial Buildings, M. Luckiesh. Elec. World, vol. 94, no. 24, Dec. 14, 1929, p. 1181. In recent analysis cost of lighting six representative types of industrial buildings, four single-storey, and two multi-storey, for eight-hour work period in day-time and for average weather conditions, was studied.

LOCOMOTIVE REPAIR SHOPS

MONTREAL. Railway Locomotive Shops Designed for Highest Efficiency. Contract Rec. (Toronto), vol. 43, no. 4, Jan. 22, 1930, pp. 67-70, 7 figs. Main features of new buildings erected by Canadian National Railways in Montreal; locomotive shop is rectangular in plan, 265 ft. 4 in. wide by 1,056 ft. long; lighting is by Holophane units; electric welding circuit is wired through sub-floor and plugs are located at convenient points on steel columns.

LOCOMOTIVES

DIESEL. 1,200-H.P. Diesel-Compressed Air Locomotive For the German State Railways. Engineering (Lond.), vol. 128, no. 3334, Dec. 6, 1929, pp. 748-749, 1 fig. Mechanical portion was built by Maschinenfabrik Esslingen A.-G. of Esslingen, while Diesel engine and compressed-air transmission, with which it is equipped, were manufactured by Maschinenfabrik-Augsburg-Nurnberg (M.A.N.); locomotive is of 4-6-4 type; power developed by engine is utilized for drying air compressor; compressed air thus obtained is passed into heater, through which exhaust gases from engine are led, and is then transmitted to locomotive cylinders, which are placed outside frames at one end.

ELECTRIC. 5,400-H.P. Electric Locomotive for the Paris, Lyons, and Mediterranean Railway. Engineering (Lond.), vol. 128, no. 3335, Dec. 13, 1929, pp. 786-787, 2 figs. Details of locomotive made by Oerlikon designed so as to be capable of hauling 700-ton train at speed of 56 mi. per hr. up gradient of 0.8 per cent, and at 68 mi. per hr. on level; consists essentially of single frame, which is mounted on two articulated subframes; each of latter is equipped with three driving axles and truck, latter being of standard P.L.M. type; two pantograph collectors and four contact shoes on each side are provided for current-collection purposes.

FEEDWATER HEATERS. Locomotive Feed Water Heater. Engineer (Lond.), vol. 148, no. 3857, Dec. 13, 1929, p. 632, 3 figs. Improved type of A.C.F.I. apparatus has been fitted to Pacific type engines No. 2580, Shotover and No. 2576 White Knight, on L. and N.E. Railway; standard type of A.C.F.I. heaters, consisting of two circular chambers placed on top of boiler behind chimney, have been superseded by heater arranged to fit into smokebox, ahead of chimney; this arrangement eliminates heat losses by radiation.

FIREBOXES, COPPER WELDING. Copper Welding (Die Kupferschweissung), R. Samesreuther. V.D.I. Zeit. (Berlin), vol. 73, Dec. 7, 1929, pp. 1731-1732, 4 figs. Discussion deals principally with copper welding of locomotive fireboxes; comparison of riveted and welded copper fireboxes; method of welding and after-treatment of welds.

FORGINGS. Locomotive Forgings, L. H. Fry. Am. Soc. Steel Treating—Trans., vol. 17, no. 1, Jan. 1930, pp. 1-33 and (discussion) 33-53, 17 figs. Production of locomotive forgings which will give good results in service necessitates employment of correct methods from melting of steel to finished forging; various steel-melting processes are discussed and compared; importance of ingot structure is considered; forging process is described and resulting structures of steel forgings illustrated by photomicrographs.

LUBRICATING GREASES

ZINC OXIDE. A Zinc-Containing Lubricant for the Prevention of Corrosion. Metals and Alloys, vol. 1, no. 6, Dec. 1929, pp. 281-283. In running of device known as Keenok pinion in which rapidly varying local stresses are set up, it was found that serious trouble was caused by corrosion of working parts; conclusion was reached that corrosion was electrolytic effect produced by rapidly varying local stresses to which parts were subjected; prolonged study was made of means to prevent corrosion; successful results were reached by employing as lubricant grease with which considerable proportion of zinc oxide was mixed. From Engineer (Lond.), Sept. 27, 1929.

M

MACHINE SHOP PRACTICE

PROGRESS IN. Progress in Machine-Shop Practice, K. H. Condit. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 26, 27. Progress report prepared by Machine Shop Practice Division of American Society of Mechanical Engineers outlining most important development, during past year; adaptation of new tungsten carbide cutting tools to machine tool uses in considered most important development.

MACHINERY

WELDED CONSTRUCTION. Economy of Material in Welded Construction, M. Hilpert. Welding Jl. (Lond.), vol. 26, no. 313, Oct. 1929, pp. 315-316 and 331, 4 figs. Figures and data give probable reduction in weight secured by welding process, compared with other methods of assembly. Abstract of paper presented before Matls. Congress in Berlin.

Welding in Machinery Manufacture (Schweissen im Maschinenbau), H. Neese. V.D.I. Zeit. (Berlin), vol. 73, no. 49, Dec. 7, 1929, pp. 1738-1739, 12 figs. Advantages of welding in machinery manufacture are briefly set forth; good machines, good electrodes, and good training of welders are, however, absolutely necessary.

MAGNESIUM ALLOYS

TEMPERATURE EFFECT. Compression and Extrusion, A. Portevin. Metallurgist (Supp. to Engineer, Lond.), Nov. 1929, pp. 173-175, 2 figs. Review of paper previously indexed from Révue de Métallurgie, Aug. 1929; relationship between behaviour of given metal or alloy under high-temperature compression test and its behaviour in extrusion press is discussed; author obtains autographic stress-strain diagrams of four distinct types; interpretation of these four types in terms of single generalized pair deformation of metal under viscous flow and under work-hardening conditions, respectively.

MALLEABLE CASTINGS

USE IN MACHINE CONSTRUCTION. Malleable Castings Offer Many Possibilities to Designers, J. B. Deisher. Machine Design, vol. 1, no. 3, Nov. 1929, pp. 31-34, 4 figs. Applications of malleable castings to machine construction are discussed; machinability of malleable casting is one of its economic virtues; castings can be poured at comparatively low casting temperature resulting in smooth surface; present and potential uses; research and standardization of quality.

METAL SPRAYING

COMPRESSED-AIR. Protection of Steel from Corrosion by Non-Ferrous Metals. Metal Industry (Lond.), vol. 35, no. 22, Nov. 29, 1929, p. 518, 2 figs. Description of mechanical process of spraying molten metal directly on to steel, developed by Metals Coating Co.; wire of any commercial metal is fed at definite rate through nozzle into oxy-acetylene or oxy-hydrogen flame; molten metal is atomized and sprayed by means of compressed air; special attachment used when tubes are to be coated internally.

METALS

COLD WORKING. Effects of Cold Working on Physical Properties of Metals, R. L. Templin. Am. Inst. Min and Met. Engrs.—Tech. Pub., no. 238, 1929, pp. 1-15 and (discussion) 15-17, 2 figs. Factors of variations in conditions present in remounting, casting, chilling, and preheating of initial ingot are assumed to remain constant; factors that must be considered simultaneously with cold working; definition of cold work and equivalent cold work; graphs, tabular data, and formulae are given. Bibliography.

HARD-FACING. Development and Application of Hard-Facing, M. C. Smith. Machy. (N. Y.), vol. 36, no. 3, Nov. 1929, pp. 219-222, 6 figs. Description of materials and methods employed in newly developed process of applying veneer of hard alloy to metal surface by fusion welding; repairing oil-well tools by welding on metal lead to development of hard-facing; three classes of alloys used in hard-facing; problem of finding. suitable hard-facing alloyt; heory of mixed-alloy welding rod; substituting hard-facing for heat-treatment; kinds of hard-facing alloys available; advantages offered by hard-facing process.

TESTING. Vibration Strength (Schwingungsfestikeit), P Ludwik. Zeit des Oesterreichischen Ingenieur und Architekten Vereines (Vienna), vol. 81, nos. 41/42, Oct. 11, 1929, pp. 403-406. Results of bending and impact endurance tests of polished and variously notched bars of duralumin, copper, zinc, cast iron, steel, steel alloys, and other metals, are discussed.

MINES AND MINING

MANITOBA. Mining in Manitoba during 1929, J. P. de Wet. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 1, Jan. 3, 1930, pp. 11-17, 5 figs. General review, with notes on activities of each of principal operating companies; notable features were establishment of large-scale metal-mining enterprise in Northern Manitoba, and success of Tyndall limestone in securing contract for 1,000,000 cu. ft. of building stone for use in Toronto.

QUEBEC. Mining in Quebec during 1929, J. E. Perrault. Can. Min. Jl., (Gardenvale, Que.), vol. 51, no. 2, Jan. 10, 1930. pp. 32-34. Estimated total value of mineral production is more than $43,000,000; Horne copper smelter at Noranda; prospecting active, particularly in western Quebec, in Gaspe Peninsula and in Chibougamou lake district; use of aircraft; Gaspe zinc, lead, and copper deposits; asbestos in largest individual product; water power development; geological service.

MORTISING MACHINES

TESTS. Mortising Wood (Langlochfraesen in Holz), G. Harnisch. V.D.I. Zeit. (Berlin), vol. 73, no. 43, Oct. 26, 1929, pp. 1538-1540, 13 figs. Communication regarding tests made by author on design and performance of usual mortising and characteristics of various kinds of woods.

MOTOR TRUCKS

DESIGN. Trends in Motor Truck Design, B. B. Bachmann. Ry. Age (Motor Transport Sec.), vol. 87, no. 26, Dec. 28, 1929, pp. 1513-1514. Discussion of general characteristics of motor-truck design showing that modern design is balanced between transportation requirements of vehicle and available materials of construction.

N

NON-FERROUS FOUNDRY PRACTICE

CASTINGS. Notes on Castings, L. Shane. Am. Soc. Naval Engrs.—Jl., vol. 41, no. 4, Nov. 1929, pp. 589-596. Author claims that difficulty in making composition G castings is almost exactly contemporaneous with introduction of open-flame furnace, such as Schwartz, or Rockwell, or Monarch furnaces; writer has solved problem in many places, reducing losses to almost negligible extent by merely requiring manufacturing plants where he has been on duty to return to practices of 35 years ago; procedure in effect at Portsmouth Navy Yard, where difficulties in manufacture of Composition G have been overcome; method of manufacture of manganese bronze; monel castings.

O

OIL ENGINES

INDICATORS. Indicating Oil Engines, G. B. Fox. Diesel Engine Users Assn. (Lond.), no. 307, 1929, pp. 1-15 and (discussion) 16-30, 9 figs. Discussion of manipulation of indicator, defects; indicating air compressors; light spring diagrams; tuning multi-cylinder engine; reference to examples; types of diagrams; types of indicators; simple dead-weight spring tester.

P

PAVEMENTS

STREET, DESIGN. Street Paving Design Progress, B. Vallas. Can. Engr. (Toronto), vol. 58, no. 1, Jan. 7, 1930, p. 104. Committee report of street paving, design and construction presented at convention of American Society for Municipal Improvement; curing cement-concrete roadways; construction of sidewalk necessary.

BRICK. Resurfacing Old Pavements with Vitrified Brick, H. G. Sours. Clay Workers, vol. 93, no. 1, Jan. 1930, pp. 40-42. Description of resurfacing practice of Summit County, Ohio; nature of work; methods of constructing curbs, patching and levelling of depressions, laying and rolling brick; costs; conclusions and recommendations.

CONCRETE. Building Industrial Driveways. Concrete, vol. 36, no. 1, Jan. 1930, pp. 44-46, 5 figs. Instruction covering methods for constructing concrete pavements for industrial traffic; thickness of slabs; materials and proportions; preparing subgrade; joints and curbs; curing concrete pavements.

PETROLEUM INDUSTRY

PROGRESS IN. Progress in the Petroleum Industry. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 41-47, 2 figs. Progress report submitted by Petroleum Division, of American Society Mechanical Engineers, dealing with following subjects: progress in pipe-line transportation, pipe joints and fittings, welded pipe lines, pumping station machinery, automatic pipe-line pumping stations, construction of pipe lines, pipe-line tankage, corrosion of pipe. lines, progress in oil refining; tanks and tank roofs; refining stills; pumps; automatic control of stills; gasoline recovery and stabilization; general practice and power plant practice.

PLANERS

HYDRAULIC-DRIVE. Planing Machine With Hydraulic Drive (Tischhobelmaschine Mit Fluessigkeitsantrieb), M. Kronenberg. Werkstattstechnik (Berlin), vol. 23, no. 21, Nov. 1, 1929, pp. 613-615, 1 fig. It is shown that from theoretical point of view, machines which avoid all rotary masses must be efficient and would make possible development of planers into speed-cutting equipment; design of machine of this type is discussed; tests have shown increase in cutting power, quiet performance, and smooth reversing.

POWER PLANTS

STEAM VS. HYDRO-ELECTRIC. Economics of Water vs. Steam Power, G. A. Orrok. Can. Engr. (Toronto), vol. 58, no. 1, Jan. 7, 1929, pp. 111-114, 3 figs. Evaluation of cost of water power; comparative total costs of steam and hydro-electric power; limitations to which hydro-electric plants are subject; self-sufficiency of steam plants; cost of steam-generated power is steadily decreasing. Paper read before Wrold Eng. Congress, Tokyo, previously indexed from Mech. Eng., Dec. 1929.

PRESSURE VESSELS

DESIGN. Building of Vessels for High Pressure and High Temperature Service, T. M. Jasper. Combustion, vol. 1, no. 6, Dec. 1929, pp. 23-30, 13 figs. Paper considers pressure vessels intended for severe service under following headings: design, materials, fabrication, and testing; proper method of design is to construct pressure vessel and then test; results of various tests are shown graphically; discussion of various materials for pressure vessel construction together with their outlet strengths; methods of plate manufacture; welded joint testing. Paper read before Tokyo World Engineering Congress.

PROTECTIVE COATINGS

METALLIC. Practical Experiences with Protection of Boiler Parts Against Combustion by the "Alumetier" Process (Praktische Erfahrungen ueber den Schutz von Kesselteilen gegen Verbrennung durch das Alumetierverfahren), C. Commentz. Korrosion und Metallschutz (Leipzig), vol. 5, no. 11, Nov. 1929, pp. 248-249. "Alumetier" process, which has been successfully used in past few years for protection of grate bars and other boiler parts from furnace gases, consists in first spraying metal parts with aluminum layer, after which they are given airtight coating; aluminum and iron are diffused at suitable temperature, thus forming tenaceous heat-resisting alloy.

PUMPING STATIONS

DIESEL. Diesel Engines for Water Works Service, R. L. Baldwin. Water Works Eng., vol. 83, no. 2, Jan. 15, 1930, pp. 81, 82 and 101. Development of Diesel engine and its employment in pumping plants; case of motor-driven triplex pump; comparison with other prime movers; operating costs. Indexed in Engineering Index 1929, from Can. Engr., Dec. 10, 1929.

R

RAIL MOTOR CARS

GASOLINE-ELECTRIC. Separate Power Supply for Rail Auxiliaries. Ry. Elec. Engr., vol. 20, no. 12, Dec. 1929, pp. 414-417, 4 figs. Description of two new power plants, one six-cylinder and other eight-in-line, of similar design, developing 400 and 535 hp., respectively, developed by J. G. Brill Co., Philadelphia; eight-cylinder equipment described in detail; in addition to main engine, small automotive-type four-cylinder of 15 hp. is used to drive 32- to 40-volt generator, having continuous rating of 7.5 kw., for battery charging and other purposes; low-voltage circuit diagram given.

RESULTS WITH. Rail Motor Car Section. Ry. Age, vol. 87, no. 21, Nov. 23, 1929, pp. 1234-1235, 1 fig. Review of Rail Motor Car Section of Toronto Meeting of Motor Transport Division, American Railway Assn., with abstracts of reports and papers; Comparison of Ability of Rail Motor Cars Versus Steam for Operation Under Serious Snow Conditions, Lollis; rail cars attract no traffic; rail car in Canada; description of rail motor train, Blue Bird, operated daily by Chicago Great Western between Rochester and Minneapolis.

RAILROAD MECHANICAL ENGINEERING

PROGRESS IN. Progress in Railroad Mechanical Engineering. Mech. Eng., vol. 52, no. 1, Jan. 1930, pp. 57-58. Progress report submitted by Railroad Division of American Society Mechanical Engineers, dealing with following subjects: high-pressure locomotives, turbine locomotives, internal-combustion locomotives and freight cars.

RAILROAD OPERATION STATISTICS

CANADA. Railway Operating Revenues, Expenses and Other Statistics. Can. Ry. and Mar. World (Toronto), no. 383, Jan. 1930, pp. 8-11. Statistics covering all railroads, Canadian National and Canadian Pacific.

RAILROAD STATIONS

HAMILTON, ONT. Passenger Station at Hamilton for Canadian National Railways. Can. Ry. and Mar. World (Toronto), no. 383, Jan. 1930, pp. 6-7, 1 fig. Brief discussion of changes in plans for passenger station; building will measure 83 ft. from north to south, 189 ft. from east to west; general layout of building is given.

RAILROAD TIES

PRESERVATION. The Crosstie in Canada, G. P. MacLaren. Ry. Eng. and Maintenance, vol. 26, no. 1, Jan. 1930, pp. 22-23, 1 fig. Description of practices generally adopted by Canadian railways; purchase and manufacture of ties; shipping ties to treating plants; seasoning of ties; yard layout; adzing, boring and incising plant; checking of hardwood ties; advantages of boring ties before treatment; mechanical wear of ties; axe-made vs. sawn ties; substitute ties. Abstract from paper previously indexed from Eng. Jl., Dec. 1929.

RAILROADS

SNOW REMOVAL. Fighting Snow in a Real Snow Country, C. B. Brown. Ry. Eng. and Maintenance, vol. 26, no. 1, Jan. 1930, pp. 13-15, 4 figs. Account of problems encountered and methods employed in keeping Canadian National Lines open during winter; snow fences and sheds help; heavy work encountered at terminals; expense necessarily runs high. Presented before World Eng. Congress, Tokyo.

RAIN AND RAINFALL

RUN-OFF. Simple Chart Aids Forecasting of Run-Off, L. H. Parker. Elec. World, vol. 95, no. 2, Jan. 11, 1930, p. 97, 1 fig. Problem of forecasting seasonal river for hydro plants of Turlock, Calif., irrigation district has resulted in development of run-off indicator which is discussed; watershed of Tuolumne River is located partially in high altitudes of Sierra Nevada and no accurate reports of snow depth and water content are available as early in year as was desirable.

ROAD DESIGN

CURVES. A Simple Treatment of Super-Elevation, Transition Curves and Vertical Curves, H. Criswell. Surveyor (Lond.), vol. 76, no. 1977, Dec. 13, 1929, pp. 593-596, 8 figs. Curvature and super-elevation as applied to highway construction, vertical curves included; theory of transition curve; methods of effecting super-elevation; comparison of two methods; need of transition curves; need for vertical curves.

ROAD MATERIALS

BITUMINOUS. Road Tar, H. C. Head. Instn. Mun. and County Engrs.—Jl. (Lond.), vol. 56, no. 12, Dec. 10, 1929, pp. 649-660 and (discussion), 661-675. General remarks of tar as road material; early road tars; characteristics of good read tars; methods of application; hints to tar distillers; petroleum bitumens; slipperiness. Paper prepared for Pub. Works, Roads and Transport Congress 1929.

ROADS

ASPHALT. Developments in Asphalt Pavements, H. W. Skidmore. Can. Engr. (Toronto), vol. 58, no. 2, Jan. 14, 1930, pp. 129-130 and 139. Classification of soils; old roadbeds as foundations; bases; black base; thorough mixing of aggregates important. Previously indexed from Roads and Streets, July 1929.

ROLLING MILLS

BEARINGS. Report of the A.I. and S.E.E. Special Committee on Bearings and Special Study Regarding Lubrication of Anti-Friction Bearings on Mill and Crane Motors, F. D. Egan. Iron and Steel Engr., vol. 6, no. 10, Oct. 1929, (discussion) pp. 547-551. Discussion of paper published in July 1929 issue of magazine, which was given by A. J. Standing, J. L. Brown, C. C. Pecue, H. A. Winne, A. M. MacCutcheon, S. N. Roberts, and W. B. Connally.

Roll Bearings for Cold Rolling Mills, C. E. Davies. Metal Industry (Lond.), vol. 35, nos. 20 and 21, Nov. 15 and 22, 1929, pp. 459-462 and 496-497, 5 figs. Nov. 15: Conditions under which cold roll bearings are called upon to operate; British practice in cold rolling steel and non-ferrous metals; unavoidable disadvantages of roller bearings; demand for highly efficient and robust bearings; forced lubrication; design of bearings for flood lubrication; recirculating oil. Nov. 22: Trouble due to heating of bearings eliminated; exceptionally lower power consumption at highest speeds attained, taking maximum possible reduction per pass; high-speed strip mill.

EXPERIMENTAL. Cold-Rolling Mill at the Research Laboratory, Sheffield University. Engineering (Lond.), vol. 128, no. 3334, Dec. 6, 1929, pp. 729-730, 5 figs., partly on p. 728. New laboratory to be devoted to study of cold working of metal is equipped with plant equal, if not superior in capacity and efficiency, to any similar installation of experimental machinery for research work in connection with cold rolling and drawing of metals; rolls, which are 10 in. in diam. by 10 in. face, are suitable for cold rolling steel and any other metal strip up to 6 or 7 in. wide, and any thickness from 3/15 in. down to thinnest strip usually rolled; these rolls are of Hadura alloy steel.

ROOFS

CONCRETE. Steep Concrete Roof Slab Constructed of Gunite, E. R. Huber. West. Construction News, vol. 4, no. 24, Dec. 25, 1929, pp. 669-670, 2 figs. Method of guniting roof wing of Christian Science Benevolent Association Building, Arden Wood, San Francisco; slope is three vertical on two horizontal; slab is of concrete, 3 in. thick and reinforced with steel bars; all gunite was composed of one part cement to four and one half parts of graded sand.

S

SAND

MOISTURE DETERMINATION. Comparison of Methods of Determining Moisture in Sands, W. R. Johnson. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 261-270, and (discussion) 271-279, 3 figs. In applying water-cement method of proportioning concrete to actual job conditions there is need for quick, accurate method of determining moisture content in sand; number of methods being used include drying to constant weight, measurement of displacement in liquid, change in electrical resistance due to moisture, and change in specific gravity of testing liquid; advantages and disadvantages of these methods.

SEWAGE DISPOSAL

SEPARATION. Successive Separation in Sewage Disposal Systems, F. C. Temple. Surveyor (Lond.), vol. 76, nos. 1978 and 1979, Dec. 20 and 27, 1929, pp. 615-616 and 647-648. Dec. 20: General review of various methods of liquefaction and separation in one operation; mechanical separation of solids and liquids; Indian research work; macerating tank; Imhoff and Travis tanks. Dec. 27: Bio-aeration treatment; two-stage process; removal of solids from tanks; ideal installation. Paper presented at Assn. of Managers of Sewage Disposal Works conference.

SEWAGE FILTERS

ENGLAND. Sewage Trickling Filters for Bradford, England. Eng. News Rec., vol. 104, no. 3, Jan. 16, 1930, p. 104. Main features of 60-acre trickling sewage filter project; beds cover from three to eleven acres each and are terraced out in sections on hillside.

SHEET-METAL WORKING

DRAWING. Influence of Rounding Off in Drawing of Hollow Pieces of Thin Sheet (Einfluss der Abrundung beim Ziehen von Hohlkoerpern aus duennen Blechen), H. Draeger. Stahl und Eisen (Duesseldorf), vol. 49, no. 48, Nov. 28, 1929, pp. 1731-1732. Results of author's experimental investigations; influence of rounding off of drawing angle on tensile stress of workpiece was tested on brass and white-metal sheets.

STEAM

HIGH-PRESSURE. High-Pressure Steam Operation in Future Economic Practice (Der Hochdruckdampfbetrieb in der zukuenftigen Engergiewirtschaft), S. Loeffler. Ingenieur (Hague), vol. 44, no. 45, Nov. 9, 1929, pp. 223-231, and (discussion) W231-232, 16 figs. High pressure steam processes and equipment are discussed from standpoint of opinion, still prevailing sometimes, that there is no advantage in applying pressures over 35 atmos.; author states that no advantage is to be obtained when temperature is not raised accordingly; high-pressure boilers, equipment, pipe lines, and operation characteristics are given.

STEAM CONDENSERS

WATER CHLORINATION. Chlorinating Circulating Water Keeps Condenser Clean, V. M. Frost and W. F. Rippe. Power, vol. 70, no. 25 Dec. 17, 1929, pp. 961-963, 6 figs. Investigation at Kearny station for purposes of experimenting with chlorine gas for treatment of circulating water; discussion of test procedure; chart showing record of chlorination dosage and concentration; curve of heat-transfer comparison of chlorinated and unchlorinated condenser; list of pro and con items of chlorination. Abstract of paper read before Metropolitan Section, A. S. M. E., Nov. 21.

STEAM-ELECTRIC POWER PLANTS

BIRMINGHAM, ENGLAND. The Hams Hall Generating Station of the Birmingham Corporation. Engineering (Lond.), vol. 128, nos. 3336 and 3337, Dec. 20 and 27, 1929, pp. 793-796 and 829-832, 34 figs. partly on supp. plates. Dec. 20: Particulars of main turbo-alternators with maximum continuous rating of 30,000 kw. and running at speed of 1,500 r.p.m.; turbines are of single-casing type, impulse blading being used throughout. Dec. 27: Switchgear and main transformers.

FRANCE. Extensions in the Issy-Les-Moulineaux Plant of the Compagnie Parisienne de Distribution d'Electricité (Les Extensions de l'Usine d'Issy-Les-Moulineaux de la Compagnie Parisienne de Distribution d'Electricité), Galatoire-Malégarie. Génie Civil (Paris), vol. 95, no. 14, Oct. 5, 1929, pp. 314-323, 13 figs., partly on supp. plate. Extension comprises six boilers of 1,800 sq. m. and 44 kg. steam pressure superheated to 450 deg.; turbo generator of Compagnie Electrique-Mécanique of 35,000 kw. and two of 11,000 kw. of Société Générale de Construction Electriques et Mécaniques and Société Rateau; notes on boiler and turbine equipment, coal and ash handling, etc., and construction of building; double-page plate of drawing.

NEW YORK CITY. 160,000 KW. Generator Goes into Operation at the New York Edison Company's Plant, D. S. Snell. Power, vol. 70, no. 27, Dec. 31, 1929, pp. 1030-1033, 7 figs. Discussion of mechanical features of unity power factor, three-phase, 25-cycle, 1,500-r.p.m., 11,400-volt generator recently installed in 14th St. station of New York Edison Co.; procedure in shipment and handling; unusual arrangement of ventilating air-cooling system; outline of ventilating system, showing arrangement of blowers, air coolers and housings; electrical features. See also Engineering Index, 1928, p. 1744.

OPERATING PRESSURES AND TEMPERATURES. Steam Pressure and Temperatures, F. S. Clark Power, vol. 70, no. 24, Dec. 10, 1929, pp. 932-935, 6 figs. Conclusions of study made by author and associates of Stone and Webster; effect of various factors that should be considered in selecting operating pressure and temperature of central power plant; experience with 1,200-lbs. installations; fuel economy of high steam pressures and temperatures; growth in capacity of turbine-generator units since 1903; developments in higher steam temperatures; moisture in turbine exhaust for various initial steam conditions. Abstract of paper presented at World Power Conference in Tokyo.

TEST CODES. Test Code for Complete Steam-Electric Power Plants. Mech. Eng., vol. 52, no. 1, Jan. 1930. pp. 74-75. Tentative draft of code in series of twenty-one, formulated by Am. Soc. Mech. Engrs. Committee on Power Test Codes.

STEAM POWER PLANTS

DESIGN. Influence of Operating Conditions on Layout and Cost of Construction of Steam Power Plants (Einfluss der Betriebsverhaeltnisse aud die Ausgastaltung und die Ausbaukosten von Dampfkraftanlagen), J. Kock. Waerme (Berlin), vol. 52, no. 50 Dec. 14, 1929, pp. 955-960, 10 figs. Importance of obtaining reliable basic data for design of a plant; factors governing selection of power equipment and pipe lines; advantages in use of constant-pressure accumulators combined with regenerative process; peak-load service; examples are given showing advantages of constant-pressure accumulators.

HIGH-PRESSURE. The Future of Higher Steam Pressures in Steam Electric Generating Stations, I. E. Moultrop. Am. Inst. Elec. Engrs.—Jl., vol. 48, no. 12, Dec. 1929, pp. 875-877. See also Power, vol. 70, no. 27, Dec. 31, 1929, pp. 1035-1036. Construction and operating experience has shown that large part of theoretically possible gains in efficiency due to higher steam pressures has been obtained in practice; future possibilities of higher pressures are described.

STEAM PIPE LINES

FRICTION OF. Friction of Water Vapour in Pipe Lines and Connections (Du frottement de la vapeur d'eau dans les tuyaux et ajustages), J. Rey. Chaleur et Industrie (Paris), vol. 10, no. 115, Nov. 1929, pp. 519-525. Theoretical mathematical analysis and application of equations developed on superheated and saturated steam, water vapor, etc.; comparison of experimental results obtained by Ledoux, Auscher and author; tabulation of coefficients of friction.

WATER SEPARATORS. Calculation of Water Separators for Steam Pipe Lines (Berechnung der Wasserabscheider fuer Dampfleitungen), E. Kaschny. Waerme (Berlin), vol. 52, no. 44, Nov. 2, 1929, pp. 824-829, 3 figs. Table is given which can be used to determine diameter of water separator; points to be observed in calculation of wall thickness; use of welded separator for high pressures and temperatures should be avoided.

STEAM TURBINES

DESIGN. General Trend of Steam Turbine Development, E. L. Robinson. Blast Furnace and Steel Plant, vol. 17, no. 12, Dec. 1929, pp. 1825-1829, 8 figs. Results that have been attained through improvements in steam utilization in production of power by steam turbine are outlined; fuel savings striking; size of units; double flow units; regenerative cycle; economic rating; higher temperatures; resuperheated; higher pressures; compound units; economic indications;

heat rates; auxiliary apparatus. Paper presented before World Power Conference at Tokyo.

Limits of Economy, Pressure, Temperature, and Output in Turbine Design (Grenzen der Wirtschaftlichkeit, des Druckes, der Temperatur und der Leistungen im Turbinenbau). Brennstoff und Waermewirtschaft (Halle), vol. 11, no. 15, Aug. 1, 1929, pp. 266-270, 7 figs. Curves showing progress in heat consuming from 1905 and estimated up to 1935; efficient coefficients and heat consumption per kw-hr. of ideal and actual installation; 6,000 kw. for 50 atmos. and 20 atmos. back pressure at 3,000 r.p.m. and 1,060 to 1,500 hp. Diesel engine installations are discussed and compared.

STEEL

AIRCRAFT. Steels for Automobiles and Aeroplanes, W. H. Hatfield. Automobile Engr. (Lond.), vol. 19, no. 261, Nov. 1929, pp. 464-474, 1 fig. Review of steels available for use in manufacture of automobiles and airplanes; manufacture of steel used in automobile and airplane production reviewed; ordinary carbon and alloy steels; valve steels; spring steels and springs; steels for chassis frames and bodies; tubes; nitriding steels and nitralloy; rustless steels; rustless sheets and strips; most suitable steel for each part is recommended in five-page table.

ALLOY. New Fields for Alloy Steels Opened by More Exacting Demands, C. E. MacQuigg. Iron Trade Rev., vol. 85, no. 25, Dec. 19, 1929, pp. 1559-1561. Present adaptations of alloy steels and how they have solved multitude of problems where question of physical properties was paramount; in 1928 over 6 per cent of entire production of steel in this country was alloy steel, including copper-bearing steel; bridges, rails, airplanes, and cutting tools constitute four typical applications. Abstract of paper presented before Am. Inst. Min. and Met. Engrs.

Types of American Alloy Steels. E. F. Cone. Iron Age, vol. 124, no. 26, Dec. 26, 1929, pp. 1735. Results of canvass of 1928 production to determine how much alloy-steel of different types was made in United States; copper and chromium steels lead in ingots; molybdenum alloy steels; many special steels are made; features of alloy cast steels; chromium leads among alloying metals; some of industrial uses.

ELECTRIC-PROCESS. Production of Electric Steel for Castings, G. Batty. West. Mach. World, vol. 20, no. 12, Dec. 1929, pp. 451-454, 1 fig. Two sharply differentiated methods of procedure are discussed as being applicable to production of both straight carbon and alloy steels for castings; it is affirmed that, in ordinary conditions that pertain in steel foundry, where scrap contamined by adherent sand is used as part of charge, definite boil of bath must be secured, with some inevitable elimination of carbon, in order that finely divided non-metallics be cleansed from bath.

TEMPERATURE EFFECT. Steam Piping of the New Central Plant of C. P. D. E. and Properties of Steel at High Temperatures (La tuyauterie de vapeur de la nouvelle Centrale de la C. P. D. E., etc.), Dessus, Leconte, and J. Galibourg. Société des Ingénieurs Civils de France—Mémoires et Compte-Rendu des Travaux (Paris), vol. 82, nos. 5/6, May, June, 1929, pp. 479-538, 16 figs. Description of high-pressure steam electric plant of Issy-les-Moulineaux of Compagnie Parisienne de Distribution d'Electricité with special reference to tests showing behaviour and strength of steel of high-pressure steam pipe.

STREET TRAFFIC CONTROL

GREAT BRITAIN. Control of Road Traffic. Modern Transport (Lond.), vol. 22, nos. 559, 560 and 562, Nov. 30, 1929, p. 16, Dec. 7, 1929, pp. 24 and 28, Dec. 21, 1929, pp. 23-24. and vol. 23, no. 564, Jan. 4, 1930, pp. 16-17, 7 figs. Problem of traffic drifts; formulation of definite route plan; restricting routes; coercing drivers; one-way street and advantages of system; underlying principles; system in operation; lessons in driving; acquiring bad driving habits; proposed "highway code"; transporting masses; road passenger traffic control; increased travelling facilities; calculating service requirements; unified control necessary.

STRUCTURAL STEEL

WELDING. Electrically Welded Steel Structures (Elektrisch geschweisste Eisenkonstruktionen), E. Rosenberg. V.D.I.Zeit. (Berlin), vol. 73, no. 59, Dec. 7, 1929, pp. 1742-1746, 24 figs. Preliminary tests are described for welding of steel railroad bridge, based on which basic calculations are recommended; suggestions for simplification of design with regard to advantages of electric welding; reliability of welded joints; description of electrically welded roof of 100m. long and 12 m. wide pavilion.

FABRICATION. Fabricating and Handling Equipment. Iron Age, vol. 125, no. 2, Jan. 9, 1930, pp. 151-154 and supp. p. opposite p. 167, 6 figs. Description of unusual materials-handling methods employed in fabricating plant of R. C. Mahon Co., Detroit, whereby structural steel fabricator makes savings and gets output of 17.9 tons monthly per man; steel handled on gravity and monorail conveyors; handling steel during punching; turn-over table for drilling H-columns.

T

TEMPERATURE

CONTROL. Time-Cycle Control Units. Am. Mach., vol. 71, no. 26, Dec. 1929, p. 1043, 3 figs. Photographs are given showing examples of what may be accomplished in governing of operations having repetitive timing.

HIGH, MEASUREMENT OF. The Accurate Measurement of High Temperature, W. E. Forsythe. Am. Ceramic Soc.—Jl., vol. 12, no. 12, Dec. 1929, pp. 780-813, 9 figs. Standard temperature scale defined; methods of measuring temperature from very low values to highest obtainable are described; use of thermocouples discussed; different form of optical pyrometers discussed and advantages and disadvantages of types pointed out; use of absorbing screens in extending scale of optical pyrometer outlined.

TOOL STEEL

HARDENING. Inherent Hardenability Characteristics of Tool Steel, B. F. Shepherd. Am. Soc. Steel Treating—Trans., vol. 17, no. 1, Jan. 1930, pp. 90-110 and (discussion) 110, 15 figs. Paper discusses variations in hardening properties encountered in carbon tool steels; pointing out that among steels of practically identical composition, wide variations in depth of hardness penetration are possible; it shows by use of spcial test, magnitude of these variations between heats from same manufacturer and between different manufacturers.

TOOLS

ELECTRIC. Electric Tools (Elektrowerkzeuge), H. Schoenberr. V.D.I. Zeit. (Berlin) vol. 73, no. 47, Nov. 23, 1929, pp. 1681-1684, 14 figs. Notes on design and construction of electric tools, taking as example development in design of hand drilling machines; discussion of machines and motors for d.c. and a.c. operation.

TUBES

STEEL, CALORIZING. Calorizing Tubes to Resist Corrosion, B. J. Sayles. Iron Age, vol. 124, Dec. 5, 1929, pp. 1510-1512, 4 figs. Methods employed in calorizing seamless-steel tubes for oil stills; calorizing serves dual purpose on cracking-still tubes rendering interior immune to sulphur corrosion while exterior is protected from oxidation; rotating retort contains steel tubes, granular aluminum, and hydrogen atmosphere.

V

VISCOSIMETERS

HOT-WIRE. Two Hot-Wire Viscosimeters, E. G. Richardson. Jl. of Sci. Instruments (Lond.), vol. 6, no. 11, Nov. 1929, pp. 337-343, 6 figs. Instruments based on convective cooling of electrically heated wire, for giving distribution of velocity across liquid, flowing in cylindrical tube and flowing in annular space between two concentric cylinders, one rotating and other at rest; examples of their use are given.

W

WASTE ELIMINATION

ELECTRIC MANUFACTURING PLANTS. Waste Reduction at Westingbouse, C. B. Auel. Am. Mach., vol. 71, no. 25, Dec. 19, 1929, pp. 1011-1012, 4 figs. Methods employed by Westinghouse Electric and Manufacturing Co. for elimination of waste are discussed; company saves $50,000 annually through intelligent handling of plant educational campaign directed against waste.

WATER METERS

TESTING. Methods of Testing Large Water Meters, R. E. Ferguson. Can. Engr. (Toronto), vol. 57, no. 27, Dec. 31, 1929, pp. 855-856, 3 figs. Testing with Freeman nozzle; field tests; installation of 8-in. meter for testing; testing for loss of pressure; effect of setting on testing 4-in. compound meter in field. Article previously indexed from Am. City, Oct. 1929.

WATER PIPE LINES

CORROSION. The Durability of Distribution Systems, H. Y. Carson. Am. Water Works Assn.—Jl., vol. 21, no. 12, Dec. 1929, pp. 1675-1683, and (discussion) 1683-1686, 6 figs. Effect of soil and water corrosion on uncoated and cement-lined cast-iron and wrought-iron pipe; durability of cast iron; physical and chemical aspects; rust on cast iron; removing incrustations.

WATER SUPPLY

CANADA. St. Lawrence and Southern Hudson Bay Drainage, Ontario and Quebec. Dept. of Interior, Canada—Water Resource Paper, no. 58, 1929, 390 pp. Report of Dominion Water Power and Reclamation Service, Department of Ottawa presenting results of hydrometric investigations in Ontario and Quebec, arranged under headings of main and tributary basins.

WATER WHEELS

PELTON. Unsteady Jet Flow from Pelton Wheel Nozzles, R. H. Evans. Engineering (Lond.), vol. 28, no. 3333, Nov. 29, 1929, p. 701, 2 figs. Experiments were carried out on 7-hp. Pelton wheel, 14½ in. diam. at Leeds University; results show that it is very desirable to fit series of guides behind needle, parallel to axis, so as to eliminate any whirl in water and reduce amount of turbulence near jet.

WATER WORKS

TORONTO. The New Toronto Filtration Plant and Other Extensions, W. Gore. Am. Water Works Assn.—Jl., vol. 21, no. 12, Dec. 1929, pp. 1620-1628, 1 fig. Extensions to be carried out provide for additional daily supply of 75,000,000 gals.; layout of extensions; diagram showing inter-connection of present and new water-supply systems; new 200 m.g.d. filtration plant; filtered water tunnel will be 7 ft. in diam. or length of 30,993 ft.; new service reservoir will contain 50,000,000 gals.

WELDING

MACHINERY. *See Machinery.*

RODS FOR. Progress in Use of High-Grade Welding Rods (Fortschritte in der Verwendung hochwertiger Schweissdraehte), F. Sommer. V.D.I. Zeit. (Berlin), vol. 73, no. 49, Dec. 7, 1929, pp. 1764-1768, 5 figs. After description of welding rods in general use, some new types are described; special mention is also made of new rods for corrosion and heat-resisting welds and wires for autogenous welding.

STRUCTURAL STEEL. *See Structural Steel.*

TECHNIQUE OF. Welding Technology (Schweisstechnik), Fuechsel. V.D.I. Zeit. (Berlin), vol. 73, no. 49, Dec. 7, 1929, pp. 1725-1726 and 9 figs. partly on supp. plate. Brief notes on applications and limitations of welding, introductory to series of article in same journal on welding practice, each of which is indexed separately.

WOOD CONSTRUCTION

TEST OF. Wood as a Construction Material (Holz als Bauonstruktionsmittel), K. Schaechterle. V. D. I. Zeit. (Berlin), vol. 73, no. 50, Dec. 14, 1929, pp. 1771-1780, 71 figs. Paper reports results of test made by railroad administrations of Germany in cooperation with Stuttgart Institute of Technology to determine strength of many types of wood joints; principles of design of wood trusses; review of use of wood in construction of city auditorium of Muenster, 18 m. radio towers near Koenigsberg, train-sheds of Stuttgart railroad station; centring of concrete bridge arches up to 140 m. span, etc.

WOOD

CREOSOTED. Treated Timber in Dock and Bridge Construction, R. J. Middleton and P. E. Philip. Eng. News-Rec., vol. 104, no. 5, Jan. 30, 1930, pp. 185-186. Abstracts of two papers on use of creosoted Douglas fir piles and timber for dock, trestle and truss-bridge construction in Western States and in Canada, presented at annual meeting of American Wood Preservers Association; fire hazards in creosoted dock construction; construction of Fraser River timber-bridge, at Quesnel, B.C., consisting of Howe-truss spans, three 180 ft. and two 150 ft. long.

WORLD ENGINEERING CONGRESS

TOKYO, JAPAN. The World Engineering Congress in Japan. Engineering (Lond.), vol. 128, nos. 3336 and 3337, Dec. 20 and 27, 1929, pp. 820-82 and 853-855. Dec. 20: Summaries covering number of miscellaneous subjects; production and use of coal; Diesel-engine problems; machine tools; agricultural engineering; electrical engineering; telegraphy, telephony, etc.; illuminating engineering; endurance properties of metals; general metallurgy. Dec. 27: Aeronautics; steam plants; turbo-compressors and pumps; hydro-electric installations.

The World Engineering Congress in Japan. Engineer (Lond.), vol. 149, no. 3861, Jan. 10, 1930, pp. 50-51. Mention is made of two papers; Railway Transportation of Perishable Freight, by C. A. Richardson and E. T. McCormick, and Collecting Snow Plow, K. Hashima; credit for longest paper will probably go to 35,000-word contribution from F. L. Estep, dealing with steel industry of United States; brief reviews of following papers: Public Health Engineering, by C. W. Fuller, P. Eddy and E. B. Phelps; Earthquake and Building Construction, K. Mashima; Progress of Illuminating Engineering in Japan, S. Seki. (Continuation of serial.)

WROUGHT IRON

MANUFACTURE. Comparative Properties of Wrought Iron Made by Hand Puddling and by the Aston Process, H. S. Rawdon and O. A. Knight. U. S. Bur. of Standards—Jl. of Research, vol. 3, no. 6, Dec. 1929, pp. 953-992, 40 figs. Radically new process, recently developed is now coming into commercial use, in which pig iron, which has been refined in Bessemer converter, is poured into molten slag so as to produce intimate mingling made by hand puddling forms the subject of this report; test results failed to show any marked difference in products of two processes; new product appears to have all of essential properties usually connoted by name, wrought iron.

Engineering Index

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A

ACETYLENE GENERATORS

Tests on. Seventh Session of the German Acetylene Commission (Siebente Sitzung des Deutschen Acetylenausschusses), E. Sauerbrei. Autogene-Metallbearbeitung (Halle), vol. 23, no. 1, Jan. 1, 1930, pp. 5-9. Session in Berlin in 1929, reported on removal of dangerous mixtures in acetylene generators; testing of high- pressure water containers; testing methods for chemical purifying compounds, small generator of 2 kg. filling capacity, etc.

AERIAL TRANSPORTATION

Financing. Western Air Issues Statement for 1929. Aviation, vol. 28, no. 6, Feb. 8, 1930, p. 269. Consolidated operating statement of Western Air Express Inc., and Western Air Express Corp., of Dec. 31, 1929, is given; during 1929 company increased its daily schedule mileage from 2,400 to 7,200; passenger traffic and passenger revenue increased almost fourfold during year.

Government Subsidies. State and Aerial Transportation Companies (Lo stato e le societa di transporti aeri), C. Rocca. Rivista Aeronautica (Rome), vol. 62, no. 12, Dec. 1929, pp. 494-511. General discussion of policy of subventions to private aviation companies; subvention policies of Italy, France, and other states; system of cooperation between state and private aerial transportation companies.

United States. Science in Relation to Regulating and Promoting Civil Aviation, W. P. MacCracken. Roy. Aeronautical Soc.—Jl., vol. 33, no. 228, Dec. 1929, pp. 1139-1166, 18 figs. Aerial transportation discussed from point of view of what has taken place in United States during past few years; results of Air Commerce Act of 1926; regulations by Department of Commerce; advantages of vast distances in United States to aeronautical developments; attitude of public; student pilots' permit; increase in air mail; accident analysis; aerodynamic loads and spinning.

AERODYNAMICS

Air Flow. Air Flow Through Suction Valve of Conical Seat, K. Tanaka. Tokyo Imperial Univ.—Report of Aeronautical Research Inst. (Tokyo), vol. 4, no. 51, Nov. 1929, pp. 361-424, 54 figs. partly on supp. plates. Analytical investigation of air flow through suction valve of conical seat; four flow configurations investigated here analytically assuming them as potential flow and their motions to be two-dimensional; some modified flow states which were derived from variations of profiles of valve and seat were also solved analytically; results compared with corresponding experimental results obtained in Part 1. (In English.)

AERONAUTICAL RESEARCH

Germany. Jahrbuch 1929 de. Deutschen Versuchsanstalt fuer Luftfahrt, E. V., Berlin-Adlershof, edited by W. Hoff, Ottfried V. Dewitz, and G. Madelung. Munich and Berlin: R. Oldenbourg, 42 marks. Reviewed in Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, pp. 100-101. Year book, an illustrated quarto volume, reviews in two divisions activities of Adlershof station during year ending March 1929; first short division contains general information and abstracts of over 200 papers and reports on test work done; second division contains 39 papers, with their discussions.

AERONAUTICS

United States. Remarkable Development in the South of Aeronautical Activities, C. E. Williams. Mfrs. Rec., vol. 97, no. 3, Jan. 16, 1930, pp. 49-52, 9 figs. Account of progress in development of all phases of aeronautical activities in Southern States covering airplane manufacture, airport construction, airway establishment.

AGRICULTURAL MACHINERY INDUSTRY

Denmark. Danish Market for Agricultural Implements, Machinery, and Tools, H. Sorensen. Commerce Reports, no. 2, Jan. 13, 1930, pp. 106-107. Current market conditions; Danish agricultural implements industry; harvesting machinery; market for grain drills and threshers; plows, harrows, and cultivators sold in Denmark; hay rakes and land rollers; potato planters and diggers; use of tractors in agriculture; dairy and creamery machinery and equipment; poultry equipment; distribution and credit conditions.

Exports and Imports. American Industrial Machinery Exports Fluctuate, L. J. Cochrane. Commerce Reports, no. 3, Jan. 20, 1930, pp. 173-175, 2 figs. Gains and losses in principal classes of machinery; metal-working, oil well, and refinery machinery, mining and quarrying machinery and pumping equipment; power generating, construction, conveying, and textile machinery.

AIRPLANE BRAKES

Wheel, Bendix-Perrot. Aero Wheel-Brakes, Hall. Flight (Lond.), vol. 21, no. 48, Nov. 29, 1929, p. 1266; see also Aeroplane, vol. 337, no. 22, Nov. 27, 1929, pp. 1236, 1238, 1 fig. Description of Bendix-Perrot wheel brake and its component parts; how torque is to be transmitted to fuselage; wide wheel tread is desirable; reduction in landing run of machines fitted with modern Bendix-Perrot brake was 50 per cent; fitting of brakes has effect of assisting ground crew; it permits use of tail wheel, instead of skid; servo control necessary. Abstract of paper read before Westland Aircraft Soc.

AIRPLANE DESIGN

1930 Trend. 1930 Airplane Design. Aviation, vol. 28, no. 7, Feb. 15, 1930, pp. 331-340. Opinions of 1930 trend in airplane design are given by airplane builders; bigger flying boats and research on aerodynamic novelties, variegated wing loadings, duralumin triumphant, L. C. Milburn; evolution along standard lines and restricted landing speeds, R. B. Beisel; cantilever wings and lower aspects ratios, H. C. Richardson; more variable-lift devices and cantilever wings, better landing gears, T. P. Wright; size depends on demand, wood and metal remain in balance, A. A. Gassner. (To be continued).

AIRPLANE ENGINES

Design. The Engine Builders Look at 1930. Aviation, vol. 28, no. 7, Feb. 15, 1930, pp. 341-348. Symposium of engine design tendencies by powerplant engineers and manufacturers; better accessibility and improved standard fuels, skeptical on Diesel, G. J. Mead; More air-cooled Vees, better mountings, more coherent installation, and Diesels sometime, but not yet, P. B. Taylor; relation between engine forms and fuselage form, better fuels not to be counted on, R. Insley; better accessories and better reliability, better cooperation of airplane and engine designer, H. M. Mullinnix; other discussions. (To be continued.)

Diesel. Junkers Develops Diesel Engine for Aircraft Use, E. P. A. Heinze. Automotive Industries, vol. 62, no. 4, Jan. 25, 1930, pp. 121-122, 3 figs. Description of Junkers Diesel aircraft engine which is of two-stroke piston type and maintains 650 hp. up to altitude of 11,400 ft.; weight is 2.6 lbs. per hp. and piston speed 2,160 ft. p.m.

Lubrication. Aircraft Engine Operation. Lubrication, vol. 15, no. 12, Dec. 1929, pp. 133-144, 18 figs. Requirements of operation of average airplane engine; choice of proper grades of oil to meet operating conditions; cooling and protection of lubrication while in air; advantages of dry sump lubrication; engine and bearing construction; oiling diagrams of Packard 12-cylinder V, Wright Whirlwind, Curtiss Challenger, Curtiss Conqueror, and Kinner aircraft engines; bearings and gear assembly in Pratt and Whitney Wasp, Le Blond 60 Model 5AD, Maybach, Continental and Cirrus Mark III engine; U. S. Government aircraft oil specifications; auxiliary lubrication.

The Lubrication of Aircraft Engines, F. A. Foord. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 33, no. 228, Dec. 1929, pp. 1089-1110 and (discussion) 1110-1132, 13 figs. Ideal characteristics of lubricant for aircraft-engine; adoption of low-viscosity oils not practicable at present; to obtain best viscosity-temperature curve for all conditions it is necessary to blend oils from different crudes; lubrication system of Bristol Jupiter, Armstrong-Siddeley Jaguar, Rolls-Royce F, Napier Lion, and A.D.C. Hermes engines, as well as combined oil cooler and cleaner; Vickers Potts are described.

Maintenance and Repair. Maintenance of Air-Cooled Engines in Commercial Operation, E. Hubbard and L. S. Hobbs. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 91-94. Principles of maintaining engines of fleet of airplanes as determined for Boeing passenger and mail service operating from Chicago to and along Pacific Coast; more difficult to form basis for judgment of fuels than of lubricating oils; cost weighed against possible damage from inferior fuel; effect on economy of temperature controls; provision for oil cooling in which regulation is effected with control of engine temperature; present conditions as to ice formation in carburetor.

Reduction Gears. Speed Reducer (Lorraine Untersetzungsgetriebe fuer Flugmotore). Automobiltechnische Zeit. (Berlin), vol. 32, no. 10, Oct. 10, 1929, pp. 630-631, 3 figs. Lorraine Co., of Argenteuil, has built speed reducer for heavy aircraft which reduces engine speed 1.545 to 1. for engine speed of 1,900 r.p.m.; mechanism is simple, consisting primarily of propeller shaft resting on two roller bearings and bronze thrust bearing; connection to propeller shaft is made by two planetary gears; mechanism is lubricated by special forced-feed system.

Salmson. A New Salmson Engine. Aviation, vol. 28, no. 5, Feb. 1, 1930, pp. 209-210. Description of new 500-hp. 18-cylinder double radial air-cooled engine Model Mk. 18 Ab; cylinders arranged in double row without stagger engine thus having same frontal area that a 9-cylinder engine of same bore and stroke has; pistons, valves, rocker gear interchangeable with corresponding parts of Model 9 Ab.230-hp., 9 Cm 260-hp., and 18 Cmb 520-hp. engines; starting by means of compressed air; weight 992 lbs.

AIRPLANE FUELS

Requirements for. Fuels and Dopes for Aircraft Engines, A. E. Dunstan. Aircraft Eng. (Lond.), vol. 1, no. 10, Dec. 1929, pp. 344-346. Review of requirements for airplane fuels and progress made in past six years towards meeting them; cracked material essential; volatility; investigation of certain additional degree of volatility in middle range which is necessary even though engine itself is hotter than average motor-car engine; physical and chemical stability necessary; question of layering; anti-knock value; increased efficiency attained by increasing compression ratios; evaluation of anti-knock quality; effect of changed conditions; best hydrocarbons; accurate testing method.

AIRPLANE MATERIALS

Metals. The Development of Metals for Aircraft Purposes, Rosenhain. Aeroplane (Lond.), vol. 37, no. 26, Dec. 25, 1929 (Aeronatutical Eng. Supp.), pp. 1434 and (discussion) 1436. General trend in development of metals for airplane is given with estimation of present direction and future tendencies; various steels, aluminum alloys, and very light alloys such as those based on magnesium are considered in regard to strength-weight ratio, stiffness, resistance to fatigue, to wear, and to corrosion, strength at high temperatures, and ease of working. Abstract of paper presented before Roy. Aeronautical Soc.

Rubber. Conquest of the Air—Rubber in Airplane Construction, C. Saurer. India Rubber World, vol. 81, no. 4, Jan. 1, 1930, pp. 57-58, 5 figs. Application of rubber to automotive industry; discussion of rubber in airplane shock absorbers, and other uses in airplane construction. Paper read before Am. Soc. Mech. Engrs.

Wood. Ash, White (Aircraft Use). U. S. Navy Dept. Specification No. 39A2, Dec. 2, 1929, 4 pp. General specifications covering following; grade, material and workmanship, general and detail requirements, method of inspection, tests, packing and marking. Bibliography.

AIRPLANE PROPELLERS

VARIABLE PITCH. Ratier Metal Propeller of Variable Pitch in Flight (L'hélice métallique Ratier à pas variable en vol), P. Leglise. Aéronautique (Paris), vol. 11, no. 127, Dec. 1929, pp. 407-411, 12 figs. Difficulties of designing propellers with pitch variable in flight; formulae for calculating forces acting at blade root developed; couple perpendicular to plane of bearing which is absorbed by action of balls; value of total torque found to be very high; Ratier company developed helicoidal thrust bearing; two- and three-bladed wood propellers; details of Ratier propellers; mechanisms for controlling variations in pitch.

AIRPLANE STRUTS

AERODYNAMIC THEORY. Aerodynamic Theory and Test of Strut Forms, R. H. Smith. Nat. Advisory Committee for Aeronautics, Report no. 335, 1929, 41 pp., 40 figs. Results of direct-problem study of finding flow boundaries, in uniform stream, of few balanced combinations of sources and sinks whose types of distribution are predetermined, and then of finding theoretical pressure on boundary surfaces; this considered as strut sequel to Fuhrmann's investigation, one being study in two dimensions, other in three; mathematics for equations of two-dimensional potential flow.

AIRPLANE WINGS

DESIGN. Wings—A Coordinated System of Basic Design, R. U. Upson. Soc. Automotive Engrs.—Jl., vol. 26, no. 1. Jan. 1930, pp. 15-30 and (discussion) 30 and 37, 13 figs. Practical coordination of existing data to furnish improved method for establishing best general proportions of wings; low-wing monoplane in power flight; summary of wing variables; effect of reduction in fixed drag; low-wing monoplane and rectangular-wing biplane in gliding flight; wind-tunnel research; flight data; effect of plan form on induced drag and lift curve; generalized equations for airfoil sections; computation of parasite drag.

PRESSURE DISTRIBUTION. Wind Tunnel Pressure Distribution Tests on Series of Biplane Wing Models, M. Knight and R. W. Noyes. Nat. Advisory Committee for Aeronautics—Tech. Notes No. 330, Dec. 1929, 6 pp., 36 figs. on supp. plates. Information is given on changes in forces on each wing of biplane cellule for various combinations of stagger and gap, stagger and sweepback, stagger and decalage, and gap and decalage; since each test was carried up to 90 deg. angle of attack, results may be use, in study of stalled flight and of spinning as well as in structural design of biplane wings.

AIRPLANES

EXPERIMENTAL. The Tanager and the Dub Pilot, E. P. Warner. Aviation, vol. 28, no. 6, Feb. 8, 1930, pp. 249-252, 4 figs. Discussion of Tanager as symbol of trend of times and one of most foremost fruits of Guggenheim Safe Aircraft Competition; qualities of safe airplane are summarized as author rates it; two auxiliary controls for trailing-edge flaps and adjustable stabilizer; flap controls serve to reduce minimum speed; landing gear of immense ruggedness; very soft shock absorber system; possibilities of beginner pilot flying Tanager in air safely and landing.

FIRE PREVENTION. Combatting Airplane Fires, H. Brunat. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 550, Jan. 1930, 18 pp., 14 figs. Measures and precautions recommended for reducing danger of fire; examples are given of study of fires and question of how fires break out and spread in each particular case; suggestions made to engineer in designing and building airplane, to mechanics in choosing material, and to pilot in flight which will greatly reduce danger of fire. From Comité Français de Propagande Aéronautique, Paris.

PASSENGER (COMMERCIAL). Sunbeam Cabin Biplane. Aviation, vol. 28, no. 5, Feb. 1, 1930, pp. 208. Details of new Sunbeam Model C-1 biplane produced by Commercial Aircraft Co., at Los Angeles Metropolitan Airport, Van Nuys, Calif., which has Wright J-6 300-hp. engine; four passengers seated in cabin; open cockpit for pilot and passenger; aerotruss brazed-steel wing ribs throughout wings and ailerons; fireproof treating of fabric covering; wing span 34 ft.; 1,000 lbs. payload.

PASSENGER (GENERAL DEVELOPMENT CO.) A Giant American Monoplane. Flight (Lond.), vol. 21, no. 1094, Dec. 13, 1929, pp. 1298-1301, 2 figs. Description of Christmas monoplane designed to carry 160 passengers; wing span 262 ft.; power 8,800 hp.; four planes to be built by General Development Co., at once; two fuselages are girders, constructed of steel tubing and covered with plywood; in nose of each is unit of four 1,100-hp separate engines symmetrically arranged around propeller shaft; passenger accommodation arranged in 14 compartments each seating from 4 to 6 people in leading edge; top speed 145 m.p.h.; cruising range 800 miles.

PASSENGER (HODKINSON). The Hodkinson Transport. Aviation, vol. 28, no. 5, Feb. 1, 1930, pp. 208-209, 1 fig. Description of eight-place triple-engined transport sesquiplane powered with three Curtiss Challengers engines, both outboard engine nacelles being mounted directly on upper surface of wings; wood wings; steel-tube fuselage; upper wing span 56 ft.; 1,380 lbs. payload.

PASSENGER (JUNKERS). Giant Junkers Airplane G 38 (Das Junkers-Grosslandflugzeug G 38). V.D.I. Zeit. (Berlin), vol. 74, no. 1, Jan. 4, 1930, pp. 2-6, 10 figs. Detailed description of structural features and aviation equipment of tri-motored monoplane having wing span of 44 m., length of 23 m. and maximum height of 6.5 m., weighing 13 tons, capable of lifting 11 tons; engines develop 2,400 hp., speed is 170km. per hr., range 3,400 km.; in its design this airplane resembles original Nurfluegel type patented by Junkers in 1910.

RADIO APPARATUS. Air Transport Communication, R. L. Jones and F. M. Ryan. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 1, Jan. 1930, pp. 50-54, 33 figs. Design of radio-telephone system for transport planes in flight requires quantitative knowledge of transmission conditions encountered in plane-to-ground communication; experimental investigations of these conditions over available frequency range has been carried out and results are given; complete aircraft radio-telephone system designed for use of air transport lines and airplane radio receiver designed for reception of government radio aids to air navigation are described.

TRAINING (AIRCRAFT BUILDERS). Student Prince Training Plane. Aviation, vol. 28, no. 5, Feb. 1, 1930, p. 210, 1 fig. Description of new training biplanes Student Prince manufactured by Aircraft Builders, Inc., Portland, Ore.; positive absence of bounce in landing; upper wing span 30 ft. 3 in.; Cirrus Mark 111 4-cylinder in-line engine, with streamline cowling.

AIRPORTS

PLANNING. Comments on Prize-Winning Designs in the Lehigh Airports Competition, A. Black. Am. City, vol. 42, no. 1, Jan. 1930, pp. 101-104, 3 figs. General conditions of contest; comments on winners of four highest awards.

The Lehigh Airports Competition, C. F. McReynolds. Aviation, vol. 28, no. 3, Jan. 18, 1930, pp. 104-107, 2 figs. Description of quadrant airport designed by A. C. Zimmerman and H. Harrison which won first prize; design provides day and night operations in any wind direction; star loading point provides three-storey arrangement with passenger handling on ground floor.

AIRSHIPS

R.100. The Airship R.100, R. B. Brigham. Flight (Lond.), vol. 21, no. 1096, Dec. 27, 1929, pp. 1352-1354, 1 fig. Design and construction of airship R. 100 is given; 16 main longitudinals and 16 transverse frames; making of spiral strip duralumin tube girders, by specially designed machine; building up of upper main bracing; adjustments of structure; method of mooring; inspection for corrosion.

R.101. A Comparison of England's Two New Airships. Aviation, vol. 28, no. 2, Jan. 11, 1930, pp. 65-68, 5 figs. Airship R.101 is compared with R.100 in regard to structural differences; methods of attaching envelope; R.100 not fitted with reefing girders; passenger accommodation is located in one bay of ship and is on three floors, whereas that of R.101 is in two bays; another difference in favour of R.101 is that its evaporative cooling system makes equivalent heat of 1,000 hp. in one radiator available to warm air.

AIRWAYS

RADIO BEACONS. Course-Shift Indicator for Double-Modulation Type Radio-beacons, H. Diamond and F. W. Dunmore. Aero Digest ,vol. 15, no. 6, Dec. 1929, pp. 168 and 170. Course-shift indicating instrument developed to further increase reliability of visual directive radio-beacon system developed by Bureau of Standards; instrument indicates to station operator whether given course as laid out in space remains unvarying during given time of operation and greatly facilitates check of beacon calibration.

ALLOY STEEL

NOTES ON. Notes on Alloy Steels, J. H. Andrew. Foundry Trade Jl. (Lond.), vol. 41, no. 694, Dec. 5, 1929, pp. 411-412. Some lesser-known facts concerning alloy steels are discussed; advantages associated with hot work; constitution and mechanical strength; formation of carbides; choice of alloy steels; depth hardness; temper brittleness; quenching temperatures; influence of rate of cooling on fracture. Abstract of paper presented before Instn. of Engrs. and Shipbldrs. in Scotland.

ALLOY STEEL CASTINGS

PROPERTIES OF. Compares Properties of Various Alloy Steel Castings, D. Zuege. Foundry, vol. 58, nos. 1 and 2, Jan. 1, pp. 100-103 and Jan. 15, 1930, pp. 71-74, 5 figs. Jan. 1: Data relating to alloy steels adapted to foundry use; classification; characteristic effects of chromium, nickel, manganese, vanadium, and molybdenum upon structure of steel; comparison of chrome-nickel and manganese carbon steel. Jan. 15: Physical characteristics for casting purposes compared; reactions of different steels for various heat treatments; agreement between structure and properties.

ANTIMONY MINES AND MINING

CHINA. Report on the Pan-Hsi Antimony Mine, Yi-Yang, Hunan, C. C. Tien, S. Y. Yuo and H. C. Wang. Far Eastern Rev. (Shanghai), vol. 25, no. 9, Sept. 1929, pp. 411-414, 4 figs. One of most important antimony mines in Hunan, situated about 48 mi. southwest of city of Yi-Yang Hsien; topography and geology; ore deposit; mining; smelting; mechanical equipment; transportation; tabular data on production and operating expenses.

ARCHES, CONCRETE

CONSTRUCTION STRESSES. The Behaviour of a Reinforced Concrete Arch during Construction, S. B. Slack. Am. Soc. Civil Engr.—Proc., vol. 56, no. 2, Feb. 1930, pp. 365-368. Discussion by H. J. Gilky, and A. H. Fuller, of paper indexed from issue of Nov. 1929.

ASBESTOS DEPOSITS

RUSSIA. Asbestos Deposits in Northern Baschenova in Ural (Das Asbestvorkommen noerdlich Baschenowa in Ural), A. Ohnesorge. Zeit. fuer Praktische Geologie (Halle), vol. 37, no. 9, Sept. 1929, pp. 166-169, 8 figs. Report of study trip, describing briefly deposits, genesis, and structure of veins; production in 1927-1928 was 27,000 tons.

ASPHALT

OKLAHOMA. Accelerated Weathering Properties of Oklahoma Asphalts, P. G. Shelley. Okla. Geol. Survey—Cir., no. 19, Oct. 1929, 37 pp., 1 fig., 5 supp. plates. Oklahoma sand and rock asphalt deposits are estimated to contain from 1 to 13 million tons; discussion of other research work; collection and description of samples; laboratory work; results of weathering tests. Bibliography.

ATMOSPHERIC ELECTRICITY

STUDY OF. Study of Fulminating Matter; Serpentine Forms (Contribution à l'étude de la matière fulminante. Les formes serpentines), E. Mathias. Académie des Sciences—Comptes Rendus (Paris), vol. 189, no. 21, Nov. 18, 1929, pp. 813-815. Impurities in atmosphere and their influence on kind, colour and other characteristics of fulminating phenomena caused by atmospheric electric discharges.

AUTOMOBILE BEARINGS

STANDARDIZATION. Ball and Roller Bearings Division. Soc. Automotive Engrs. Jl.—Reports of Divisions to Standards Committee (Section 2), Jan. 1930, pp. 14-20, 2 figs. Proposed American Standard and proposed revision of S.A.E. Standard for annular ball bearings of single-row type; proposed American recommended practice for annular ball and roller bearings of wide type.

AUTOMOBILE BODIES

DESIGN. Variation in Structure and Material for Use in Automobile Bodies Viewed in the Light of Recent European Trends, A. F. Denham. Automotive Industries, vol. 62, no. 5, Feb. 1, 1930, pp. 158-159. Review of Cast-Steel Body Conference at Society of Automotive Engineers Meeting in Detroit with abstracts of papers presented and discussion; Body Mounting, E. C. Gordon-England; summary of European and American body design differences, T. L. Hibbard; Sheet Steel and All Steel Body, G. L. Kelley.

AUTOMOBILES ENGINES

AIR FILTERS. Design of Automobile Air Filters (Luftfilter, ihre Bauart und Wirkungsweise), G. F. Dierfeld. Motor (Berlin), vol. 17, no. 11, Nov. 1929, pp. 38-41, 9 figs. There are two types of filters, centrifugal and screen type; centrifugal type operates primarily on centrifugal principle in which dust particles are thrown out into special duct while clean air enters engine; second type, operating on screen principle, has no moving parts, but must be cleaned periodically; examples of both are given.

FUEL VAPORIZING. Experiments in Vaporizing Fuel, G. Autenreith Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 13 and 108, 1 fig. Results obtained in internal-combustion engines in which practically all vaporization was accomplished before mixture entered manifold system; advantages obtained if complete or approximately complete vaporization can be produced before fuel reaches inlet manifold; vaporizing device described; power and economy improved.

MOUNTING. Elimination of Chassis Vibration, E. H. Smith. Soc. Automotive Engrs.—Preprint for mtg., Jan. 20-24, 1930, 4 pp., 3 figs. Development of method of mounting engine so as to reduce transmission of vibration from it to frame; rubber blocks of various shapes were tried until truncated-pyramid type gave promise of excellent results; longer dimension was placed crosswise of car, which afforded horizontal engine-stability; rubber washers used there to separate engine from frame; device by which vibrations in engine and frame could be measured electrically; rubber mounting reduced frame vibration to one-sixth of its original value.

SPARK PLUGS. Spark Plug Terminal Material is Factor in Performance, H. Rabezzana and D. W. Randolph. Automotive Industries, vol. 62, no. 3, Jan. 18, 1930, pp. 83-87 and 99, 16 figs. Factors affecting secondary potential and breakdown of sparking voltage of plugs under operating conditions; results of extended study made by AC Spark Plug Co. of electrical characteristics of ignition system in engine operation; employment of new electrode alloy substantially reduces sparking voltage required; engine speed, temperature and proper carburetion are important.

SUPERCHARGERS. An Exhaust Gas Turbo Charger. Automobile Engr., (Lond.), vol. 19, no. 262, Dec. 1929, pp. 509-510, 7 figs. Description of recent German developments in small exhaust-gas turbine for use with high-speed internal-combustion engine; heat difficulties overcome by internal air cooling of rotor and turbine blades; turbo-charger units can be fitted to any standard car; air thus preheated and compressed effects perfect evaporation of fuel in carburetor.

AUTOMOBILE MANUFACTURE

NITRIDATION. Nitriding Investigations, R. Sergeson. Soc. Automotive Engrs. Jl., vol. 26, no. 1, Jan. 1930, pp. 110-111. Résumé of developments of nitralloy and nitriding process; results obtained by nitriding compared with those obtained by carburizing effects of various temperatures during nitriding process; furnaces, methods and results; nitriding increases strength of steel.

AUTOMOBILE SHOCK ABSORBERS

DISCUSSION ON. Shock Absorbers, J. M. Nickelsen. Soc. Automotive Engrs.—Preprint, for mtg. Jan. 20-24, 1930, 4 pp. Things which appear most pertinent in connection with shock absorbers and their action on car are discussed, including type of control that can be secured through use of two-way hydraulic shock absorber and possible variation in energy absorption due to temperature which occurs in some of units on market.

AUTOMOBILE STANDARDIZATION

S.A.E. REPORT. S.A.E. Standards Report Adopted with Few Changes. Automotive Industries, vol. 62, no. 4, Jan. 25, 1930, pp. 129-131, 1 fig. Review of Standards Committee meeting of Society of Automotive Engineers in Detroit is given with changes made in proposals of divisions, regarding roller chain standards, metric-size spark plugs, electric head and tail lamps, non-ferrous metals, tanks for chromium plating, and passenger car body types.

AUTOMOBILE TRANSMISSIONS

HERRINGBONE GEAR. Composite Herringbone Gears, A. Nichols. Automotive Industries, vol. 62, no. 2, Jan. 11, 1930, p. 58, 1 fig. Discussion of composite herringbone gear invented by H. T. Thompson, chief engineer of Reo Motor Car Co.; one-half of gear has one pitch while other half has different pitch; automobiles with transmissions having composite herringbone gears have been driven under all possible conditions, from low to high car speed and from no load to full load on drive, change then being made to over-drive or coasting action; passengers in car not being able to distinguish by sound when gears were being used and when they were not.

AUTOMOBILES

FRONT-WHEEL DRIVE. Front-Wheel Drive, W. J. Muller. Soc. Automotive Engrs.—Preprint, for mtg. Jan. 20-24, 1930, 3 pp. Design of Ruxton front-wheel-drive automobile is discussed; Universal, Cardan and Weiss joints; lubrication; improved driving stability of front-wheel-drive car; steering advantages; disposition of drive-universals and axis of steering-knuckle spindles; greatest outstanding departure lies in transmission; lost traction on steep grades; weight transfer due to acceleration; weight distribution.

Bodies for Front-Wheel-Drive Cars, J. Ledwinka. Soc. Automotive Engrs.—Preprint for mtg., Jan. 20-24, 1930, 2 figs. Opportunity for body designer of front-driven cars to create harmony and beauty of lines; pan can be brought down even with bottom flange and height of springs increased and more comfortable cushion made; advantage of appearance in overall height, advantage of lowering centre of gravity which will add to steadiness, reducing side sway, and adds to roadability of car; front-wheel drives are necessarily of long wheelbase requiring economy in length of foot-room in body; muffling noise at front; absence of gear shift lever through floor.

Bucciali Front-Wheel Drive Car Has Independent Suspension, P. M. Heldt. Automotive Industries, vol. 62, no. 3, Jan. 18, 1930, pp. 75-and 96. Description of front-wheel-drive car also possessing independent suspension for both front and rear wheels, which has been developed by Bucciali Brother, Paris; transmission is arranged with its shafts transverse to frame and speed-charge mechanism is incorporated in drive beyond speed reducing gear.

PERFORMANCE TESTING. Speed of Automobiles with Minimum Fuel Consumption (Die Fahrgeschwindigkeit des niedrigsten Brennstoffverbrauches von Kraftfahrzeugen), O. Steinitz. Automobiltechnische Zeit. (Berlin), vol. 32, no. 35, Dec. 20, 1929, pp. 810-812, 2 figs. Results of calculation show that best speed in relation to fuel consumption per kilometer lies between half and total of maximum speed.

AUTOMOTIVE FUELS

DETONATION. Comparison of Antiknock Ratings Determined in Different Laboratories, C. H. Barton, C. H. Sprake and R. Stansfield. Soc. Automotive Engrs.—Preprint for mtg. Jan. 20-24, 1930, 4 pp., 2 figs. Tests conducted in laboratories of three British oil companies to obtain uniform ratings of antiknock values described; Delco, Armstrong-Whitworth and Ricardo E-35 engines tested; very concordant knock ratings for different fuels obtained with engines of widely different design and working conditions if temperature and speed are carefully controlled and settings adjusted for maximum-knock mixture strength.

Detonation Characteristics of Some of the Fuels Suggested as Standards on Antiknock Quality, J. M. Campbell, W. G. Lovell and T. A. Boyd. Soc. Automotive Engrs.—Preprint for mtg. Jan. 20-24, 1930, 6 pp., 4 figs. Quantitative data of some individual fuels suggested presented in terms of compression ratio for incipient knock over entire range of composition from zero to 100 per cent concentration as determined in admixture with normal heptane; normal heptane only one having sufficient degree of tendency to knock to make it suitable to form lower limit of scale of antiknock quality consisting of two pure fuels mixed in various proportions.

New Knock Testing Method Developed at University of Michigan, G. G. Brown and H. E. Zuck. Nat. Petroleum News, vol. 22, no. 3, Jan. 15, 1930, pp. 61-62 and 64, 2 figs. Method consists essentially in determining, by use of variable-compression, single-cylinder engine, compression ratio at which fuel gives distinct knock; this engine was developed in laboratory of National Advisory Committee for Aeronautics; one of new features is use of injection pump instead of carburetor for conveying fuel into cylinder.

Knock Test Apparatus and Methods are Standardized by Michigan Engineering Experiment Station, G. G. Brown. Automotive Industries, vol. 62, no. 4, Jan. 25, 1930, pp. 112-115 and 122, 4 figs. Description of methods and installed apparatus employed by Department of Engineering Research, University of Michigan, for making tests of fuels and giving certificates of special knock rating; single-cylinder variable-compression engine used; next important development is means of detecting incipient knock which is independent of human ear.

RESEARCH. Pressure Feed Gasoline System Recommended for Aircraft. Automotive Industries, vol. 62, no. 5, Feb. 1, 1930, pp. 157. Review of Cooperative Research Sessions of Society of Automotive Engineers meeting with abstracts of three papers by members of Bureau of Standards; The Properties of Gasoline with Reference to Vapour Lock, O. C. Bridgeman; Influence of Atmospheric Conditions on Knock Test, D. B. Brooks; Effect of Engine Design and Fuel Volatility on Acceleration Characteristics, C. S. Bruce.

SPECIFICATIONS. Fuel Specifications as Viewed by the Fleet Operator, A. Hughes, Jr. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 49-53. Conditions met by operator in purchase of fuels and practical limitations of fuel specifications are surveyed; requirements that fuel must meet to be satisfactory to operator; experience of United Railway and Electric Co. of Baltimore with fuels used since it began operations in 1915; close cooperation of engine and petroleum engineers with fleet operators is urged.

B

BALANCING APPARATUS

SELF-CENTREING. Design and Use of Self-Centreing Devices. Machy. (N. Y.), vol. 36, no. 5, Jan. 1930, pp. 398-400, 1 fig. Design of pivoted levers and sliding rods provided with self-centreing features which automatically return parts to central positions; self-centreing devices for angular movement; self-centreing device; self-centreing devices of sliding type; methods of eliminating lost motion.

BALANCING MACHINES

JAPANESE. A Japanese Balancing Machine. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, pp. 110-111, 7 figs. Kuno of Mitsubishi Research Laboratories has invented and developed machine by means of which, it is claimed, amounts and positions of weights required to balance rotor can be determined with great accuracy in relatively short time; factor which it measured is dynamic unbalance of rotor; it is, however, also applicable to static balancing of rotors.

BAUXITE

ANALYSIS. Bauxites and Their Chemical Composition (Les bauxites et leur composition chimique), V. Charrin. Génie Civil (Paris), vol. 96, no. 3, Jan. 18, 1930, pp. 63-64. Tabulated chemical analysis of French types of red, white, and gray refractory bauxite.

BEAMS

CONTINUOUS. Moment and Shear Diagrams for Continuous Beams and Rigid Building Frames, N. M. Stineman. Am. Concrete Inst.—Jl., vol. 1, no. 3, Jan. 1930, pp. 211-277, 18 figs. Distinction between continuous beam and rigid frame; methods employed in computing values for diagrams; ratio between column stiffness and girder stiffness; use of diagrams with illustrative examples; cut-and-try method not necessary; methods of obtaining approximate shear and bending moments in unequal spans; rigid frames with girders of unequal span; columns in same storey having unequal stiffness.

BEARINGS

JOURNAL. Journal Bearing Practice, F. Hodgkinson. Mech. World (Manchester), vol. 86, nos. 2241 and 2242, Dec. 13 and 20, 1929, pp. 560-562 and 576-577, 8 figs. See also Metal Industry (Lond.), vol. 35, nos. 25 and 26, Dec. 13 and 20, 1929, pp. 565-568, and 591-592, 8 figs. Dec. 13: Problems of bearings for dynamos, motors, steam turbines, and the like where flooded lubrication is applied and machinery must be placed in operation with full unit load on bearing; accuracy required in machining bearings; Michell or Kingsbury bearing. Dec. 20: Data regarding fluid pressures on bearings. Abstract of paper read before Instn. Mech. Engrs.

BELT DRIVE

DISCUSSION OF. The Necessity for Elasticity in Power Transmission, V. Sahmel. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 81-87, 7 figs. Careful discussion of use of belt wrapping pulley in short centre drives, with some of more important problems involved in such installations.

BELTS AND BELTING

LEATHER. Good Practice in the Use of Leather Belts, R. C. Moore. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 43-52, 15 figs. Practical analysis of belt operating requirements based on author's investigations as chief engineer of large belt manufacturer; determining horsepower rating; table giving maximum horsepower rating recommended for leather belting; effect of misalignment of pulleys.

RUBBER. Good Practice with Rubber Transmission Belts, T. A. Bennett. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 53-54, 3 figs. Practical discussion of rubber belting in transmission work; rubber belt construction. (To be continued.)

BENZOL

ANILINE RECOVERY. Continuous Operating Benzol-Washing Plant for Recovery of Aniline from Aqueous Salt Solutions (Die kontinuierlich arbeitende Benzolwaschanlage zur Gewinnung des Anilins aus einer waesserigen Salzloesung), O. Krebs. Chemische Fabrik (Berlin), no. 37, Sept. 11, 1929, pp. 407-408, 1 fig. In certain dye works large quantities of alkaline solution of glycine containing about 30 per cent of aniline are produced; continuous extraction process by which aniline liquor is passed downwards in thin streams through rising column of benzol affords means whereby gylcine solution may be freed almost completely from aniline at small cost.

RECOVERY PLANTS. Recovery of Benzol from Coal Gas, with Particular Reference to the Use of Active Charcoal, H. Hollings, S. Pexton, and R. Chaplin. Gas Jl. (Lond.), vol. 188, no. 3474, Dec. 18, 1929, pp. 777-780. Experimental work indicates that constituent primarily responsible for gum formation and depreciation of active charcoal is hydrocyanic acid; its removal results in great prolongation of life of charcoal and in production of benzol which does not resinify under normal storage conditions. Conclusion of paper read before Instn. Chem. Engrs. from same journal, Dec. 11, 1929, indexed in Engineering Index, 1929.

BLAST FURNACE GAS

POWER GENERATION. A French Interconnected System, L. A. E. Sekutowicz and A. Evain. Elec. Rev. (Lond.), vol. 105, no. 2717, Dec. 20, 1929, pp. 1118-1120, 1 fig.; see also Elec. Times (Lond.), vol. 8, no. 11, Nov. 27, 1929, pp. 1079-1080. Electricity generating plant and distribution network of Société Electrique de la Siderurgie Lorraine; installations that have so far been completed comprise 10 works, which include 60 blast furnaces; 5 four-cylinder gas engines of 22,000 kw., and 6 converter groups are installed; kilowatt-hour transmitted by network of company from commencement has been 7,931,074 in 1923 and 112,403,727 in 1928.

BLOOMING MILLS

REVERSING. 35 in. Reversing Roughing Rolling-Mill Plant. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, pp. 103-105, 1 fig. Details of mill constructed by Brightside Foundry and Engineering Co. for Tata Iron and Steel Co. of India; mill and its drive have been proportioned for large production; largest bloom size to be rolled will be approximately 18 in. by 18 in. in section, and smallest 8 in. by 8 in.; description of main electrical equipment, mill train, roll-changing mechanism, roller tables, and manipulator.

BLUEPRINT WASHING MACHINES

NEW WASHER-DRYER. A New Washer-Dryer for Photoprints. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, p. 116, 3 figs. Washing and drying machine for blueprints made by Precision Photo Printing Plant, is characterized by fact that after prints have been fed in they require no attention until they are delivered dry ready for delivery.

BOILER CONTROL

COMBUSTION. Automatic Boiler-Control Equipment in Steam-Electric Power Plant of Chantenay (Installation de réglage automatique de chaudières à l'usine génératrice thermique de Chantenay), J. Hak. Revue Générale de l'Electricité (Paris), vol. 26, no. 24, Dec. 14, 1929, pp. 969-974, 7 figs. Automatic combustion-control system of Roucke was installed for 24 Babcock and Wilcox boilers of 340 sq. m. and 2 boilers of same type of 635 sq. m. feeding 6 turbo-alternators of 5,000 and 2 of 10,000 kw.; short note on evaporation tests and fundamental equations of combustion regulation employed are given.

BOILER MANUFACTURE

FLANGING PRESSES. Hydraulic Boiler-Plate Flanging Press. Engineering (Lond.), vol. 129, no. 3338, Jan. 3, 1930, pp. 14, 2 figs. on p. 16. Press was made by Rice and Co. and supplied to firm of marine-boiler makers; on machine of this type are anvil block fixed to table, and plow block attached to inner of two vertical hydraulic rams.

BOILER OPERATION

LOAD FLUCTUATIONS. Influence of Load and Load Fluctuations on Operating Efficiency of Boiler Plants (Einfluss der Belastung und der Belastungsschwankungen auf den Betriebswirkungsgrad), E. Praetorius. Waerme (Berlin), vol. 53, no. 1, Jan. 4, 1930, pp. 1-5, 10 figs. There is often great discrepancy between designed and actual efficiency of boiler plant due to very great losses and operating fluctuations which frequently occur; these losses depend partly on status and nature of boiler load and partly on degree of fluctuations; comparative tests of Josse, Koeniger, and author are discussed.

BOILER TUBES

BEADING. Effect of Beading of Tubes on Properties of Material and Stresses in Tube Plates (Die Wirkung des Einwalzens von Rohren auf die Werkstoffeigenschaften und die Spannungsverhaeltnisse der Rohrplatte), E. Siebel. Mitteilungen auf dem Kaiser-Wilhelm-Institut fuer Eisenforschun (Duesseldorf), vol. 11, no. 17, 1929, pp. 279-285, 13 figs. Permanent deformations of tube plate and their influence on propertics of material; results of tests with expanded rings; influence of rolling process on Rockwell hardness and notch strength; influence of width of ring.

BOILERS

HIGH PRESSURE (BENSON). Experiments on Benson Boiler (Untersuchungen am Bensonkessel), E. Josse. V.D.I. Zeit. (Berlin), vol. 73, no. 51, Dec. 21, 1929, pp. 1815-1819, 5 figs. Efficiency and heat balance; heat contents of steam; stresses and heat transfer coefficient of heating surfaces at various boiler loads and at pressures above and below critical value; condition of water and steam at different locations of heating surface; operating experiences are shown in tables and curves. Communication from mechanical engineering laboratory of Charlottenberg Institute of Technology.

PULVERIZED-COAL FIRED, TESTING. Experiments on Temperature Distribution, Heat Emission, and Combustion in a Modern Pulverized-Coal Boiler (Versuche ueber Temperaturvertileung Waermeabgabe und Verbrennungsverlauf in einem neuzeitlichen Kohlenstaubkessel), E. Kuhn. Archiv fuer das Eisenhuettenwesen (Duesseldorf), vol. 3, no. 7, Jan. 1930, pp. 441-458, 23 figs. Description of boiler and testing equipment and evaluation of results; temperature distribution in combustion chamber and boiler, and other test results are presented graphically.

VIBRATIONS. Hum of Boilers (Das Brummen der Dampfkessel), W. Weck. Internationale Bergwirtschaft und Bergtechnik (Halle), vol. 22, no. 24, Nov. 27, 1929, pp. 387-389, 4 figs. Explanation of cause of and hum, means of prevention; effect of inferior fireboxes and poor draft.

WATER TUBE. New Design of Water-tube Boiler. Times Trade and Eng. Supp. (Lond.), vol. 25, no. 598, Dec. 21, 1929, p. 336. Departure from usual design of water-tube boiler has been made by Woelcker, Bernburg, Germany; design is such that combustion chamber and surface heated by radiation are arranged at about same level, while drums and tubes that are heated by contact with combustion gases are situated at lower level.

BORING AND TURNING MACHINES

SINGLE-COLUMN. Large Single-Column Boring and Turning Mill. Machy. (Lond), vol. 35, nos. 895, Dec. 5, 1929, pp. 308-309, 3 figs. Description of single-column boring and turning mill, built by Etablissements Charles Berthiez, Paris, which is claimed to be largest of this type ever built; maximum diameter of work 23 ft.; maximum height turned 14 ft.; provision for increasing turning capacity; constant-speed motor employed, 18 changes of table speed and 12 rates of feed being obtained by means of two gear boxes.

BRICK CONSTRUCTION

REINFORCED. La Brique Armée Homogène dans la Construction Générale, L. Atthenont. Paris: Librairie Polytechnique Ch. Béranger, 15 rue des Saints-Pères 1929, 90 f. Reviewed in Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, p. 109. Title must be translated Homogeneous Reinforced Brickwork in Construction Generally, subtitle being, Its Calculation Simplified, according to Rules applicable to Homogeneous Bodies; author's main purpose is to prove that brick can take place of concrete in steel-reinforced structures, and is, in many respects, to be preferred.

BRICKMAKING PLANTS

COAL HANDLING. Coal Handling in Operation of Ring Kilns (Kohlenbefoerderung nach und auf den Ringofen), W. Gressier. Tonindustrie-Zeitung (Berlin), vol. 53, nos. 71 and 73, Sept. 5, 1929, pp. 1285-1286, and Sept. 12, pp. 1317-1319. Suggestion for rationalization in transport of coal to plant and feeding of fuel in kiln; transport direct to work by ships or railroad cars; motor trucks and tractors; methods and equipment for charging kiln with fuel.

INDIANA. Northern Indiana Brick Company Operates Modern Sand-Lime Brick Plant at Mishawaka, Ind. Pit and Quarry, vol. 19, no. 8, Jan. 15, 1930, pp. 61-65, 11 figs. Northern Indiana Brick Co., Mishawaka, Ind. operates one of most modern sand-lime brick plants in Middle West; plant uses only most up-to-date types of equipment, went into operation on May 28, 1928, and has capacity of 30,000 bricks per day; during summer months plant is operated 18 hrs. per day and produces as high as 55,000 bricks.

BRIDGE CONSTRUCTION

FINANCING. The Financing of Bridge Construction Work in New York. Engineering (Lond), vol. 129, no. 3341, Jan. 24, 1930, pp. 113-114. Port of New York Authority has, in recent years, financed bridge construction amounting to nearly $100,000,000 by method which consists in sale of bonds of nature of debenture, or income, bonds to provide funds for major part of cost of each project being paid out of appropriations made by States of New York and of New Jersey.

BRIDGES, RAILROAD

CONSTRUCTION. An Interesting Bridge Reconstruction on the G.W.R., H. S. B. Whitley. Ry. Gaz. (Lond.), vol. 52, no. 3, Jan. 17, 1930, pp. 82-83, 3 figs. Description of old structure replaced by double-line bridge in 42 working hours; St. Austell station; three main girders vary in length from 82 to 92 ft., and weigh from 21 tons to 30 tons.

RECONSTRUCTION. Rapid Process for Replacing Metallic Railroad Bridges (Procédé rapide pour le remplacement de ponts-rails métalliques). Génie Civil (Paris), vol. 95, no. 26, Dec. 28, 1929, pp. 644-645, 4 figs. Description of methods used by Société Commerciale de Belgique in replacing steel-truss and steel-girder superstructures of bridges of state railways of Greece.

BRIDGES, STEEL ARCH

GREAT BRITAIN. Newcastle-Gateshead New Road Bridge. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, pp. 95-96, 13 figs. partly on supp. plates. Outline of bridge and its approaches and other particulars accompanying series of drawings of various parts of structure crossing Tyne River; arch of mild steel, is of two-hinged type; it consists of two crescent-shaped ribs arranged at 45 ft. centres; arch ribs were built out simultaneously from all four hinges; foundations for abutments were taken down to solid rock; continuous girder spans were launched into position by rolling out from earth approaches.

BRIDGES, TOLL

PAST AND PRESENT. Toll Bridges, Past and Present, P. K. Schuyler. Brooklyn Engrs. Club—Proc., vol. 28, part 2, Jan. 1930, pp. 19-31 and (discussion) 32-40. 8 figs. Toll bridges in United States: types, franchises, rates of toll, methods of financing; outlook for future legislation; map showing toll bridges of United States; table of private and public toll bridge financing for past few years shows total of $227,000,000; proposed series of national toll bridges.

BRONZE

FOUNDRY PRACTICE. Copper Oxide Eliminates Aluminum, J. H. Cheetham. Foundry, vol. 58, no. 3, Feb. 1, 1930, pp. 99. Description of series of tests made to ascertain whether contaminated copper alloy could be purified after melting and before pouring; estimated savings in using copper oxide against remelting whole aluminum-contaminated heat.

BUILDINGS

CONSTRUCTION PROGRAM. South's 1929 Building Program Relatively Greater Than in Rest of Country, C. E. Williams. Mfrs. Rec., vol. 97, no. 6, Feb. 6, 1930, pp. 62-66, 5 figs. Some major building projects which indicate something of diversity of building in South.

REMODELING. Remodeling: An Opportunity for the Architect, R. L. Davidson and W. E. Malm. Arch. Rec., vol. 67, no. 2, Feb. 1930, pp. 180-201, 20 figs. Remodeling opportunities as means of making business; meaning of obsolescence; calculating obsolescence; remodeling of buildings containing stores; modernizing elevator equipment in office and apartment buildings; light-weight construction; alteration costs; present standards of foot-candles of illumination for commercial interiors; reflection value of various paint colours; building planning service.

C

CABLEWAYS

DRIVE. Influence of Karlik Pulley on Stress of Cable and on Type of Cableway Drive (Der Einfluss der Karlikscheibe auf die Beanspruchung des Zugseiles, etc.), A. Schurig. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 22, no. 25, Dec. 6, 1929, pp. 491-494, 8 figs. Examples from different installations with and without Karlik drive are illustrated and discussed, showing great saving in power in favour of Karlik drive; brakes for Karlik drives are described. (Concluded.)

SOUTH AFRICA. The Elands Valley Aerial Ropeway. S. African Min. and Eng. Jl. (Johannesburg), vol. 40, no. 1990, Nov. 16, 1929, pp. 282-284, 8 figs. Illustrations, credited to R. Starkey, and text describing aerial cableways transport asbestos ore 5 and 9/10 miles from New Amianthus asbestos mine to Elandshoek station on Delagoa Bay railroad; Bleichert monocable with capacity 7½ tons per hour.

CALCIUM CARBIDE

STATISTICS. Statistics of Manufacture and Consumption of Calcium Carbide, Dissolved Acetylene and Oxygen in 1929 (Wirtschaftliche Statistik betr. Herstellung un Verbrauch von Calcium-carbid, geloestem Acetylen und Sauerstoff im Jahre 1929), W. Rimarski. Autogene-Metallbearbeitung (Halle) vol. 23, no. 1, Jan. 1, 1930 pp. 2-4. Statistical data and figures are indicated.

CAMS

DESIGN. Avoiding Variation in Curvature of High-Speed Cams (Bekaempfung der Unstetigkeiten bei schnellaufenden Steuernocken), R. Doerfel. Maschinenbau (Berlin), vol. 8, no. 21, Nov. 7, 1929, pp. 729-731, 6 figs. Development of appropriate curve for various purposes is indicated and its design by aid of simplates, is discussed.

CAR DUMPERS

ROTARY. Rotary Car Dumper a Feature of State Line Station. Power, vol. 71, no. 6, Feb. 11, 1930, pp. 204-207, 6 figs. Illustrated description of automatically operated car dumper, which is 60 ft. long and has capacity of twenty 120-ton cars per hour; cars are pushed up incline by electrically operated mule, and on decline are controlled by electric-pneumatic retarders.

CARBON-DIOXIDE REFRIGERANTS

EFFECT OF. Carbon Dioxide Preservation of Meat and Fish, D. H. Killeffer. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 140-143, 2 figs. Effect of carbon-dioxide gas on meat; degree of preservative action; effect of carbon dioxide on bacterial growth; application of transportation of meat and fish.

CARS, STREET RAILROAD

DOUBLE DECK. New Light-weight Double-deck Bogie Car for Birmingham. Elec. Ry. Bus. and Tram. Jl. (Lond.), vol. 62, no. 1540, Jan. 17, 1930, pp. 25-28, 4 figs. Outstanding features of experimental tram car; overall length 33 ft. 6 in.; overall width 6 ft. 3 in.; seating capacity 63 passengers; curve illustrating acceleration and deceleration of tramcar; curve illustrating current consumption of new car as compared with other cars.

MAINTENANCE AND REPAIR. Renewing Wheel Flanges. Am. Mach., vol. 72, no. 7, Feb. 13, 1930, pp. 305-306, 3 figs. Description of methods employed by United Railways and Electric Co., Baltimore, Md., in repairing wheel flanges of its trolley cars.

SASKATOON. Double Truck, Double End One Man Cars, Saskatoon Municipal Railway. Can. Ry. and Mar. World (Toronto), no. 383, Jan. 1930, p. 41, 1 fig. Illustrated description of double-truck, double-end, one-man motor cars, employing rolling bearings and air operated doors; general dimensions of cars are given; structural features are also given.

CARS, TANK

UNIVERSAL DESIGN. 80-Ton Railway Wagon for 3-Ft. Gauge. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, pp. 102-103, 6 figs. Details of car trucks of unusual design supplied by Baguley (Engineers), Ltd. to Anglo-Persian Oil Co. for use on their 3-ft. gauge lines in Persia; intended for transport of steel tanks, 83 ft. long and 10 ft. in diam., load full being 80 tons; stock is required to take curves of 95-ft. radius; trucks are designed with four six-wheel trucks by means of which good distribution has been ensured.

CAST IRON

ANNEALING. Modern Methods of Annealing Gray and Malleable Cast Iron (Neuzeitliches Gluehen von Grau und Temperguss), R. Stotz. Giesserie (Duesseldorf), vol. 16, no. 52, Dec. 27, 1929, pp. 1209-1220, 21 figs. Notes on annealing pots of iron alloys resistant to piping; annealing media and their preparation; chamber and tunnel ovens for pulverized-coal and gas firing; pulverizing costs for bituminous coal; ideal annealing curves are presented.

ARC WELDING. Metallic Electrodes for Cast-iron Arc Welding, S. Satch. Am. Inst. Min. and Met. Engrs.—Trans., 1929, pp. 144-165 including discussion. Writer has been able to obtain series of cast irons, from gray to white, without using cast-iron electrodes but by coating on wrought-iron bars mixtures of carborundum and graphite; practical application of cast-iron welding. Article indexed in Engineering Index, 1929, from Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 162, Jan. 1929.

EXPANSION. Expansion Coefficients of Cast Iron (Beitrag zum Ausdehnungs Koeffizienten des Gusseisens), F. Roll. Giesserei Zeitung (Berlin), vol. 27, no. 1, Jan. 1, 1930, pp. 4-7, 11 figs. Brief notes of structure of metals, after which author explains relation of expansion to structural constituents, and relations of expansion coefficients to alloying elements; expansion coefficient increases slowly with amount of heating until it approaches a maximum. Bibliography.

TEMPERATURE EFFECT. Influence of Structure of Cast Iron on Changes Due to High Temperature (Influence de la structure de la fonte sur les alterations subies aux températures élevées), A. Le Thomas. Académie des Sciences—Comptes Rendus (Paris), vol. 189, no. 17, Oct. 21, 1929, pp. 639-641. Differences in behaviour of series of 10 bars of cast iron of diameters varying from 13.0 to 100.5 mm., but otherwise similar, due to heat treatment have been examined; more slowly cooling thick bar is more stable than quicker cooling thin one.

WELDING. Welding of Cast Iron and Cast Steel (Schweissen von Gusseisen und Stahlguss), W. Hoffmann. Autogene Metallbearbeitung (Halle), vol. 22, no. 22, Nov. 15, 1929, pp. 331-333, 5 figs. Experiments are carried out in order to determine behaviour of various iron and steel castings when welded; average values of quantity which can be obtained are tabulated.

CEMENT PLANTS

TEXAS. Trinity's Cement Plants at Dallas and Fort Worth Each Has Capacity of 4,000 Barrels Daily, T. K. Knox. Pit and Quarry, vol. 19, no. 8, Jan. 15, 1930, pp. 27-39, 47 figs. The plants of Trinity Portland Cement Co., Tex., former wet-process, and latter dry-process, are described and illustrated.

CEMENT, PORTLAND

CLINKERS. Multistage Process for Burning Portland Cement Clinker, R. D. Pike. Indus. and Eng. Chem., vol. 22, no. 22, Feb. 1930, pp. 148-152, 6 figs. Apparatus for three-stage process; modification of original arrangement; potash collection at Davenport; process with waste-heat boiler and potash-collecting plant; calculation of heat balances; Davenport experiment; complete separation of calcining and clinkering stages; comparison of proposed arrangements; comparison with usual rotary kiln.

CERAMIC KILNS

HEAT RECOVERY. Cooling Zone as Source of Heat in Ring-Kiln Practice (Die Kuehzone im Ringofenbetrieb als Wasemequelle), G. Paschke. Tonindustrie-Zeitung (Berlin), vol. 53, no. 73, Sept. 12, 1929, pp. 1320-1321, 2 figs. Cooling in ring kiln should be conducted in such manner that after heat is utilized for air heating and other heating purposes, there should always be some heat left in cooling zone. (Concluded.)

CHAIN DRIVE

ROLLER. Roller Chain Drives—Their Selection and Use, R. S. Dyson. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 88-90, 9 figs. Description of constructional features of roller chain; proper application gives best results; information needed in selecting roller chain drive; formula for chain pull.

SILENT. Silent Chain Drives, C. R. Weiss. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 57-61, 9 figs. Constructional features which influence selection, installation and operation of silent chains in economic transmission of power; installation of chain drives; lubrication of silent chain; advantages of chain drives.

CHAINS

MANUFACTURE. Link and Sprocket Chains, Their Manufacture, Properties and Application (Glieder und Gelenkketten, ihre Herstellung, Iegenschaften und Verwendung), F. Reidig. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 22, no. 25, Dec. 6, 1929, pp. 494-497. Conveyor chains, crane chains, drive chains and other sprocket chains are discussed, and references are made to D.I.N. standards. (Concluded.)

CHEMICAL ENGINEERING

ECONOMIC TREND. Economic Trend in the Chemical Industry, H. H. Dow. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 113-116, 2 figs. Description of interchange system; development of labour savers in chemical plant; brine and bromine-plant development at Midland; epsom-salt plant; brine evaporation.

CHIMNEYS

CONCRETE. Heat Permeability of Reinforced-Concrete Chimneys (Die Waermedurchlaessigkeit von Eisenbetonschrornsteinen), O. Graf. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 1, Jan. 1930, pp. 23-24, 7 figs. As results of measurements on experimental chimney heat-conductivity coefficients of reinforced concrete, masonry, and other insulating materials are given for conditions approximating those in practice.

CITY PLANNING

BOSTON. Planning for Boston—1630-1930, E. M. Herlihy. City Planning, vol. 6, no. 1, Jan. 1930, pp. 1-13, 5 figs. Secretary of Boston City Planning Board traces development of Boston city plan during last 300 years; maps of Boston in 1630, 1722, 1880 and 1926.

CIVIL ENGINEERING

UNITED STATES. Present Status of Major Engineering Projects. Eng. News-Rec., vol. 104, no. 6, Feb. 6, 1930, pp. 254-258, 5 figs. Progress noted on highway and railroad bridges, hydro-electric power projects, water-supply structures; railway terminals and improvements, flood control and navigation, sanitary district of Chicago, Merchandise Mart, Chicago, etc.

CLAY DEPOSITS

CANADA. Manufactures of Canadian Clay. The Can. Engr. (Toronto), vol. 58, no. 4, Jan. 28, 1930, p. 168. Notes on distribution of deposits of raw material for brick, tile and sewer pipe in Maritime and Quebec; clay manufactures in Ontario; western production increasing; resources in British Columbia are varied.

CLAY PRODUCTS

MANUFACTURE. Fire Brick, Glazed Ware, and Enameled Ware Improved by Study of Manufacturing Methods, H. D. Hubbard. Commercial Standards Monthly, vol. 6, no. 6, Dec. 1929, pp. 159-161, 2 figs. Brief account of investigations of manufacture of clay products by U. S. Bur. of Standards.

CLOCKS

ELECTRIC. New Types of Electric Clocks (Neue elektrische Uhren), J. Baltzer. Elektrotechnische Zeit. (Berlin), vol. 51, no. 2, Jan. 9, 1930, pp. 45-47, 4 figs. Three new types are described; Junghans Electronom system, Kienzle self-winding clock with striking mechanism are discussed; Junghans clock is to serve master clock in electric time system, Kienzle and Ato clocks are independent, battery-operated time pieces.

COAL CARBONIZATION, LOW TEMPERATURE

SALERMO PROCESS. The Development of the Salermo Process. Chem. Age, (Lond.), vol. 22, no. 552, Jan. 25, 1930, pp. 75-76, 1 fig. Steady development of Salermo process during past few years; object and principles of process explained.

COAL CLEANING

MODERN TIMES. Coal Cleaning in Modern Times, R. Lessing. Gas Jl. (Lond.), vol. 189, no. 3478, Jan. 15, 1930, pp. 147-150, 5 figs. Sources of ash content; other coal constituents; significance of coal cleaning to carbonizing industries; large-scale plant in South Wales; float and sink tests. Abstract of lecture before Southern Assn. of Gas Engrs. and Mgrs.

COAL CUTTERS

TESTS, GERMAN. German Tests of Bar and Chain Coal Cutters, W. Maevert. Colliery Guardian (Lond.), vol. 139, no. 3600, Dec. 27, 1929, pp. 2462. Bar-type machines were first given preference, but chain-type cutters have recently been adopted in many instances; tabular comparative time study on bar and chain machines data on results of various tests; under many conditions, chain-type machine is now preferred. Translated abstract of article indexed in Engineering Index, 1929, from Glueckauf, Sept. 14 and 21, 1929.

COAL DEPOSITS

ORIGIN. Primordial Material of Coal (Das Urmaterial der Steinkohle, R. Potonie. Internationale Bergwirtschaft und Bergtechnik (Halle), vol. 22, no. 25, Dec. 11, 1929, pp. 395-398, 2 figs. In discussion of origin of coal it is asserted that it can be proven palaeontologically that not only lignin but also cellulose contribute to form coal.

COAL GEOLOGY

IDENTIFICATION, MEANS OF. Means of Identifying Coal Strata (Die Hilfsmittel zur Identifizierung von Steinkohlenfloezen), K. Patteisky. Internationale Bergwirtschaft und Bergtechnik (Halle), vol. 22, nos. 22 and 23, Oct. 30 and Nov. 13, 1929, pp. 315-354 and 367-373, 15 figs. Discussion of means to aid in identifying coal strata, Oct. 30: Identification of main veins in district. Nov. 13: Location of smaller deviations of main veins.

COAL MINES AND MINING

ELECTRIC EQUIPMENT. List of Manufacturers of Permissible Equipment and Explosion-Proof Accessories, as of Jan. 1, 1930, L. C. Ilsley. U. S. Bur. Mines—Information Cir., no. 6222, Jan. 1930, 5 pp. Circular prepared, to present information in easily available form, in response to inquiries received as to where accessories for permissible equipment can be obtained.

LIGHTING. Increase of Output in Coal Mining Resulting From Better Lighting (Leistungssteigerung im Kohlenbergbau durch verbesserte Beleuchtung), L. Schneider. VDE Fachberichte der XXXIV. Jahresversammlung des Verbandes Deutcher Elektrotechniker in Achen (Achen), 1929, pp. 69-70, 3 figs. In place of usual mine safety lamps 40 firedamp-proof lamps of 70 watts at 150 volts have been installed in timber at distances of 4 m.; increase in production because of this better method of lighting is shown in graphs.

SURVEYS. The Use of Ordnance Survey Data on Mining Surveys, D. A. Hutchison. Colliery Guardian (Lond.), vol. 139, no. 3600, Dec. 27, 1929, pp. 2455-9245 and (discussion) 2459-2461; see also abstract in Iron and Coal Trades Rev. (Lond.), Jan. 3, 1930, p. 7. Supplement to paper indexed in 1929; trigonometrical control; mapping problems; requirements of mine surveyor; general principles of semigraphic method of resection. Read before Inst. of Mine Surveyors.

COAL WASHING

RHEOLAVEUR. Coal Washing by Rheolaveurs (Le lavage des charbons par Rhéolaveurs), A. France. Génie Civil (Paris), vol. 95, no. 25, Dec. 21, 1929, pp. 622-623. Theory of coal washing by water or pneumatic cleaning. Paper read before Conference on Bituminous Coal at Pittsburgh.

COBALT-NICKEL ALLOYS

MAGNETIC PROPERTIES. Magnetization of Nickel Cobalts to the Saturation Point (Sur l'aimantation à saturation des nickel-cobalts et les moments autoniques du nickel et du cobalt), P. Weiss, R. Forrer and F. Birch. Académie des Sciences—Comptes Rendus (Paris), vol. 189, no. 20, Nov. 12, 1929, 789-791, 1 fig. Alloys of 70 per cent of cobalt and upwards show large extent of resistance against magnetization and it has not been possible to attain saturation; magnetizing curves for various per cents of cobalt from 40 per cent upwards are given.

COKE MANUFACTURE

BY-PRODUCT. Developments in By-Product Coke Industry, H. Zeller. Blast Furnace and Steel Plant, vol. 18, no. 1, Jan. 1930, pp. 94-95, 1 fig. Use of blast-furnace gas on ovens and release of coke-oven gas for domestic purposes is important item of improvement in by-product coke industry; phenol-removal methods perfected.

CONCRETE

REINFORCED. Review of Reinforced Concrete, E. O. Rose. Gas Jl. (Lond.), vol. 188, no. 3475, Dec. 25, 1929, pp. 830-831. Economic aspect; rapid-hardening cements; specialists in concrete; provision of form scaffolding; architectural aspect.

CONCRETE CONSTRUCTION

FORMS. Sizes of Removable and Permanent Forms, Pans, or Domes Made of Wood, Steel, or Other Material Used in Concrete Ribbed Floor Construction. U. S. Bur. of Standards—Simplified Practice Recommendation, no. R87-29, 1929, 12 pp. Recommendations covering history of project, general conference, meeting of manufacturers and dealers, results, benefits, of simplified practice, organization and duties of standing committee, and list of simplified practice recommendations.

CONCRETE MIXING

RULES FOR. Just How Do You Make Good Concrete, E. Godfrey. Can. Engr. (Toronto), vol. 58, no. 3, Jan. 21, 1930, pp. 153-154. High strength not most important property; shortcomings of water-cement ratio theory; fluidity of concrete not necessarily harmful; insufficient mixing; rodding fallacy; requisites for durable cement; making concrete waterproof; old rules best.

FIELD ANALYSIS. A Method of Determining the Constituents of Fresh Concrete, W. M. Dunagan. Am. Concrete Inst.—Jl., vol. 1, no. 2, Dec. 1929, pp. 202-210, 5 figs. Plan of method of sampling of fresh concrete from structure at any point and determining amounts of water, cement, fine and coarse aggregate, making use of Archimedian principle of water displacement; details of procedure.

PLANTS. Transit-Mix Concrete Corp. Solves Many Problems in Marketing of Concrete in New York City, W. F. Trauffer. Pit and Quarry, vol. 19, no. 8, Jan. 15, 1930, pp. 23-26, 11 figs. Description of Transit-Mix Concrete Corp., New York City, which operates number of strategically located plants which furnish most of commercial ready-mixed concrete for metropolitan area.

CONCRETE REINFORCEMENT

DURABILITY. Observation of an Exposed Reinforced Concrete Beam, W. I. Freel. Am. Concrete Inst.—Jl., vol. 1, no. 3, Jan. 1930, pp. 278-282, 4 figs. Observations on reinforced-concrete beam which had been tested to destruction and was exposed to outdoor weather conditions for 24 years; reinforcing steel embedded in cracked concrete was found incrusted with rust while steel in sound concrete, a few inches away, was discovered in perfect condition.

CONCRETE TESTING

RECENT RESEARCHES. Recent Researches on Cement, Cement Mortar and Concrete, O. Graf. Pit and Quarry, vol. 19, no. 8, Jan. 15, 1930, pp. 49-53, 9 figs. Author pleads for tests which correspond to actual field conditions and reviews progress made in improving desirable mechanical properties of concrete and cement mortar; texture and structure of cement mortar and concrete; use of concrete in road construction. Indexed in Engineering Index, 1929, from V.D.I. Ziet. Sept. 28, 1929.

CONSTRUCTION EQUIPMENT

TRANSPORTATION. Winter Transportation Problems. Can. Engr. (Toronto), vol. 58, no. 3, Jan. 21, 1930, p. 144. Methods of hauling equipment and supplies for construction of mining plant at Flin Flon and power development at Island Falls, both in northern Manitoba; branch railway constructed; tractor-train service.

CONSTRUCTION EQUIPMENT INDUSTRY

FOREIGN MARKETS. Foreign Markets for American Road Construction Equipment, L. J. Cochrane. Commerce Reports, no. 2, Jan. 13, 1930, pp. 94-96, 2 figs. Exports radiply increasing; shipments in 1928 double those in 1925; Canada leading market; sales to Russia; Cuba and Argentina purchase much machinery; marked increase in exports to Brazil, Mexico and Uruguay; demand increases in Columbia, South Africa, and Germany; trends in Australian and Japanese markets; gains and losses in business in other principal markets; comparison of exports; of various types of road construction and maintenance equipment.

CONSTRUCTION INDUSTRY

SOUTHERN STATES. Drainage and Flood Control Active Factors in South's Expansion, C. E. Williams. Mfrs. Rec., vol. 97, no. 3, Jan. 30, 1930, pp. 44-47, 5 figs. Survey of important construction and engineering projects of general character undertaken or proposed in 16 Southern States last year shows that, in addition to numerous projects completed, work is now under way on major jobs in widely scattered sections of South, and that work will shortly be initiated on undertakings for which contracts were let in closing weeks of 1929.

UNITED STATES. Facts and Figures of Construction. Eng. News-Rec., vol. 104, no. 6, Feb. 6, 1930, pp. 259-262, 3 figs. Drop in construction during 1929 likely to be made up in 1930, with total of ten billions in prospect; public works and utilities budgets ample, costs stable, and financing is easier; bond sales on increase; bond yields and stock prices; prevailing bond coupon rates; construction volume and national income; production of major commodities; prices of materials; estimated construction budget for 1930.

CONVEYORS

AID PRODUCTION. Conveyors Aid Production Problems. Iron Age, vol. 125, no. 4, Jan. 23, 1930, pp. 300-302, 6 figs. Rearrangement of factory made by Dayton Pump and Manufacturing Co., Dayton, Ohio, so as to eliminate waste space and installation of comprehensive conveying system for handling materials; handling of pumps in calibrating room; method of visual control of production.

COPPER

ELECTROLYTIC. Further Observations on Workability of Electrolytic Copper (Weitere Beobachtungen bei der Knetbearbeitung von Elektrolyt-Kupfer), K. Bernhoeft and W. Wunder. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 1, Jan. 1930, pp. 27-29, 8 figs. Rupture of electrolytic copper bars occurring with hot rolling has led to great economic losses; suggestions are given for improving quantity of rolling-mill product; tests show that above all, transverse fractures must be avoided in rolling.

COPPER ALLOYS

P.-M.-G. METAL. P.-M.-G. Metal. Foundry Trade Jl. (Lond.), vol. 41, no. 692, Nov. 21, 1929, pp. 375-376, 5 figs. Description of P.-M.-G. metal which is substitute for gun-metal and phosphor bronze; melting practice being carried out in pit fires of usual type, conditions being exactly same as for gun-metal, except that less notice was taken of casting temperature; moulding; mechanical tests; heat-treated P.-M.-G.; comparison of cast P.-M.-G. metal with Admiralty gun-metal.

COPPER MINES AND MINING

MICHIGAN. Mining Methods and Practice in the Michigan Copper Mines, W. R. Crane. U. S. Bur. of Mines—Bul., no 306, 188 pp., 147 figs. History and early development; transition period; recent methods; character and occurrence of ore; development of mines; extraction of ore by advancing methods, retreating methods and robbing pillars; exploration of mines; support in mines; handling ore and rock; drainage and ventilation; mining practice; suggested improvements in practice; records of unit production; costs in detail.

CORE MAKING

OIL SAND. Hidden Facts in Oil-Sand Practice, F. Hudson. Foundry Trade Jl. (Lond.), vol. 41, nos. 696 and 697, Dec. 19 and 26, 1929, pp. 443-446, 459-460 and (discussion) 460 and 464, 11 figs. Dec. 19: Object is to promote interest in research relative to fundamental principles required for successful, economical and efficient oil-sand core practice; sieve and subsidence test; effect of sand relative to binder economy and core in regard to strength, permeability, finish, heat conductivity, refractoriness, and gas evolution on casting. Dec. 26: Effect of binders relative to core strength, permeability and finish. Paper presented before Inst. Brit. Foundrymen.

D

DAMS, CONCRETE

FROST DAMAGE. Repairs to Dam at Lake St. Francis, P. E. Bourbonnais. Can. Engr. (Toronto), vol. 58, no. 3, Jan. 2, 1930, pp. 141-143, 3 figs. Gunite employed in repairing disintegrated portions of Allard Dam at Lake St. Louis, Que.; dam, consisting of series of plain concrete arches 15 ft. span, is 43 ft. high and 602 ft. long; failure was due to poor concrete and frost action; details of reinforcing and anchorage arrangement in gunite repair coating.

DAMS, HIGH

SYMPOSIUM. High Dams—A Symposium. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 1, Jan. 1930, pp. 183-185, 1 fig. Discussion by F. G. Switzer, of paper indexed from issue of Nov. 1929.

DAMS, MASONRY

RAISING. The Assouan Dam. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, pp. 101-102, 5 figs. Reference is made to report reviewed in Feb. 8, and Mar. 8, 1929, issues of this journal on proposed heightening of dam; in accepting general plans for strengthening structure put forward by Commission, Macdonald made proviso that, as maxmum, water level shall be raised by only 8 m., instead of 9 m. proposed by Commission, and has reserved right to introduce additional strengthening works which will not interfere with general plan; contract for work has been let to M. Norton Griffiths and Co.

DAMS, ROCK FILL

FAILURES. The Failure of a Rock Fill Dam in Victoria, J. T. Noble Anderson. Engineer (Lond.), vol 149, no. 3863, Jan. 24, 1930, pp. 100-102, 5 figs. Report of investigation of failure of Eildon (Sugarloaf) weir across Goulburn River, on April 26, 1929; subsidence of bank on up-stream side of core wall occurred, exposing core wall to maximum depth of 26 ft.; in discussing whether whole structure is efficient for purpose for which it was designed, Board states that in its present condition it probably is not, nor can original design be restored.

DEPARTMENT STORES

DESIGN. Planning Future Expansion for the Department Stores, K. Welch. Arch. Rec., vol. 67, no. 2, Feb. 1930, pp. 202-204, 4 figs. Vice-president in charge of design of Grand Rapids Store Equipment Corporation discusses means which can be provided for additional expansion in future when designing entirely new building.

DIESEL ENGINES

ANTE-CHAMBER. Size of Ante-Chamber and Its Influence on Working of Ante-Chamber Diesel Engine (Die Vorkammergroesse und ihr Einfluss auf das Arbeitsverfahren der Vorkammer-Dieselmaschinen), H. Mehlig. Automobil-technische Zeit. (Berlin), vol. 32, nos. 32 and 34, Nov. 23, 1929, pp. 723-725, and Dec. 10, 1929, pp. 783-785, 5 figs. Report of investigation carried out at Institute for Internal Combustion Engines and Thermotechnology of Hanover Institute of Technology; influence of heat admission during compression; differential equations for compression; influence of change of speed, cross-section ratio and compression temperature.

AUTOMOTIVE. Light-Weight Diesel-Engines, O. D. Treiber. Soc. Automotive Engrs.—Preprint for mtg. Jan. 20-24, 1930, 3 pp., 5 figs. Light-weight engines must run at high speeds, utilize high-strength materials at high stresses, and develop high mean effective pressure; with equal mean effective pressures, Diesel engines can be made only about 15 per cent heavier than corresponding gasoline engines for motorcoach and motor truck service; advantages and disadvantages of plain and auxiliary combustion chambers; foundry conditions limit lightness; mechanical details of Triber engines.

Combustion Chambers, Injection Pumps and Spray Valves of Solid Injection Oil Engines, J. E. Wild. Soc. Automotive Engrs.—Preprint for mtg., Jan. 20-24, 1930, 23 pp. Relation between method of combustion, shape of combustion chamber and characteristics of injected fuel spray is discussed; design of engine with precombustion chamber, and engines with direct injection, spray atomization and spray atomization by air whirls; engines with auxiliary air chamber taken up; devices developed to introduce fuel into combustion chamber, covering various injection valves, injection pumps and nozzlse.

BUCKEYE. The Buckeye Diesel Makes Its Appearance. Power, vol. 71, no. 2, Jan. 14, 1930, pp. 62-63, 3 figs. Description of four-stroke-cycle mechanical-injection Diesel brought out by Buckeye Machine Co., Lima, Ohio; capacities from 200 to 400 hp.; bore and stoke 13 by 18 in.; rating 65 hp. per cylinder at 277 r.p.m.; individual fuel-injection pump for each cylinder; design characteristics of engine.

CANADA. The Adoption of the Diesel Engine in Canada. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, p. 124. Review of progress made during past year in application of Diesel power to locomotives, ship propulsion, portable generating plants, and stationary power plants.

CRANKSHAFTS. New Formula for the Calculations of Shafts for Diesel and Semi-Diesel Engines (Nouvelle formule pour le calcul des arbres des moteurs Diesel et Semi-Diesel, Technique du Bureau Véritas—Bul. (Paris), vol. 11, no. 12, Dec. 1929, p. 252. Machine Section of Technical Committee of the Bureau Veritas has presented proposal for revision of formulae employed for calculation of crankshafts applicable to all internal-combustion engines; this proposal, which has been approved and accepted, is presented.

DESIGN. New Fulton Diesel is Designed for Mechanical Injection. Power, vol. 71, no. 4, Jan. 28, 1930, pp. 138-139, 4 figs. Description of four-stroke-cycle mechanical-injection Diesel built by Fulton Iron Works Co.; cylinders 13½ in. by 18 in.; 65 hp. per cylinder at 300 r.m.p.; engines made in sizes ranging from two to eight cylinders; constructional features of frame, crankshaft, and mechanical injection system.

HISTORY. Development of Diesel Engine from Viewpoint of its Construction and its Use (L'évolution du moteur Diesel au point de vue de sa construction et de son emploi), A. Garnier. Vie Technique et Industrielle (Paris), vol. 11, no. 117, June 1929, pp. 523-529, 2 figs. Author reviews Diesel-engine practice up to 1913 and investigates whether disadvantages experienced at that time still have left traces on conception of present-day engineers.

MARINE (DOXFORD). The Opposed-Piston Oil Engine, J. Harbottle. Mech. World (Manchester), vol. 87, nos. 2244 and 2245, Jan. 3 and 10, 1930, pp. 11-14 and 33-36, 9 figs. Jan. 3: Comparison of two-stroke-cycle double-acting engine of opposed-piston type; scavenging system of Junkers, Doxford and Cammel Laird-Fullagar oil engines. Jan. 10: Starting air valves, manoeuvring, and cycle of operations of Doxford engine described; materials; fuel consumption; lubricating oil; comparison of unbalanced forces and couples. Abstract of paper read before Inst. Mar. Engrs.

MARINE (RICHARDSONS-WESTGARTH). Development and Performance of the Richardsons-Westgarth Oil Engine, W. S. Burn. Mech. World (Manchester), vol. 86, no. 2240 and 2241, Dec. 6 and 13, 1929, pp. 536-538 and 554-555, 8 figs. Dec. 6: System of alternate nozzle scavenge air ports at one side of centre of liner and exhaust ports on other side has been retained withmodifications which improved scavenge efficiency; scavenge pump; fuel-pump unit; fuel injection experiments. Dec. 13: Results of tests; design of combustion chambers, fuel-valves, and fuel-valve nozzles; nozzle coolng or cleaning. (Concluded.) Abstract of paper before North-East Coast Instn. of Engrs. and Shipbldrs.

DIPHENYL

DERIVATIVES. Syntheses in the Diphenyl Series, R. L. Jenkins, R. McCullough, and C. F. Booth. Indus. and Eng. Chem., vol. 22, no. 1, Jan. 1930, pp. 31-34. Methods which give excellent yields are described for preparation of following mono-substituted derivatives of diphenyl: ortho and para, chloronitro, and amino-diphenyls; melting points and boiling points of these materials are given; methods for four of these derivatives have been applied on semi-plant scale; commercial production of any of them awaits only development of sufficient demand. Bibliography.

DISCS

ROTATING. The Effect of Axial Restraint on the Stress in a Rotating Disc, W. G. Green. Lond., Edinburgh, and Dublin Philosophical Mag. and Jl. of Science (Lond.), vol. 8, no. 53, Dec. 1929, pp. 993-1018, 2 figs. University of London doctorate thesis presenting theoretical mathematical analysis of rotating disc carried on shaft; symmetrical distribution of normal traction about point on plane boundary; symmetrical distribution of tangential surface traction about point on plane boundary.

DISTRIBUTION PROBLEMS

TREND IN. The New Trend in Distribution, W. G. Jamison. Power Transmission, vol. 36, no. 1, Jan. 1930, pp. 104-110. Study of problems of distribution with suggestion toward applying to them type of engineering analysis which has been so successful in increasing production; application of power increases production; development of method of studying cost of distribution. Condensed report of address before Soc. Indus. Engrs.

DRILLING MACHINES

HIGH SPEED. High-Speed Automatic Drilling Machines. Engineering (Lond.), vol. 129, no. 3338, Jan. 3, 1930, p. 29, 2 figs. Details of machines made by Ludwig Loewe and Co. A. G. of Berlin; heads may be used singly or in groups up to four, and two types are made, one of which, intended for mass production, has drive of eight speeds, viz. 420 to 2,100 r.p.m. through plain change pulleys; other, intended for ordinary work, has four speeds, from 600 to 2,000 r.p.m., obtained by stepped pulleys controlled by handwheel.

DRYDOCKS

BROOKLYN. Opening of New Todd Graving Dock. Mar. Eng. and Shipg. Age, vol. 35, no. 1, Jan. 1930, pp. 22-24, 5 figs.; see also Pac. Mar. Rev., vol. 27, no. 1, Jan. 1930, pp. 6-7, and 30, 5 figs.; and Mar. News, vol. 16, no. 8, Jan. 1930, pp. 49 and 59, 1 fig. Particulars of Todd's new graving dock at Robins plant at Erie Basin, Brooklyn, N.Y., unique methods were employed in design and construction of this dock owing to fact that dock is located in subsoil and foundation of quicksand and boulders.

E

ECONOMIZERS

COMBINED WITH AIR HEATERS. Increased Efficiency with Industrial Steam Raising Plant. World Power (Lond.), vol. 12, no. 72, Dec. 1929, pp. 579-582, 6 figs. Construction and operation of supermisers; discussion of supermiser installation at Consett Iron Works; accessories and instruments.

85 Per Cent Efficiency from Lancashires. Power Engr. (Lond.), vol. 24, no. 285, Dec. 1929, pp. 484-489, 7 figs. Illustrated description of supermiser installed at Manton Colliery workshop where important economies are being realized by its operation; boiler plant consists of battery of thirteen 8 ft. 6 in. by 30 ft. Lancashire boilers, delivery steam at 100 lbs. per sq. in. and 450 deg. fahr.; description of entire power plant; test results of Lancashire boilers fitted with supermiser.

ELECTRIC CABLES, HIGH TENSION

SWITZERLAND. High-Voltage Cable Equipment of Oberhasli Power System (Die Hochspannungskabelanlage der Kraftwerke Oberhasli A.-G.), P. E. Schneeberger. Schwiez. Elektrotechnischer Verein (Assn. Suisse des Electriciens)—Bul. (Zurich), vol. 20, no. 22, Nov. 2, 1929, pp. 753-767, 22 figs. Generated load of from 112,000 to 28,000 kva. in Handeck plant is transmitted on 50-kv. cable installed in tunnels which in winter form only admittance to plant; transmission system is described and electric characteristics are given; construction work is illustrated.

ELECTRIC EQUIPMENT

PROTECTION. Protection of Electric Equipment Against Excessive Voltages (Der Schutz elektrischer Anlagen gegen Ueberspannungen), E. Flegler. Elektrotechnische Zeit. (Berlin), vol. 51, no. 3, Jan. 16, 1930, pp. 73-77, 11 figs. Precise knowledge of excessive voltage phenomena is required in order to evaluate protective value of equipment; cathode-oscillograph investigations by W. Rogowski pertaining to these phenomena is referred to as having brought much of value to increase knowledge of subject; paper gives picture of protection of electric equipment against excessive voltage in light of investigation.

ELECTRIC FURNACES

RECENT DEVELOPMENTS IN. Recent Developments in Electric Furnaces, D. F. Campbell. Inst. of Metals—Advance Paper, 1929, 20 pp., 8 figs. Improvements and modifications in melting practice during last two years; relative performance of small and large induction furnaces; high-frequency furnaces; heat-treatment furnaces; specific furnaces, including continuous furnaces for annealing brass strip; largest brass works, where electricity is utilized more than elsewhere described with explanation of uses of electricity, energy consumed, and effect of special precautions to improve power and load factors.

ELECTRIC LAMPS

INCANDESCENT. Life of the Electric Incandescent Lamp (Das Leben der elektrischen Gluehlampe). W. Kochler. Licht und Lampe (Berlin), vol. 19, no. 1, Jan. 9, 1930, pp. 22-26, 4 figs. General viewpoint as to proper use and purpose; dependence of life on utilization; adaptability of lamp to operation conditions; use of silvered lamps; lamps with more than one filament system; graphs and tables are given.

Behaviour of Incandescent Lamps in Closed Fixtures (Das Verhalten von Gluehlampen in geschlossenen Geleuchten), B. Schmelzle. Licht und Lampe (Berlin), vol. 18, no. 23, Nov. 14, 1929, pp. 1300-1302. Life and temperature measurements on lamps of 500 and 750 watts in firedamp-proof fixtures; analysis and discussion of results.

NEON. Technical Data Concerning the Fabrication of Luminous Tubes (Betriebstechnisches ueber die Fabrikation von Leuchtroehren), M. Arndt. Licht und Lampe (Berlin), vol. 18, no. 23, Nov. 14, 1929, pp. 1307-1308, 5 figs. As discolouring has been experienced mainly in lamps made by small manufacturing concerns, without adequate means of research and experience, some of important manufacturing processes are outlined.

ELECTRIC LIGHT AND LIGHTING

COLOUR. Importance of Colour in Lighting, W. A. G. Martin. Elecn. (Lond.), vol. 104, no. 2693, Jan. 17, 1930, p. 63. Two aspects to be studied; reflection and translucence; illumination and decoration; possibility of attaining perfect balance by day and night; blending fittings with furnishing; wide choice available.

FIXTURES. Engineering Progress and Increase in Profits Resulting from Use of Application of Light Metals in Lighting Equipment Industry (Technischer Fortschritt und Gewinnsteigerung in der Beleuchtungsindustrie durch Leichtmetallverwendung), P. Schwerber. Licht und Lampe (Berlin), vol. 18, no. 24, No. 28, 1929, pp. 1371-1374. Properties of light metals and alloys, application of these and their influence on economic side in fixture manufacturing are discussed.

ELECTRIC LINES

VOLTAGE DROP CALCULATION. Line Voltage-Drop Diagram with Consideration of Phase Displacement (Diagramm des Spannungsabfalles in einem Netzwiderstand bei Phasenschiebung), W. Werdenberg. Schweiz. Elektrotechnischer Verein (Assn. Suisse des Electriciens)—Bul. (Zurich), vol. 20, no. 23, Dec. 1, 1929, pp. 797-800, 4 figs. Diagram for calculation of line-voltage drop as function of phase angle applicable to electric lines and transformers.

ELECTRIC LOCOMOTIVES

FRANCE. Electrically Driven Stock of Chemins de Fer du Midi (Le matériel roulant électrique Chemins de Fer du Midi). Industrie Electrique (Paris), vol. 38, no. 897, Nov. 10, 1929, pp. 485-492, 4 figs. Principal characteristics of type 2C2, 500-hp., 1,500-volts, 85 km. per hr ; and type BB 1,000-hp. rail motor ear, carrying 19,100 kg. of passengers and 16,000 of freight, at 85 km. per hr.

ELECTRIC MANUFACTURING PLANTS

BALTIMORE. Western Electric's Mammoth Baltimore Plant, R. W. Edmonds. Mfrs. Rec., vol. 97, no. 4, Jan. 23, 1930, pp. 53-55, 9 figs. Plans and progress of work started Jan. 19, 1929, on new Point Breeze plant of Western Electric Co. at Baltimore to employ 30,000 workers.

ELECTRIC MEASURING INSTRUMENTS

ELECTRIC MEASURING INSTRUMENTS. Meter and Instrument Section: Chairman's Address, E. W. Hill. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 396, Dec. 1929, pp. 24-27. Electric meters do not measure electricity; elusive electrons can be numbered but electric meter does not do it expressly; what is measured is not alone number or quantity of electrons engaged, but something more important and fundamental, namely, their activity while they execute tasks imposed on them by man's ingenuity.

ELECTRIC MEASUREMENTS

REMOTE. Indicating and Recording Methods in Remote Measuring Practice (Neue Anzeige und Registriermethoden in der Fernmesstechnik), W. Stern. Elektrotechnische Zeit. (Berlin), vol. 51, no. 3, Jan. 16, 1930, pp. 77-80, 10 figs. It is shown how remote measurement installations can be combined with remote-control equipment; new method for registration of output measurements for load-distributing installation in which load mountains are automatically recorded by instrument.

ELECTRIC MOTORS

CAPACITY EFFECT. The Capacity Effect and Natural Free Period of a Direct-Current Armature, J. C. Prescott. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 397, Jan. 1930, pp. 185-191. Correspondence between electrostatic and "dynamical" capacities is re-stated in somewhat different form, and theory of instability of compounded motors is developed as extension; series of experiments is described, results of which are cited as confirmation of results obtained by mathematical analysis, and details of solution of certain of equations are given.

STARTERS. The Sousedik Automatic Starter for Three-Phase Motors. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, p. 106, 6 figs. Starter invented by J. Sousedik is designed to overcome disadvantages of using ordinary wound-rotor motor with slip rings, while retaining simplicity of squirrel-cage type; consists essentially of two soft iron cores which, when motor is at rest, are pressed against spindle by helical springs.

SQUIRREL CAGE. 1,250-Hp. Motors Drive Boiler-Feed Pumps, P. C. Smith. Power, vol. 71, no. 6, Feb. 11, 1930, pp. 218-219, 3 figs. Dimensions of 3,600-r.p.m. squirrel-cage induction machines kept small through use of fabricated-steel frame.

ELECTRIC POWER SUPPLY

WISCONSIN. Ontario Under Wisconsin Conditions, G. C. Neff. Pub Service Mgmt., vol. 48, no. 1, Jan. 1930, pp. 5-6 and 26-28 and no. 2, Feb. 1930, pp. 45-48 and 60-63. Author proves that if Wisconsin conditions were substituted in Ontario, or if Ontario hydro-electric system, owned and operated by province and municipalities, had to operate under conditions in Wisconsin, there would have to be spent in Niagara system alone approximately $175,000,000 more than has already been spent there and that fixed charges on this together with necessary added operating expenses would add $31,000,000 to annual cost of Niagara part of system alone.

ELECTRIC RAILROADS

ELECTRIC RAILROADS. More Business and How to Get It. Elec. Ry. Jl., vol. 74, no. 2, Feb. 1930, pp. 89-90. Ways of securing additional traffic were theme of annual meeting of Central Electric Railway Assn. held at Cleveland Jan. 23-24; other topics of interest were technique of freight handling and employee training.

Electric Traction on Railways, R. Brooks. Manchester Assn. of Engrs.—Trans. (Manchester), 1928-29, pp. 37-68 and (discussion) 69-80. Application of electricity to operation of suburban services and to specific types of main-line sections; equipment for motor coaches and locomotives; current collection and regenerative braking; important types of transmission gear from motors to axles of locomotives and their suitability for different services; operating results, and progress of electrification in various countries. Indexed in Engineering Index, 1929, from Metropolitan Vickers Gaz., July 1929.

EQUIPMENT. Rolling Stock Purchases Largely Increased, T. M. van der Stempel. Elec. Ry. Jl., vol. 74, no. 1, Jan. 1930, pp. 33-36, 2 figs. Nearly 1,300 passenger cars, 130 freight and service cars and 77 electric locomotives were bought during 1929 by electric railways; cars for handling heavy traffic on city surface lines predominated; large car orders also were placed for rapid transit lines and for electrified suburban service; interurbans purchases comparatively few new cars; rolling stock ordered during 1929 as listed under 22 States, Porto Rico and Canada.

OPERATION COSTS. Electric Railway Costs and Fares in 1929, A. S. Richley. Elec. Ry. Jl., vol. 74, no. 1, Jan. 1930, pp. 13-14, 6 figs. Fares and wages continue to increase, but in smaller measure than during 1928 and 1927; commodity prices and construction costs maintain level practically same as during past three years; curves illustrating trend of fares and costs from 1926 to 1929 inclusive.

ELECTRIC SWITCHGEAR

INTERNAL ISOLATION. Internal Isolation Switchgear. Elecn. (Lond.), vol. 104, no. 2692, Jan. 3, 1930, p. 13, 2 figs. Principles of new design; stationary circuit breaker; elimination of heavy gear; economy in size and weight; self-interlocking.

ELECTRIC TRANSFORMERS

LOSSES. Additional Losses in Transformers (Ueber zusaetzliche Verluste in Transformatoren), F. Heiles. VDE Fachberichte der XXXIV. Jahresversammlung des Verbandes Deutscher Elektrotechniker in Aachen (Aachen), 1929, pp. 71-74, 6 figs. Leakage field of transformer under certain conditions can cause considerable addtiional losses in winding copper when no special preventive measures in arranging and design of windings are taken; various winding arrangements are discussed and formula for their loss calculation is developed.

POTENTIAL. New Type Potential Transformer for High Voltages (Ein neuer Spannungstransformator fuer Hoochsspannungen), A. Meyerhans. Elektrotechnische Zeit. (Berlin), vol. 51, no. 1, Jan. 2, 1930, pp. 17-18, 4 figs. Construction of less expensive potential transformer is described; principal electric characteristics and main dimensions are given.

RATIO MEASUREMENTS. A Ready Method of Measuring the Voltage Ratio and Phase Angle of High-Voltage Transformers, G. Yoganandam. Instn. Elec. Engrs. (Lond.), vol. 68, no. 397, Jan. 1930, pp. 192-193. Quick and ready method, in which well-known high-voltage Schering bridge is employed, is described; formula for voltage ratio and phase angle are given, together with expressions for sensitivity of bridge; accuracy obtained by method meets requirements of all industrial tests as well as research work.

SWITCHED UNDER LOAD. Transformers Which Can be Switched Under Load (Unter Last schaltbare Transformatoren), De Francesco. VDE Fachberichte der XXXIV. Jahresversammlung des Verbandes Deutscher Elektrotechniker in Aachen (Aachen), 1929, pp. 86-88, 6 figs. Requirement of equipment is bought about by inter-connected operation and regulation of network systems; equipment of Peoge, Chemnitz, based on patents of Jansen, is described.

ELECTRIC WELDING. ARC

ATOMIC HYDROGEN. The Role of Atomic Hydrogen in Welding, S. Martin. Jr. Am. Mach., vol. 72, no. 7, Feb. 13, 1930, pp. 301-304, 10 figs. Discussion of unusual method of welding steels, alloys and non-ferrous metals with outline of what it can, and what it cannot do; application to cast steel and steel with high carbon content, chrome steel, aluminum, copper, duralumin, and zinc.

AUTOMATIC. Automatic Arc Welding, W. L. Warner. Am. Welding Soc.—Jl., vol. 8, no. 10, Dec. 1929, pp. 9-20, 11 figs. Requirements of fusion welding are taken up; importance of suitable clamping apparatus and procedure for welding thin sheet metal successfully discussed; magnetic effect produced by electric current passing through arc must be controlled; how flux opèrates and how it is handled; electromagnetic control scheme developed by General Electric Co.; applications of automatic arc welding. Paper presented before Am. Welding Soc. and Am. Soc. Mech. Engrs., indexed in Engineering Index, 1929.

ELECTROPLATING

ELECTROPLATING. The Recent Awakening of the Electro-Depositing Industry, R. S. Hutton. Chem. Age, (Lond.), vol. 22, no. 553, Feb. 1, 1930, pp. 7-8. Work of pioneers; research and electroplating industry; organization of research; chromium plating; appeal for cooperation in research; more funds required.

ENGINEERS

SALARIES. What Happens to the Engineer. Am. Mach., vol. 72, no. 7, Feb. 13, 1930, p. 307, 2 figs. Tabular presentation is given of replies to questionnaire issued in 1927 by Executive Committee of Machine Shop Practice Division of American Society of Mechanical Engineers to 2,700 engineers.

EXPLOSIVES

DETONATION. Calibration of Cordeau Detonant for Measuring Time in Dautriche Method of Determining Detonation Velocities (Die Eichung von Trinitrotoluol Zuendschnur. etc.), H. Selle. Zeit. fuer das Gesamte Schiess-und Spreng-stoffwesen (Munich), vol. 24, no. 11, Nov. 1929, pp. 420-422. Accuracy of detonation velocities of explosives as determined by Dautriche method depends on accuracy with which detonation velocity of T.N.T. in cordeau detonant is known; detonation velocities of cordeau detonant from various sources should not vary more than 2 per cent; detonation velocity of fulminate fuse was found to be 5151 m. per sec. by spark-chronograph method.

GERMANY. Development of Explosives in Germany During and Since the World War (Entwicklung des Sprengstoffwesens in Deutschland in und nach dem letzten kriege), Mente. Zeit. fuer die gesamte Schiess-und Sprengstoffwesen (Munich), vol, 24, no. 10, Oct. 1929. pp. 373-376. Effect of War on explosives practice especially with regard to shortage of raw material; new explosives developed since War; simplification in explosives due to mining classification lists.

F

FEEDWATER TREATMENT

SCALING. Prevention of Scaling by Water Treatment Inside of Boilers (La prevention des incrustations par le traitement de l'eau a l'intérieur des chaudières). Génie Civil (Paris), vol. 95, no. 2, Jan. 11, 1930, pp. 43-44. Internal treatment methods based on chemical reactions and substances reacting on incrustation because of their physical properties; precautions to be taken and limitations in use of internal treatment are briefly outlined.

FERTILIZER INDUSTRY

DEVELOPMENTS IN. Impending Developments in the Fertilizer Industry, E. Collett. Chem. Age (Lond.), vol. 22, no. 549, Jan. 4, 1930, pp. 3-4. 1 fig. Review of recent developments showing that one of most important tendencies in synthetic fertilizer industry, which is showing itself more and more, is production of complete fertilizer, free from "ballast."

FIREBRICK MANUFACTURE

METHODS. Refractory Brick and its Manufacture, H. E. Townsend. Blast Furnaces and Steel Plant, vol. 18, no. 1, Jan. 1930, pp. 105 and 195-196. Methods by which firebricks are made are discussed; how fireclay is obtained; dry-press process; special fireclay products.

FIRE PREVENTION

BUTTE, MONT. Report on the City of Butte, Mont. Nat. Board of Fire Underwriters—Report, no. 141, Jan. 1930, 23 pp., 1 supp. map. Fire-fighting facilities; structural conditions and hazards; recommendations

EAU CLAIRE, WIS. Report of the City of Eau Claire, Wis. Nat. Board of Fire Underwriters—Report, no. 404, Feb. 1930, 19 pp., 1 supp. map. Fire-fighting facilities; structural conditions and hazards; recommendations.

Great Falls, Mont. Report on the City of Great Falls, Mont. Nat. Board of Fire Underwriters—Report, no. 133, Jan. 1930, 19 pp., 1 supp. map. Fire-fighting facilities; structural conditions and hazards; recommendations.

FLOUR MILLS

Air Conditioning. Air Conditioning a Flour Mill, E. S. Miller. Heat. Piping and Air Conditioning, vol. 11, no. 2, Feb. 1930, pp. 97-100, 2 figs. General discussion of air-conditioning requirements of flour mills; specific reference is made to mill of Acme-Evans Co., Indianapolis, Ind.; ton of air per barrel of flour.

FLOW OF AIR

Pipes. Mechanical Displacement of Air Under Low Pressure (Déplacement mécanique de l'air sous faible pression), J. Merlan. Chaleur et Industrie (Paris), vol. 10, nos. 111, 112, 113 and 114, July, Aug., Sept. and Oct., 1929, pp. 325-333, 408-414, 454-458 and 503-508, 30 figs. Mathematical analysis pertaining to flow of air in pipe lines; load losses in linear system; economic velocity; graphical methods for calculation; reaction fans; technology of fans; analytical design of perfect fan. (To be continued.)

FLOW OF FLUIDS

Pipes. Variable Flow in Pipes, H. Bateman. Phys. Rev., vol. 35, no. 2, Jan. 15, 1930, pp. 177-183. Theoretical mathematical discussion of variable pressure gradient or forced motion of pipe in longitudinal direction which, at time when it ceases to act, will have produced prescribed distribution of velocity over cross-section of pipe; subsequent changes in distribution as motion decays are also investigated; initial velocity profile with curvature of one sign will retain this property as it changes into profiles for different stages of decaying motion.

FOUNDATIONS

Design. Foundation Engineering, B. Geen. Manchester Assn. Engrs.—Trans. (Manchester), 1928-29, pp. 149-181 and (discussion) 181-194, 15 figs. Examination and choice of site; light loads; heavy loads; disadvantage of deep piers; heavy raft foundations; excavation adjacent to raft foundation; yield point of soil, piling, and desirable clauses in foundation contracts are discussed; question of determination of actual loads on footings is discussed; eccentric loads; foundations to resist flotation; allowance for impact. Indexed in Engineering Index, 1929, from Machy. Market (Lond.), Apr.9 and 26 and May 3, 1929.

FOUNDRIES

Materials Handling. The Mechanical Handling of Foundry Materials, R. Spriggs. Foundry Trade Jl. (Lond.), vol. 41, nos. 694 and 695, Dec. 5 and 12, 1929, pp. 409-410 and (discussion) p. 430. Dec. 5: Various methods of handling raw materials are outlined; mechanizing moulding; transportation of cores; difficult problems of dry-sand work. Dec. 12: Milled sand should be stored; desirability of stocking pig-iron; skip charging of cupolas; belt conveyors need ample rollers; tilting skip charging defended.

FRAMED STRUCTURES

Rigid. Moment and Shear Diagrams for Continuous Beams and Rigid Building Frames, N. M. Stineman. Am. Concrete Inst.—Jl., vol. 1, no. 3, Jan. 1930, pp. 211-277, 18 figs. Distinction between continuous beam and rigid frame; methods employed in computing values for diagrams; ratio between column stiffness and girder stiffness; use of diagrams with illustrative examples; cut-and-try method not necessary; methods of obtaining approximate shear and bending moments in unequal spans; rigid frames with girders of unequal span; columns in same story having unequal stiffness.

Rigid Design. Simplified Rigid Frame Design, H. Cross. Am. Concrete Inst.—Jl., vol. 1, no. 2, Dec. 1929, pp. 170-183. Definition of rigid frames; methods of rare analysis; sources of stresses; simplified procedure of analysis; illustrative problems; fixedend moments. Report of Special Committee.

G

GAUGES

Plug. Wear of Materials for Plug Gauges (Abnutzung-an-Werkstoffen fuer Lehrdorne), O. Nieberding. Maschinenbau (Berlin), vol. 8, no. 23, Dec. 5, 1929, pp. 798-800, 1 fig. Testing materials for gauges by U. S. Bureau of Standards has shown that materials generally used show different behaviour with respect to wear; chromium-steel surfaces and nitrided steels give best results; hardness is no measure for resistance against wear; steels tempered after hardening and which can be filed will show less wear than non-tempered materials. Material is based largely on papers by H. J. French and H. K. Herschman. See Engineering Index 1927, p. 374.

GAS HOLDERS, WATERLESS

British Columbia. Vancouver's Waterless Holder. Gas Jl. (Lond.), vol. 188, no. 3475, Dec. 25, 1929, p. 825, 1 fig. Brief note of $300,000 gas holder of British Columbia Electric Railway Co., with capacity of 3,000,000 cu. ft.; aluminum painting done entirely by spraying machine.

GAS RETORTS

Continuous Vertical. Evolution of the Continuous Vertical Retort, A. Duckham. Gas Jl. (Lond), vol. 188, no. 3475, Dec. 25, 1929, pp. 828-829. Author's remarks are confined to process known as Woodall-Duckham system; four main types used in gas-works; advantages of continuous vertical retort; output of gas per square foot of ground space; refractory materials; heat conservation; high yield of gas per ton of coal; Tokyo plant is described. Abstract of paper read before World Power Conference, Tokyo, Japan.

GEAR CUTTING MACHINE

Dividing Heads. Automatic Dividing Devices of Gear Machining Equipment (Die selbsttaetigen Teilvorrichtungen der Zahnradbearbeitungsmaschinen), H. Brandenberger. Maschinenbau (Berlin), vol. 8, no. 21, Nov. 7, 1929, pp. 727-729, 10 figs. Accurate machining, free of jerking, is obtained in dividing equipment developed; viewpoints discussed are illustrated with equipment of Bilgram-Reinecker, Gleason, Oerlikon and Maag.

GEARS AND GEARING

Planetary. An Electrically-Controlled Gear Shift. Machy. (Lond.), vol. 35, no. 899, Jan. 2, 1930, pp. 454-455, 3 figs. Description of automatic radial engagement of worm and spiral gearing which furnishes slow forward and fast return speed; planetary gearing permits electrical control; practical application of gear shift; power for driving and shifting delivered from one source; ready engagement of gear teeth assured; arrangement of electrical control.

GEOPHYSICAL EXPLORATION

Gravitational. A Gravitational Survey over the Pentland Fault near Portobello, Midlothian, Scotland, W. F. P. McLintock and J. Phemister. Geol. Survey of Great Britain (Lond.), part 2, 1929, pp. 10-28, 10 figs. Full text of paper previously indexed, jointly with paper on Buried Kelvin Valley, from abstract in Iron and Coal Trades Rev., Dec. 27, 1929.

GOLD MINES AND MINING

Gold Coast, Africa. Geological and Mining Features of the Tarkwa-Abosso Goldfield with Coloured Geological Map and Sections, O. A. L. Whitelaw and N. R. Junner. Gold Coast Geol. Survey—Memoir, no. 1, 43 pp., and index, 39 figs., supp. plates, 19 maps in pocket. Notes on early history; topography; about 85 sq. mi. surveyed in detail tabular data on employment, production, machinery, development, and ore reserves; geology of region and of gold reef; diamond drill data descriptions of individual mines.

GRINDING MACHINES

Hydraulic Drive. 78-in. Hydraulic Face-Grinding Machine. Engineering (Lond.) vol. 49, no. 3340, Jan. 17, 1930, pp. 72-74, 10 figs. Diskus-Werke A.-G., of Frankfort, have introduced machine in which work is stationary and movement is given to grinding head; machine will take grinding wheels up to 6 ft. 6¾ in. in diam. and is suitable for grinding frames or standards of large oil engines, or similar heavy work.

Roll. New Roll Grinder. Iron Age, vol. 125, no. 4, Jan. 23, 1930, pp. 318, 2 figs. Description of hydraulic roll grinder Model B designed by Landis Tool Co., Waynesboro, Pa., for rapid and accurate grinding of small diameter rolls; machine will grind roll bodies, straight, concave, or convex, and is built in four sizes having 16-, 20-, 24-, and 28-in. swing; hydraulic work-carriage traverse and reversal is featured as providing almost unlimited number of speeds.

Surface. Double-Surface Grinding Machine for Special Purposes (Doppelflaechenschleifwerk fuer Sonderzwecke), S. Weil. Machinenbau (Berlin), vol. 8, no. 23, Dec. 5, 1929, pp. 795-797, 9 figs. Equipment manufactured by Naxos-Union, Frankfort, for grinding of large flat parts and frames of speed presses and rotating machinery; parts are ground on top and below and sometimes both sides; side frames to be ground are clamped in double layers and have thickness of from 60 to 100 mm. each.

GYPSUM

Hydration. Speed of Hydration of Gypsum Anhydrite, P. P. Budnikov. Journal Russkovo Physico-Chimicheskovo Obshchestva (Leningrad), vol. 41, no. 9, 1929, pp. 1717-1720, 1 fig. Report from chemical laboratories of Kharkov Institute of Technology on tests of speed of hydration of natural and synthetic gypsum.

H

HARDNESS TESTING

Conversion Values. Conversion of Hardness Numbers of Steels and Some Metals (Umrechnung von Haerteziffern bei Staehlen und einigen Metallen), A. Wallichs and H. Schallbroch. Maschinenbau (Berlin), vol. 8, no. 24, Dec. 19, 1929, pp. 824-827, 6 figs. Conversion values relative to Brinell number are experimentally determined for hardness testing equipment of various types and for carbon and chromium-nickel steels, aluminum and copper alloys; conversion curves are developed for practical use.

HEAT TRANSMISSION

Constants. Heat Transfer Constants and Applications of Heat Transfer, W. R Woolrich and L. Holdredge. Heat. Piping and Air Conditioning, vol. 11, no. 2, Feb. 1930, pp. 127-131. General consideration of five general applications of heat transfer that are encountered in heating and ventilating engineering; authors have given constants which are recomputed for 70-deg. difference in temperature and rearranged to more usable form; heat requirements for heat transmission from buildings.

HIGHWAY ADMINISTRATION

United States. Imperative Necessity for More Federal Aid in Road Building, T. L. Oddie. Mfrs. Rec., vol. 97, no. 2, Jan. 9, 1930, pp. 56-57. Steady increase in state expenditures for road work; vehicle usage increases; great mileage of low-type roads big problem; must rebuild big mileage hard-surfaced roads to present standards; urges speed in enacting bills providing $50,000,000 additional federal aid annually; need for increase in federal aid allowance per mile; need for increased expenditures for roads in forest reserves.

HIGHWAY ENGINEERING

American Methods. American Construction Methods Influence Highway Building Throughout the World, P. Johnson. Mfrs. Rec., vol. 97, no. 2, Jan. 9, 1930, p. 66-68, 7 figs. Discussion of plans of International Road Congress to meet in United States in 1930 with representation from Western Europe, Russia, Australia, Africa, Latin America and Orient.

HIGHWAY SYSTEMS

United States. Greater Mileage of Paved Highways Nation's Acute Need, E. E. Duffy. Mfrs. Rec. vol. 97, no. 2, Jan. 9, 1930, pp. 53-55, 8 figs. Motor-vehicle registration and usage outstrips road construction resulting in traffic congestion; country's mileage of first class pavements averages but 2,000 miles for each state.

HOSPITALS

Air Conditioning. Temperature and Humidity Control of an Oxygen Chamber, J. B. Hashagen. Heat. Piping and Air Conditioning, vol. 11, no. 2, Feb. 1930, pp. 122-123, 3 figs. Illustrated description of oxygen chamber designed by A. L. Barach, and used in Columbia Presbyterian Hospital in New York City; temperature and humidity control; operation of system.

HOT WATER HEATING

Piping. Pipe and Orifice Sizes for Small Gravity Circulation Hot Water Heating Systems, E. G. Smith. Heat., Piping and Air Conditioning, vol. 11, no. 2, Feb. 1930, pp. 135-152, 12 figs. Investigation of two-pipe underfoot feed, direct-return system with bare mains; presentation of tables which have been prepared from results of experimental work; methods of pipe-line layout; tables giving capacities of direct radiation of orifices designed for vapour systems. Presented before Am. Soc. Heat. and Vent. Engrs.

HOT WATER SUPPLY

Heat Storage. New Small Type of Hot-Water Storage Equipment (Ein neuer kleiner Heisswasserspeicher). Rittershaussen. Elektrotechnische Zeit, (Berlin), vol. 51, no. 1, Jan. 2, 1930, pp. 12-13, 1 fig. Expensive metering equipment which is required for connection of hot-water storage equipment to network has prevented introduction of small types; new rate is developed by which this equipment can be avoided and resulting changes in storage equipment are outlined.

HYDRAULIC ACCUMULATORS

Principles. Hydraulic Power Accumulation, A. Page. Elec. Rev. (Lond.), vol. 105, no. 2718, Dec. 27, 1929, pp. 1131-1134, 7 figs. Brief outline of applications and principles of hydraulic power-accumulating installations, widely adopted on Continent, with reference to possibilities of this system of water-power storage as applied to steam-generating stations.

HYDRO-ELECTRIC POWER DEVELOPMENTS

India. Upper Ganges Canal—Hydro Electric Scheme. Times Trade and Eng. Supp. (Lond.), vol. 25, no. 603, Jan. 25, 1930, p. 452. Irrigation branch of United Provinces Government are constructing hydro-electric scheme of considerable local economic importance in connection with Upper Ganges Canal; irrigation branch will deliver low-tension three-phase 50-cycle power at sub-stations in all towns and large villages having population of 500 and upwards.

Quebec. Beauharnois Hydro Power Development. Can. Engr. (Toronto), vol., 58 no. 1, Jan. 7, 1930, pp. 101-103, 5 figs. Principal features of power development being undertaken by Beauharnois Power Corp.; large portion of initial 80-ft. head development of 500,000 hp. has already been sold; power canal, 15 miles long, provides navigation facilities; curve showing increase in total power installations in Ontario and Quebec from 1900 to 1928.

Winnipeg. Growth of the Winnipeg Hydro System, J. G. Glassco. Can. Engr. (Toronto), vol. 58, no. 4, Jan. 28, 1930, pp. 161-163, 3 figs. Manager of Winnipeg Hydro-Electric System notes substantial increase in consumption and corresponding reduction in power and lighting rates since inauguration of Winnipeg "Hydro"; central heating plant giving satisfactory results; power development under construction will give additional 100,000 hp.

HYDRO-ELECTRIC POWER PLANTS

British Columbia. Powell River Hydro-Electric Plant, British Columbia. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, pp. 112-113 and 6 figs. partly on p. 106. Gravity-type dam has maximum height of 58 ft. and spillway length of 600 ft; flood discharges are passed through 19 Taintor gates; plant was intended to supply power to 250-ton paper mill, but mill was extended to capacity of over 500 tons; power plant consists of two distinct installations; more recently provided generator room contains one vertical-shaft turbine direct connected to C.G.E. 12,000-kva., 2300-volt, 50-cycle, three-phase generator.

Ice Control. Protecting Hydro Power Plants from Ice, S. Mornington. Can. Engr. (Toronto), vol. 58, no. 4, Jan. 28, 1930, pp. 169-172, 13 figs. Description of compressed air installation made at one of Seattle's hydro-electric plants to safeguard station from ice during winter and from fine trash at all times; compressed air thaws slush ice. Indexed in Engineering Index, 1929, from Compressed Air Mag., July 1929.

I

ICE PLANTS

Knoxville, Tenn. 130-Ton Plant with Dual Pressure, C. P. Goree, Jr. Refrigeration, vol. 47, no. 1, Jan. 1930, pp. 59-62, 6 figs. Illustrated description of new plant of Atlantic Ice and Coal Co. at Knoxville, Tenn., which embodies many outstanding new features of design; floor plan showing layout of principal equipment.

IMHOFF TANKS

Digestion, Etc. Foaming and Sludge Digestion in Imhoff Tanks, W. D. Hatfield. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 172-174, 1 fig. Progress of digestion, foaming, gas collection, sludge liquor alkalinities, acidities, pH's, and lime treatment of digestion chambers in Imhoff tanks covering two-year record of routine study and analysis is discussed; high carbon dioxide in gas seemed to be best indication of poor digestion and probable foaming. Bibliography.

INDUSTRIAL MANAGEMENT

Japan. The Management Movement in Japan, L. M. Gilbreth. Mgmt. Rev., vol. 19, no. 2, Feb. 1930, pp. 39-44. Account of section 12 or World Engineering Congress in Japan which was devoted to scientific management and brief review of papers presented.

INDUSTRIAL RESEARCH

Application to Industry. Industrial Research, F. A. Freeth. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, p. 115. Main stress is laid upon spirit in which research is conducted; author deals with question of research not as confined to chemical industry, but as applicable to general industries of country as whole; suggests that key to successful industrial research will be found in development of individual scientific enthusiasm of research worker. Abstract of address before joint meeting of Soc. of Chem. Industry, Inst. of Chem., Soc. of Dyers and Colourists, and Manchester Literary and Philosophical Soc.

INTERNAL COMBUSTION ENGINES

Combustion. Contribution to the Study of Normal Burning in Gaseous Carbureted Mixtures, M. R. Duchene. Nat. Advisory Committee for Aeronautics—Tech. Memo., no. 547, Jan. 1930, 18 pp. 10 figs. Results of numerous investigations; study to provide equipment permitting study of propagation of region of reaction in mixtures of air and carbureted gases enclosed within cylinder; influence of richness of explosive mixture on rate of flame propagation, of degree of volumetric compression on one of hydrocarbons, and of variation of initial temperature of mixture before compression. From Service Technique et Industriel de l'Aéronautique, Bul. Technique, no. 54, Dec. 1928.

Combustion Analysis. Combustion Balance in Multi-Cylinder Internal Combustion Engines, C. E. Cox. Instruments. vol. 3, no. 1, Jan. 1930, pp. 63-64, 1 fig. Cards of pressure-time type drawn on paper fed from large roll are discussed; chart showing pressure peaks which cover 275 deg. of crank angle including compression and part of expansion; many cards are recorded on short chart so that easy analysis of combustion conditions can be made.

IRON AND STEEL METALLURGY

Advancement in. Advancement in Iron and Steel Metallurgy During 1929, H. M. Boylston. Fuels and Furnaces, vol. 8, no. 1, Jan. 1930, pp. 23-36. Discussion of progress made in ferrous metallurgy; development of stainless iron and steel; changes in dimensions and capacity of blast furnaces; increase in size of open hearth furnaces and developments in open hearth process; advancements in steel making, uses of alloy steels and knowledge of their compositions; studies of constitutional diagrams, use of x-ray, and developments of automatic metallographic polishing machine; developments of various heat treatments and resulting structure of materials; advances made in nitriding process.

L

LEAD ALLOYS

Developments of. Lead and Lead Alloys, G. O. Hiers. Min and Met., vol. 11, no. 277, Jan. 1930, pp. 5-6. Development of lead-calcium alloy with high fatigue strength; use of lead-alloy anodes in electrolytic zinc production; lead-lined articles for chemical equipment; antimonial lead-sheet tank linings for chromium plating; Bureau of Standards investigating use of lead for bearing metal. Bibliography.

LEVEES

Construction, Mississippi River. Levee-Building Operation, C. S. Hill. Eng. News-Rec., vol. 104, no. 6, Feb. 6, 1930, pp. 232-239, 20 figs. Construction conditions, methods and plans of Mississippi flood protection; lump unit-price requirements; borrow-pit restrictions; payment practices; track layout for industrial railway operation; standard superflood levee sections; appraisal of construction methods; dragline excavators; slackline cableway excavators; industrial railway haulage; tractor and crawler wagon work; experimental machines. Introductory note by T. H. Jackson.

LIBRARIES

Lighting. The Lighting of the Bodleian Library, Oxford. Illum. Engrg. (Lond.), vol. 23, Jan, 1930, p. 18, 2 figs. Two schemes were proposed; to light each individual reader's desk strongly and to provide low general illumination; to provide general illumination of high intensity, and no local illumination at all; after discussion was decided that latter arrangement was best.

LIGHT AND LIGHTING

Reflectors. Characteristics of Light-Diffusing Glasses (Die Kennzeichnung lichtstreuender Glaeser), L. Bloch. Licht und Lampe (Berlin), vol. 18, no.26, Dec. 26, 1929, pp. 1483-1486, 2 figs. Properties of light-diffusing materials; directed, diffused, and total reflection; absorption; practical importance of difference between directional and diffusing transparency; samples of reflector design and their characteristics.

LOCOMOTIVE FEEDWATER TREATMENT

Ireland. Water Softening Plants on the Great Southern Railways of Ireland. Engineer (Lond.), vol. 149, no. 3863, Jan. 24, 1930, pp. 103-104, 4 figs. Policy has been adopted by this Company of laying down large water-softening plants on mainline system; plants are all of Lassen-Hjort continuous automatic separate measurement type, supplied by United Water Softeners, in which hard water and reagents applied to soften it are synchronously metered and mixed in relatively small predetermined and adjustable quantities.

LOCOMOTIVE REPAIR SHOPS

Japan. Scheduling Locomotive Repairs in a Japanese Shop, F. H. Colvin. Am. Mach., vol. 72, no. 5, Jan. 30, 1930, pp. 207-211, 10 figs. Boiler repair in locomotive shops of Imperial Government Railways in Japan is outlined; careful study of operations involved, improved methods, and modern equipment, adopted during period of seventeen years, have cut time of shopping from 30 days to five, with actual reduction in personnel.

LOCOMOTIVES

Canadian National Railways. Northern (4-8-4) Type Locomotives, Canadian National Railways. Can. Ry. and Mar. World (Toronto), no. 383, Jan. 1930, pp. 1-3, 5 figs. Illustrated description of locomotives built by Montreal Locomotive Works for either passenger or fast freight service; cylinders 25 by 30 in.; driving wheels 73 in.; working pressure 250 lbs. per sq. in.; maximum tractive effort, 56,800 lb.; total engine wheelbase 43 ft. 10 in.; total engine weight in working order 33,800 lbs.; discussion of constructional features.

High Pressure. New High-Pressure Three-Cylinder Compound Locomotive for L. M. S. R. Modern Transport (Lond.), vol. 22, no. 562, Dec. 21, 1929, p. 9, 4 figs. Description of converted "Royal Scot" incorporating double boiler-pressure of 900 and 250 lbs. per sq. in.; cylinders 11 ½ by 18 by 26 in.; tractive effort 33,200 lbs. per sq. in.; weight in working order 24 tons; total engine wheelbase 52 ft. 9 ¼ in.

LUBRICATING OIL

Airplane Engines. Relationship of Laboratory Tests and Cold Weather Motor Operation of Various Oils. Air Corps Information Cir., vol. 7, no. 640, Oct. 1, 1929, 10 pp. 23 figs. Report covers pumping tests made on selected group of 20 oils taken from samples which were tested for resistance to shear as described in first progress report; purpose was to determine relationship between viscosity curve and pour point as determined by usual laboratory methods and pumpability at low temperatures for number of representative lubricating oils; most important result is relation of viscosity to pumpability at low temperatures.

LUMBER INDUSTRY

Exports and Imports, United States. Approximately $5,000,000 Increase in 1929 Wood Export, A. Marlowe. Commerce Reports, no. 6, Feb. 10, 1930, pp. 382-384. Net increase in value of exports of lumber and wood products in 1929 indicated by figure of $166, 951,000 which preliminary official statistics show, falls only about $200,000 short of reaching $5,000,000 mark, and is rise of nearly 3 per cent; comparison of last two year's trade by main groups of export schedule.

M

MACHINE TOOL DESIGN

Germany. Developments in German Machine Tool Design. Machy. (Lond.), vol. 35, no. 896, Dec. 12, 1929, pp. 360-364, 6 figs. Throughout past year standardization has been keynote of development in German machine tool industry while influence of rationalization in its strictest sense is also apparent; most striking example is provided by standard centre lathe developed by Union of German Lathe Builders; multi-operation machines; simplification of controls; reduction of loading time; improvements in drives.

Great Britain. Developments in British Machine Tool Design. Machy (Lond.), vol. 35, no. 896, Dec. 12, 1929, pp. 321-334, 28 figs. Review of British machine tool design during year; extra movement of rapid traverse adopted; station loading is growing practice; adaptation of standard centre mounting and of chucks have gradually been evelvod into radically new types; chief interest centres around motor applications; hydraulic feeds; push-button controls; ball roller and bearing applications; many different lubrication methods; pneumatic power; braces and stays; multi-spindle machines.

United States. Machine Tool Developments in the United States. Machy. (Lond.), vol. 35, no. 897, Dec. 19, 1929, pp. 390-395, 10 figs. Discussion of cylinder boring machines, horizontal boring machines, hydraulic feed, automatic milling machine, continuous milling machine, bridge type milling machine, automatic continous bevel-gear cutting machine, spiral bevel-gear generator, automatic gear shaper, gear hobbing machines, unusual hob-spindle mounting, gear burnishing machine, high-speed hydraulic press and machinability of metals. (Concluded).

MACHINE TOOLS

Hydraulic Drive. Hydraulically Operated Machine Tools. Machy. (N. Y.), vol. 36, no. 5, Jan. 1930, pp. 369-370, 1 fig. Functions of hydraulic transmissions as applied to many different types of modern machine tools are described; table is given showing different types of machines and application of hydraulic transmissions for each type.

MALLEABLE IRON CASTINGS

Malleable Iron Castings. Malleable Iron Castings (Temperguss), B. Osann. Maschinenbau (Berlin), vol. 8, nos. 23 and 24, Dec. 5 and 19, 1929, pp. 785-789 and 832-834, 20 figs. Definition; melting, casting, and annealing in pots and furnaces, cleaning and processing, are discussed; metallurgical processes, such as admixture of manganese, silicon and sulphur, influence properties; causes of failures in annealing; strength qualities; strength of malleable cast iron.

MANGANESE DEPOSITS

Manganese Deposits. World's Deposits of Manganese Ore (Die Manganerzlagerstaetten der Welt), F. Lohmann. Internationale Bergwirtschaft und Bergtechnik (Halle), vol. 22, no. 18, Sept. 4, 1929, pp. 283-290. Descriptions and capacities of deposits and analysis of ore, production and consumption in different countries from 1915 to 1927.

METALS

Crystallization. Theory of Recrystallization (Zur Therie der Rekristallisation), G. Tammann. Zeit. fuer anorganische und allegemeine Chemie (Leipzig), vol. 185, nos. 1 and 2, Dec. 10, 1929, pp. 1-34, 5 figs. General physical theory of recrystallization of metals; state of crystal after is plastic deformation; formation of recrystallization nuclei; changes in texture and structure accompanying recrystallization, with special reference to changes in grain size during thermal deformation.

MINE HOISTS

Electric. Development in the Uses of Electricity, R. P. Sloan. North-East Coast Instn. Engrs. and Shipbldrs.—Trans. (Lond.), vol. 45, 1928-1929, pp. 347-364 and (discussion) 365-372, 7 figs. Considerable amount of work had been done on investigation of winding problems with view of determining profile and dimensions of winding drums best suited to projected winding programme; in one recent case where 900-hp. motor would be required to meet existing winding conditions, it was found that if judicious alterations were made to drum profile and to shaft equipment, same hourly duty could be carried out by 400-hp. motor.

MINERAL RESOURCES

Australia. The Mineral Wealth of Australia—A Forecast, E. C. Andrews. Australasian Inst. of Min. and Met.—Proc. (Melbourne), no. 75, Sept. 30, 1929, pp. 57-58. General and political discussion of conditions which affect mining industry; improvement in prospecting, mining, and metallurgical methods; cooperation of government; relation between geological structure and minerals, of which deposits occur in Australia. Bibliography.

MINES AND MINING EQUIPMENT

Replacing of. Factors Affecting the Replacing of Equipment, P. B. Bucky. Min. and Met., vol. 11, no. 278, Feb. 1930, pp. 99-101. Discussion as to whether new equipment will make more profit for mining operation or will it pay better to keep on using old equipment.

MOTOR BUS BRAKES

DESIGN. Heavy-Duty-Motorcoach Brake-Design, G. A. Green. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 41-48, 12 figs. Need for four-wheel brakes on motor coaches; motor coach- and automobile-brake problems compared; advantages and disadvantages of conventional forms of brake-operating mechanisms, namely, mechanical, compressed-air and hydraulic systems, are listed and commented upon; merits of materials used are compared; metal-to-metal and propeller-shaft brakes; future developments of braking systems for heavy-duty motor coaches.

MOTOR BUS CLUTCHES

TWO TYPES COMBINED. Combining Two Types of Clutch. Commercial Motor (Lond.), vol. 50, no. 1295, Jan. 7, 1930, p. 798, 1 fig. Description of combined cone and plate-type clutch embodied in 1930 passenger models of Karrier motor buses; it has been found that most satisfactory proportion of total torque for plate clutch varies from 15 to 25 per cent according to vehicle load.

MOTOR BUS DESIGN

TREND OF. The Trend of Motor Coach Design, F. R. Fageol. Can. Ry. and Mar. World (Toronto), no. 383, Jan. 1930. pp. 46-47. General review of motor-bus design of less few years; probable design in future. Abstract of paper read before Soc. Automotive Engrs. and Am. Ry. Assn.'s Motor Transport Division.

MOTOR BUS LINES

ELECTRIC RAILROAD OPERATION. Bus Operations Are Steadily Expanded by Electric Railways, J. R. Stauffer. Elec. Ry. Jl., vol. 74, no. 1, Jan. 1930, pp. 20-26, 3 figs. Purchases of new buses and extensions of bus mileage during past year denote normal and healthy progress; almost 2,200 buses were bought and nearly 4,000 miles of route was added; bus operations by electric railways and subsidiary companies as listed under 47 states, Hawaii, Philippine Islands, Porto Rico and Canada; buses bought by railways during 1929 as listed under States, United States Possessions and Canada.

MOTORCYCLE INDUSTRY

STATISTICS. The Motor-Cycle and Cycle Industry. Engineering (Lond.), vol. 129, no. 3341, Jan. 24, 1930, pp. 114-115. Statistical data on people employed; United Kingdom exports of motorcycle and tricars; international exports; net imports of pedal cycles.

MOTOR TRUCK DESIGN

TREND IN. The Trend of Weight and Size in the Development of Motor-Truck and Motor Coaches, P. Schon. Soc. Automotive Engrs.—Preprint for mtg., Jan. 20-24, 1930, 31 pp., 4 figs. Vibrating slow-speed, four-cylinder engines replaced with higher-speed, smoothly operating, six-cylinder powerplants; improvements in chasis units; question of what constitutes overload; improvements in chassis units; question of what constitutes overload; standardization of load spaces; comparative load-space dimensions for six different motor-trucks; motor vehicles legislation and taxation; differences in state laws handicaps motor-truck design; Hoover code protects interests of transportation; pneumatic and solid tires.

MOTOR TRUCK TRANSPORTATION

TRAILERS. Tractor-Semi-Trailer Operation, A. W. Kenerson. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 105-107, 1 fig. Benefits derived by analysis made by Standard Oil Co. of Ohio of application of semi-trailer to petroleum transportation; means whereby interchangeability of tractors and trailers was accomplished throughout entire field of operation outlined; semi-trailer specifications developed; adaptation of tractors to trailers; extra heavy-duty tractor justified; mechanical flexibility and operating safety; assembly of units and initial cost.

MOTOR TRUCKS

PERFORMANCE CHARTS. Performance Capabilities at a Glance. Motor Transport (Lond), vol. 50, no. 1296, Jan. 13 1930, pp. 34-37, 3 figs. Description of chart method of quickly ascertaining from known factors road behaviour of transport vehicles; chart has been drawn up taking tractive resistance to be 40 lbs. per ton on level; second chart shows relations between engine speed, road speed, back-axle ratios and tire sizes for Sauer chassis.

SIX-WHEEL. Discussion of Six-Wheel-Vehicle Papers, E. W. Templin, L. R. Buckendale, A. M. Wolf, and G. M. Sprowis. Soc. Automotive Engrs. Jl., vol. 26, no. 1, Jan. 1930, pp. 59-66, 7 figs. Discussion following presentation of papers on six-wheel motor trucks published in December 1929 issue of Journal is given; question of whether tires of greater carrying capacity can be provided by tire manufacturers; effects of torque reaction on tires; dual rear tires for six-wheel vehicles are said to be most advantageous; diagrams showing how weight shifts between rear truck-unit axles analyzed; conversion of four-wheel into six-wheel vehicles by applying secondary axle.

N

NICKEL

ELECTROLYTIC. The Preparation of Pure Electrolytic Nickel, C. G. Fink and F. A. Rohrman. Am. Electrochem. Soc.—Preprint, no. 57-2, May 29-31, 1930, pp. 11-24, 5 figs. Elimination of copper from nickel-copper electrolytes is discussed; history and classification of methods for removing copper; experiments and results on effects of pH, current density, metal on concentration, temperature and agitation upon cathodic deposit; method for rapid removal of more than 90 per cent of copper present as impurity in nickel solutions.

O

OIL-ELECTRIC LOCOMOTIVES

THREE-POWER. Three-Power Locomotive Tested by the Illinois Central. Ry. Elec. Eng., vol. 21, no. 1, Jan. 1930, pp. 14-16, 4 figs. Description of flexibility and economy of 90-ton switcher which is proved by four months' operation, three sources of motive power: two Buda 155-hp. six-cylinder gas engines, connected to two General Electric 66-kw. electric generators; Exide iron-clad 180-cell, 544 amp-hr. storage battery floats across line, and overhead electric line; curves showing speed-tractive effort characteristics; general dimensions.

OIL ENGINES

OIL SPRAYING SYSTEMS. Experimental and Analytical Determination of the Motion of Hydraulically Operated Valve Stems in Oil Engine Injection Systems, A. G. Gelalles and A. M. Rothrock. Nat. Advisory Committee for Aeronautics—Report No. 330, 1929, 20 pp., 12 figs. Research on pressure variations in injection system of N.A.C.A. spray photography equipment and on effects on motion of timing valve stem; methods of analysis of pressure variations and general equation for motion of spring-loaded stem for timing valve are applicable to spring-loaded automatic injection valve, and in general to all hydraulically operated valves.

OPEN HEARTH FURNACES

GERMANY. Talbot Process in Steel Furnace, F. Brandt and W. Alberts. Iron Age, vol. 125, no. 4, Jan. 23, 1930, pp. 309-311, 3 figs. Description of Talbot furnace which was studied for installation in Vereinigte Stahlwerke, Huette Ruhrort-Meiderich; 200-ton open-hearth unit makes heat in four hours; details of design and operation; gas and air valves; motor-operated dampers; furnace titled by pivoted racks; furnace nearly 100 ft. long; mixed gas used as fuel; much pig iron in charge; heavy production attained; B.t.u. consumption under 4,000,000.

ORE TREATMENT

FLOTATION. The Trend of Flotation, A. J. Weinig and I. A. Palmer. Colo. School of Mines—Quarterly, vol. 24, no. 4, Oct. 1929, 152 pp. Ores adapted to flotation; discussion of methods; kinds of flotation; theory; reagents; consumption of reagents; operations; equipment; testing; practice; custom plants; concentrating plants using selective flotation; milling and reagent costs; royalties and patents; marketing of concentrates; manufacturers of flotation machines in United States; freight rates on metals, ores, and concentrates; wage scales. Bibliography.

P

PAVEMENTS

BRICK. Brick Pavements for Modern Traffic, J. Adler. Can. Engr. (Toronto), vol. 58, no. 3, Jan. 21, 1930, pp. 155-157. Paving brick and its development; cement grout and asphalt filler for joints; method of pouring asphalt filler; depth of paving brick; use of squeegee cart. Paper presented before Am. Soc. for Min. Improvements.

RUBBER. The Use of Rubber for Roads and Pavements, H. W. Newman. Commerce Reports, no 2, Jan. 13, 1930, pp. 97-98. Objections to use of rubber; advocates claim many advantages; history of rubber road building; Akron had first rubber street in America; practical endurance tests in Great Britain; advantages of rubber industry.

PHOTOELASTICITY

FAVRE'S METHOD. The Favre Purely Optical Method for Photoelastic Determination of Elastic Constraints (Méthode purement optique de Favre pour la détermination photoélasticimétrique des contraintes élastiques). Génie Civil (Paris), vol. 95, no. 22, Nov. 30, 1929, pp. 543-545. Theoretical mathematical principles of method developed by H. Favre at Zurich Institute of Technology; examples illustrating application of method to determination of principal stresses in circular disc.

PILES, CONCRETE

DRIVING. Value of Reinforced-Concrete Pile-Driving Formulae (La valeur des formules de battage des pieux en béton armé), H. Lossier. Génie Civil (Paris), vol. 95, no. 26, Dec. 28, 1929, pp. 638-641, 7 figs. General study of phenomena accompanying pile driving; comparison of Bénabenq practical formula with so-called Dutch dynamic formula; author stresses necessity of preliminary driving tests prior to driving of precast reinforced-concrete piles.

PISTON RINGS

CASTING. Casts Piston Rings Individually, E. Bremer. Foundry, vol. 58, no. 2, Jan. 15, 1930, pp. 64-68, 10 figs. Methods employed by Piston Ring Co., Muskegon, Mich., in producing rings from 5-8 to 64 in. in diam.; three cupolas used for melting; bulk of moulding is accomplished on specially designed squeezer-type moulding machines; moulding methods described in detail.

PLANERS

METAL WORKING. Combined Planer and Milling Machine of 4,100 mm. Working Width and 800 mm. Working Length (Eine kombinierte Hobel- und Fraesmaschine mit 4,100 mm. Arbeitsbreite und 8,000 mm. Arbeitslaenge), F. Sipmann. Maschinenbau (Berlin), vol. 8, no. 24, Dec. 19, 1929, pp. 827-829, 4 figs. Equipment built by Schiess-Defries in Duesseldorf for Brown Boveri and Co., in Baden, Switzerland, is to serve mainly for machining of casings of high-capacity turbines; electric drive and control throughout; equipment weighs 210,000 kg.

METAL WORKING, HYDRAULIC DRIVE. High-Speed Planer with Hydraulic Drive (Schnellhobler mit Fleussigkeitsgetriebe), C. E. Berck. Maschinenbau (Berlin), vol. 8, no. 22, Nov. 21, 1929, pp. 769-770, 6 figs. Compressed oil-driven planer developed by Lange and Geilin, Magdeburg, in collaboration with designer of compressed-oil drive, Sturm, of Stuttgart, is discussed; speed diagrams are given.

PLASTICS

CELLULOSE. The Cellulose Acetate Plastics, J. Rossman. Plastics, vol. 6, nos. 1 and 2, Jan. 1930, pp. 21-22 and 28-30 and Feb. 1930, pp. 74-75. Jan.: Progress in art of non-flammable and moulded products is reflected best in patented art, where all real research contributions are laid down. Feb.: Steadily forging to front, and capable of many applications, these products have an interesting history and have engaged serious attention of many workers and inventors. (To be continued.)

PLATES

STRESSES. On the Stresses in the Neighbourhood of a Circular Hole in a Strip Under Tension, R. C. J. Howland. Royal Soc. of Lond.—Philosphical Trans. (Lond.), vol. 229, Jan. 6, 1930, pp. 49-86. Paper presents solution by successive approximation of problem of determining stresses in plate under tension bounded by two parallel edges and containing hole midway between edges; comparison of theoretical results with those obtained by Coker, Chakko, and Satake, using optical methods.

PORCELAIN MANUFACTURE

PROCESS CONTROL. Process Control in Continuous Production, F. H. Riddle and H. F. Royal. Indus. and Eng. Chem., vol. 22, no. 1, Jan. 1930, pp. 14-20, 8 figs. System of Champion Porcelain Co.; raw materials; storage and withdrawal system for raw materials; grinding of lump andalusite and dumortierite; preparation of body; formation of cores; burning of ware; product finishing and testing; engineering department.

POTENTIOMETERS

HIGH TENSION. New Type Potentiometer for High Voltages (Ein neuartiger Spannungsteiler fuer Hochspannung), H. Schaefer. Elektrotechnische Zeit. (Berlin), vol. 51, no. 2, Jan. 9, 1930, pp. 55-56, 2 figs. Equipment consisting of 60 Dralowid high-resistance elements of megohms each, is described.

POWER PLANTS

STEAM VS. HYDRO-ELECTRIC. Water or Steam Power—The Economics of the Question, G. A. Orrok. Power, vol. 71, no. 4, Jan. 28, 1930, pp. 148-150, 2 figs. Evaluation of cost of water power; comparative total costs of steam and hydro-electric power; limitations to which hydro-electric plants are subject; self-sufficiency of steam plants; comparison curves of total costs of steam and hydro-electric power; cost of steam generated power is steadily decreasing. Paper read before World Engineering Congress, Tokyo. Indexed in Engineering Index, 1929, from Mech. Eng., Dec. 1929.

PRESSURE VESSELS

ALUMINUM. Tests With Aluminum Pressure Vessels (Versuche mit Dampffaessern aus Aluminum), M. Ulrich. Waerme (Berlin), vol. 53, no. 2, Jan. 11, 1930, pp. 25-26, 5 figs. Deformations of different boiler parts under different pressures is discussed; tests form part of experimental study being carried out at materials-testing laboratory of Stuttgart Institute of Technology.

WELDING. Welding for Boilers, Pressure Vessels and Steam Lines, C. W. Obert. Power Plant Eng., vol. 34, no. 3, Feb. 1, 1930, pp. 174-175. Present status of allowed construction and methods; welded boiler drums; welds for piping. Abstract of paper presented before Int. Acetylene Assn.

PROTECTIVE COATINGS

CORROSION. Corrosion—A Problem in Protective Coatings, F. N. Speller. Gas Jl. (Lond.), vol. 189, no. 3479, Jan. 22, 1930, pp. 209-211. Notes on relative corrosion of wrought-iron steel, and pure iron; corrosion and electrochemical theory; natural protective films; protection with thick coatings; more resistant metals. Paper read before Am. Soc. Steel Treating. Indexed in Engineering Index 1929, from various sources.

Engineering Index

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A

AERIAL TRANSPORTATION

Canada. Some Notes on the Technical Problems of Canadian Aviation, D. C. M. Hume. Flight (Lond.), vol. 21, no. 1094. Dec. 13, 1929, pp. 1312-1314. Geographical survey of Canada and climates prevailing in different parts outlined; position of Canada from flying point of view unique; effect of climate on aircraft; trouble with wood and rubber parts due to climate and fungi; difficulties with engine; evolution of skis; immediate requirements of future. Abstract of paper presented before Roy. Aeronautical Soc.

AIRPLANE ENGINES

Design. Gauging Airplane-Engine Performance, J. H. Geisse. Soc. Automotive Engrs.—Jl., vol. 26, no. 2, Feb. 1930, pp. 221-224 and (discussion) 224-225, 1 fig. All factors exclusive of reliability can be evaluated so as to provide good basis for choosing engine; effect of changes in engine weight on operating cost; tables show effect of increased engine weight, operating cost, and operation-expense items that are affected; increasing weight of 200-hp. engine from 400 to 494 lbs. would be justified provided increases in time between partial and major overhauls and total life could be correspondingly increased; engine resistance.

Diesel. Diesel Engines, W. G. Meyers. Aeronautics, vol. 6, no. 2, Feb. 1930, pp. 19-20, 70, and 72, 5 figs. Review of what has been done to date in developing Diesel or oil burning engine for high speed and light weight requirements of aircraft; opposed-piston type of oil engine developed by H. Junkers; troubles encountered in development of Diesel engines outlined by Morgan; technical features on Packard Diesel.

AIRPLANE PROPELLERS

Forging. Development of the Drop-Forged Metal Propeller, F. W. Caldwell. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Mar. 12, 1930, 5 pp. Development of type of propeller suitable for drop forging is discussed; selection of forged-steel blade of very high aspect ratio and great diameter with low camber ratios at tip, but with comparatively thick sections in inner part; eliminating fluttering tendency; designing first aluminum alloy propeller; improvements in methods of inspection; limit of life of blades not yet established; question of vibration.

Variable Pitch. Test of an Adjustable Pitch Model Propeller at Four Blade Settings, E. P. Lesley. Nat. Advisory Committee for Aeronautics—Tech. Notes No. 333, Feb. 1930, 15 pp., 11 supp. figs.

AIRPLANES

Design. Aircraft of the Near Future, W. Mitchell. Aeronautics, vol. 6, no. 1, Jan. 1930, pp. 12-14, 58, 60, and 64, 4 figs. Trend of aircraft production is outlined; passengers and freight should be carried in wings instead of fuselage; landing gear should be folded up when airplane is in flight; variable pitch propellers; superchargers; airplane structure; engine self-starters; blind flying; gyroscopic compasses; criticism of Graf Zeppelin; advantages of airships as airplane carrier.

Metal Construction. Metalizing the Airplane H. V. Thaden. Am. Soc. Mech. Engrs.—Advance Paper for mtg., Mar. 12, 1930, 7 pp. Advantages of metal airplanes; two basis schools of structural design, one making use of conventional type of framed structure and other monolithic type of structural design which in general is not amenable to conventional determinate analysis; important advantage of monolithic type; type of fuselage structure using transverse bulkheads but replacing longitudinals with sheet metal corrugated longitudinally; skin takes all of shear loads and chord loads; different wing structures; inspectability of interior of structural importance.

ALLOY STEEL

Anti-Corrosive. Recent Developments in Corrosion and Heat-Resisting Steels, R. Hadfield, T. G. Elliot and R. J. Sarjant. Chem. and Industry (Lond.), vol. 49, no. 4, Jan. 24, 1930, pp. 41T-51T, 11 figs. Development of non-corroding and heat-resisting steels; mechanical and physical properties of corrosion-resisting steels; photomicrographs; resistance to scaling and strength at high temperatures; industrial applications of corrosion-resisting and heat-resisting steels.

Heat-Resisting. Alloys That Resist Heat, T. H. Nelson. Iron Age, vol. 125, no. 6, Feb. 6, 1930, pp. 431-434, 3 figs. Selection of suitable material for heat resistance is not a simple problem; four classes of alloys available; corrosion and heat resistance are same problem; heat corrosion in domestic heaters; failure often due to chemical corrosion; special dependence on certain alloys; alloys for both corrosion and heat; special steel for valves; more nickel than chromium not essential.

ALLOYS

Aluminum. *See Airplanes.*
Bronze. *See Bronze.*
Copper. *See Copper Alloys.*

ASBESTOS

Review of 1929. Asbestos, N. R. Fisher. Eng. and Min. Jl., vol. 129, no. 3, Feb. 8, 1930, p. 116. Brief review of asbestos industry for 1929, regarded as unusually prosperous year; notes on production in Canada, Rhodesia, Union of South Africa, Cyprus, Russia, United States, and Italy; prospects for 1930 are problematical.

ASPHALT MANUFACTURING PLANTS

Chicago. Pavrite Asphalt Plant a Modern Installation, P. J. Kealy. Highway Engr. and Contractor, vol. 36, no. 2, Feb. 1930, pp. 70-73, 3 figs. Description of Chicago asphalt plant for manufacture of cold mixed bituminous product at rate of 50 tons per hour; drier arrangement; tower design; chute arrangement; heating of asphaltic cement; asphalt storage; vibrating screen, etc.

AUTOMOBILE PLANTS

Production Machine Tool for. A Production Machine-Tool of Elastic Design, J. B. Armitage. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 87-88 and (discussion) 89-90 8 figs. Adaptation of standard machine tool to automobile manufacture as worked out by one milling-machine manufacturer is discussed; beginning with milling machine of relatively simple design, special heads are substituted or added according to requirements of job; adding duplicate head at front makes machine duplex and one or more adjustable heads for vertical spindles can be supported between two main heads.

AUTOMOBILES

Front-Wheel Drive. An American Front-End-Drive Car. Sci. Am., vol. 142, no. 1, Jan. 1930, pp. 28-29, 4 figs. Description of Cord front-drive automobile; history of front-drive car in America is mostly racing; closeness with which Cord car hugs ground and yet has road clearance equal to most rear-drive cars.

B

BEAMS

Aluminum, Testing. Pioneer Tests of Aluminum Beams Reveal Good Structural Qualities, R. L. Templin and E. C. Hartmann. Eng. News-Rec., vol. 104, no. 8, Feb. 20, 1930, pp. 314-316, 5 figs. Report on tests made at research laboratories of Aluminum Co. of America; six aluminum and four steel I-beams 5 to 10 in. deep, and 10½ ft. long were tested; aluminum beams found to support 13 per cent more load than steel of same size and 130 per cent more load per pound of weight. See editorial comment on p. 307.

Perforated, Stresses in. Effect of a Circular Hole on the Stress Distribution in a Beam under Uniform Bending Moment, Z. Tuzi. Lond., Edinburgh and Dublin Philosophical Mag. and Jl. of Sci. (Lond.), vol. 9, no. 56, Feb. 1930, pp. 210-224, 6 figs. Investigation of stress distribution in beam having hole on neutral axis and subjected to uniform bending moment; experimental results obtained by photoelasticity, using new material, Phenolite, five times more sensitive than Xylonite; stresses are measured directly, counting interference fringes; experimental results compared with theory worked out in this paper.

BEARINGS

Anti-Friction, Fits in. Assembly Fits in Anti-Friction Bearings (Einbaupassungen fuer Waelzlager), T. Damm. Werkstattstechnik (Berlin), vol. 24, no. 2, Jan. 15, 1930, pp. 49-50, 2 figs.

Anti-Friction, Pressure Measurements on. Pressure Measurements on Roller Bearings (Druckmessungen an Walzenlagern), O. Von Auwers. Wissenschaftliche Veroeffentlichungen aus dem Siements-Konzern (Berlin), vol. 8, no. 2, July 8, 1929, pp. 137-143, 22 figs. Examples of measurement and possibilities of their practical application; many sidedness of measurements if viewed from economic angle.

Lubrication. Oil Lubricated Journal Bearings (Les coussinets à routement sur huile), H. Brillie and A. M. Robb. Génie Civil (Paris), vol. 95, nos. 24 and 25, Dec. 14, 1929, pp. 586-589 and Dec. 21, 1929, pp. 618-620, 14 figs.

BOILERS

Design. Influence of Design of Boiler and Firebox on Slag Formation on Heating Surface (Einfluss der Kesselbauart und Feuerraumform auf das Verschlacken der Heizflaeche). Waerme- und Kaelt-Technik (Muehlhausen) ,vol. 32, no. 2, Jan. 31, 1930, pp. 6-8, 4 figs. It is shown how, with aid of softening curve of coal ash, it is possible to determine numerically if danger of slag formation exists; advantages of such softening curves for design of boilers and boiler furnaces as compared with usual fusion-point determination is demonstrated.

Furnaces, Design of. Economics of Boiler Furnace Design, J. Y. Parce, Jr. Colo. Engr., vol. 26, no. 2, Jan. 1930, pp. 52-54, 70 and 72, 4 figs. Principal factors which enter into economic study of boiler-furnace problem are discussed; water and air-cooled wall construction; minimum total surface requirements reached when furnace is about 40 per cent water-cooled; several different ways of partially cooling furnace; each type of water-cooled furnace designed has some field for which it is particularly advantageous.

Furnaces, Water - Cooled. Furnaces for Powdered Coal—Should They be Apartmented? R. Mathews. Power Plant Eng., vol. 34, no. 4, Feb. 15, 1930, pp. 218-221, 1 fig. Discussion of boiler efficiency with reference to furnaces with water walls and article advocates more attention to thermodynamics of solid flue combustion; Scotch marine boiler offers same problem as small water-cooled furnaces; experiments must be resorted to in order to obtain necessary information; carbon particles form effective heat screen; forced circulation might be advisable.

Marine, Pulverized-Coal-Fired. Pulverized Coal for Marine Boilers, E. H. Peabody. World Eng. Congress Part 1—Paper (Tokyo), no. 426, 1929, 23 pp., 10 figs. on supp. plates. Brief discussion of pulverized-coal burning installations; major portion of paper touches on following; tests at Philadelphia Navy Yard; burner design; advantages of pulverized coal; type of pulverizer; screens for classifying pulverized coal; distributors; driers; review of papers on pulverized coal for marine purposes. (In English.)

Pulverizen-Coal-Fired. General Operation Experiences with the First Wood Steam Generator, E. W. Smythe. Engineering (Lond.), vol. 129, no. 3342, Jan. 31, 1930, pp. 149-152, 8 figs.; and Engineer (Lond.), vol. 149, nos. 3864, 3865, and 3866, Jan. 31, 1930, pp. 142-144, and (discussion) 127-128, Feb. 7, p. 170 and (discussion) 157-158, and Feb. 14, pp. 194-195, 25 figs. Record of actual experience obtained throughout various stages of development and subsequent operation of first radiant-heat boiler in Great Britain, fired exclusively with pulverized fuel, comprising plant known as Wood steam generator. Paper read before Instn. Mech. Engrs., Jan. 24, 1930.

REGULATORS. Automatic Boiler Control in a Combined Steam-Hydro-electric Plant (Automatische Kesselregelung in einem Dampf-Wasser-Kraftwerk), K. d'Huart. Waerme (Berlin), vol. 53, no. 9, Mar. 1, 1930, pp. 134-138, 14 figs. Economic load equalization of boiler sets in combined steam-hydro plants obtained with furnace control regulators; requirements of such regulations; description of Arca regulators and results obtained.

BRIDGE DESIGN

PROGRESS IN. Fifty Years of Progress in Bridge Engineering, D. B. Steinman. Iron and Steel of Canada (Gardenvale, Que.), vol. 13, no. 1, Jan. 1930, pp. 1-4, 7-8, 19-21 and 23, 5 figs. Historical sketch of improvement in bridge design and construction during past 50 years is given; theory of bridge design; different types of steel-bridge construction are described. Abstract of paper presented before Am. Inst. Steel Construction, indexed in Engineering Index 1929, from Military Engr., Sept.-Oct., 1929.

BRIDGE PIERS

STRENGTHENING. Reinforcing Railroad Bridge Piers under Heavy Traffic. Eng. News-Rec., vol. 104, no. 10, Mar. 6, 1930, pp. 406-407, 4 figs. Work on Lower Maumee River two-track, steel-truss bridge, at Toledo, involves difficult underpinning work using open metbod of widening piers.

BRIDGES, CONCRETE

DESIGN. Ferro-Concrete in Bridge Construction. Modern Transport (Lond.), vol. 22, no. 59, Nov. 30, 1929, pp. 11-12, 3 figs. Discussion of use of reinforced concrete in bridge construction; two main metbods in constructing reinforced-concrete bridge are girder type, which is built on familiar beam and slab principle, and arch type, wbicb takes form of series of parallel ribs.

CONSTRUCTION. Construction Plant and Metbods for Concrete Bridges. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 8, Oct. 1929, pp. 2049-2051 and (discussion) 2052. Abstract of committee report; discussion of factors that affect bridge contractor's bid; stream studies; progress schedule; importance of safety; pumping equipment.

BRIDGES, CONCRETE ARCH

CONSTRUCTION. Two Higb Travelling Towers with Chutes Place Concrete on New Brunswick Multiple Arch Bridge, M. Goodkind. Eng. News-Rec., vol. 104, no. 8, Feb. 20, 1930, pp. 317-321, 8 figs. Design and construction of highway bridge conisting of six 202-ft. open spandrel arches, flanked by four 40-ft. barrel arches on north end and five similar spans on south end; three-hinged steel trusses used for centreing; celluloid models cbecked design and determined location of expansion joints; contractors plant layout; details of travelling concrete towers. See editorial comment on p. 308.

Huge Steel Arch Centres Moved as Units in Rapid Construction of 48-Span Intercounty Concrete Highway Bridge across the Susquehanna River. Construction Methods, vol. 12, no. 1, Jan. 1930, pp. 54-59, 19 figs. Method of construction of concrete arch bridge, 7,374 ft. long, witb 38 ft. roadway and 6 ft. sidewalks, on highway between Philadelpbia and Pittsburgh, consisting of 28 three-rib reinforced-concrete arch spans, 180 ft. long; details of arch steel trusses used as centreing; methods of moving centreing and concreting of arch ribs.

BRIDGES, MASONRY ARCH

WIDENING. Widening the Concorde Bridge of Paris (L'élargissement du Pont de la Concorde à Paris). Génie Civil (Paris), vol. 96, no. 6, Feb. 8, 1930, pp. 134-135, 4 figs. Details of plan for widening old masonry arch bridge over Seine from 14.75 m. to total width of 35 m., 21 m. being allowed for vehicular traffic and 7 m. on each side of it for pedestrians.

BRIDGES, RAILROAD

STRESSES. On the Question of the Investigation into the Static and Dynamic Stresses in Railway Bridges (Subject III for Discussion at the Eleventh Session of the International Railway Congress Association), A. A. C. Ronsse and R. Desprets. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 11, no. 12, Dec. 1929, pp. 3013-3128, 4 figs. General considerations; brief study of vibratory state of girder on two supports; comparison between results of Frencb and German impact formulae; comparison with recent English rules.

BRIDGES, STEEL

SUPERIORITY OF. The Superiority of the Steel Bridge. Iron and Steel of Canada (Gardenvale, Que.), vol. 12, no. 12, Dec. 1929, pp. 299-301 and 316, 3 figs. Flexibility and movability defined; initial cost and maintenance cost of bridges; reasons why steel bridge is superior in permanence. (Concluded.) Reprinted from Am. Inst. of Steel Construction.

BRIDGES, STEEL ARCH

DESIGN. Plans and Research—Kill van Kull Bridge, O. H. Ammann. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 3, Mar. 1930, pp. 487-493 and (discussion) 494-500, 4 figs. Report on preliminary studies; traffic demands; comparative designs for two-hinged spandrel-braced steel arch 1,646 ft. in span; model tests found invaluable economy of special steels; discussion by J. Jones, L. S. Moisseiff, C. M. Spofford, C. E. Chase, C. E. Fowler; model studies in connection with Detroit River Bridge and Maumee River Bridge; alternative suspension design; advantages of continuous bridge; art in large bridges.

BRIDGES, STEEL TRUSS

MONTREAL. Fabrication and Erection of Superstructure of Montreal South Shore Bridge, L. R. Wilson. Eng. Jl. (Montreal), vol. 13, no. 1, Jan. 1930, pp. 3-54, 101 figs. Detailed report on construction of steel bridge, having total length of 8,817 ft. exclusive of approaches, and comprising symmetrical cantilever span 1,937 ft. long; secondary steel-truss spans vary from 96 to 249 ft. in length; general alignment of bridge is not straight; details of construction equipment. Paper presented before Eng. Inst. of Canada.

BRIDGES, SUSPENSION

GERMANY. The New Cologne-Muelheim Highway Bridge over the Rhine (Die neue Strassenbruecke ueber den Rhein in Koeln-Muelheim), F. Herbst. V.D.I. Zeit. (Berlin), vol. 74, no. 6, Feb. 8, 1930, pp. 161-167, 28 figs., partly on supp. plate. Details of design, construction, and architectural treatment of suspension bridge of 315 m. span, over 600 m. total length, and about 32 m. overall width; steel towers are 52 m. high; details of anchorages and methods of cable spinning.

PORTLAND, ORE. Rope-Strand Cables Used in New Bridge at Portland, Oregon, D. B. Steinman. Eng. News-Rec., vol. 104, no. 7, Feb. 13, 1930, pp. 272-277, 7 figs. St. Jobns Bridge witb 1,207-ft. suspended span over Willamette River, sets new record for rope-strand cables; architectural studies result in use of batter-leg towers with pointed arches; details of stiffening truss connections at main and cable bent towers; celluloid tower model gave deflections that indicated stresses below computed values; saddle details of rope-strand cable; total contract cost was $3,222,206.

BRONZE

CASTINGS. Effects of Oxidation and Certain Impurities in Bronze. J. W. Bolton and S. A. Weigand. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 281, for mtg. Feb. 1930, 17 pp., 36 figs. Paper discusses some fundamental metallurgical principles involved in production of sound cast bronze, and supplements previous paper in whicb theory was advanced tbat oxidation in bronze casting is due to incipient shrinkage; effects of certain impurities and of actual oxidizing conditions are shown; appendix deals with appearance of various inclusions. Bibliography.

C

CABLEWAYS

LOCATION OF. Improving on Rope-Tramway Location by Using Angle Towers and Stations, F. C. Carstarphen. Eng. and Min. Jl., vol. 129, no. 2, Jan. 23, 1930, pp. 59-62, 11 figs. Author contends that high efficiency of straight-line tramway location is fallacy; discussion of various problems involved in design and location; suggestions as to most economical and efficient type of design.

CANALS

WELLAND. Construction Methods on the Welland Ship Canal, E. G. Cameron. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 8, Oct. 1929, pp. 2081-2097, 12 figs. History of project; cost distribution; earth excavation; dredging operations; rock excavation; excavating and loading costs; lock construction; form work; concrete bandling and form moving in flight locks; Chippawa Creek siphon culvert.

CHESAPEAKE AND DELAWARE. The Chesapeake and Delaware Canal, E. I. Brown. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 2, Feb. 1930, pp. 293-340, 11 figs. Record of construction of navigation canal, connecting Delaware River with Chesapeake Bay, having length of 14 mi. and summit level 17 ft. above mean low water of Delaware River; history of project from 1764; quantities, yardage, prices, total costs, and methods of procedure in connection witb dredging operations; descriptions of bridges; outline of hydraulic theory as applied to project; economic value of canal.

CAST IRON

HIGH TEST. Recent Developments in the Metallurgy of Cast Iron, R. Moldenke. Metals and Alloys, vol. 1, no. 7, Jan. 1930, pp. 327-328. Outline of present-day knowledge of improving cast iron to previously not dreamt-of degree; bebaviour of graphite nuclei in cupola melting under increasing conditions of superheat, the higher the temperature the more complete being their solution in molten iron; microstructure of high-test cast iron predominately pearlitic.

CEMENT MORTAR

STUDY OF. A Study of Portland Cement Mortars Having Diatomaceous Earth as An Admixture, J. E. Buchanan. Am. Concrete Inst.—Jl., vol. 1, no. 2, Dec. 1929, pp. 184-201, 6 figs. Report on University of Idabo tests comparing behaviour and characteristics of portland-cement mortars containing small percentages of diatomaceous earth with identical plain portland cement mortars; effect of diatomaceous earth upon consistency, expansion, compressive strengtb, shrinkage in air, and time of set. Bibliography.

CHEMICAL ENGINEERING

PROGRESS IN 1929. Chemical Engineering Progress in 1929, J. W. Hinchley. Indus. Chemist (Lond.), vol. 6, no. 51, Feb. 1930, pp. 53-56. Attitude of manufacturer toward chemical research; need for chemical engineering research; improvements in fuel economy; importance of materials of construction such as iron and steel alloys; progress in utilization of iron-nickel-chromium alloys; bearing properties of stainless steel; nitrogen method of hardening steel; use of nickel alloys; metals coatings; chemical plant equipment.

CHROMIUM-NICKEL STEEL

DRAWING. Drawing Chrome-Nickel Alloy Utensils. Iron Age, vol. 125, no. 6, Feb. 6, 1930, pp. 445-446, 1 fig. Allegheny metal used for hotel, household and hospital ware requires high heat treatment and special care in processing methods employed by Lalance and Grosjean and Grosjean Mfg. Co., Woodbaven, N.Y.; white pickled instead of polished sheets; heat treated at 1,900 to 1,950 deg.; finished by grinding four times, welding to be used for attachments.

CHROMIUM PLATING

COMMERCIAL. Commercial Chromium Plating, R. Schneidewind. Univ. of Mich.—Dept. of Eng. Research, no. 3, Jan. 1930, 60 pp., 23 figs. Practical side of chromium plating is discussed; properties of chromium plate; equipment including motor generators, rheostats, tanks, fume exhausting apparatus, temperature-control equipment, racks and contacts, and anodes; process of plating; bath; preparation of surface; effect of variations in plating conditions and solutions; notes on throwing power; control methods in chromium plating; stripping; inspection; defective chromium plating; costs.

COAL

CARBONIZATION, LOW-TEMPERATURE. Low-Temperature Carbonization, D. Brownlie. Chem. and Industry (Lond.), vol. 49, no. 5, Jan. 31, 1930, pp. 92-94, 2 figs. Account of modern work on commercial scale with Babcock process; arrangement consists of overhead coal bunker, pre-drier, retort, and screw-conveyor feed gear to chain-grate stokers, while coal in passing down tbrough retort is carbonized at about 1,290 deg. fahr. by mixture of superheated steam and combustion gases.

HANDLING. *See Materials Handling.*

COAL MINES AND MINING

ELECTRIC POWER. Electric Power for the Union Pacific Company Mines, D. C. McKeehan. Min. Congress Jl., vol. 16, no. 2, Feb. 1930, pp. 128-130, 8 figs. Central power plant for Rock Springs groups of mines in southern Wyoming; description of boiler room, power house, water-cooling system, transmission lines, transformers, underground substations, and underground feeder lines.

MECHANIZATION. Mechanical Operation at Hanna Mines, J. V. McClelland. Min. Congress Jl., vol. 16, no. 2, Feb. 1930, pp. 109-112, 9 figs. Descriptions of operations at mines in Wyoming with large electric shovel, mechanical loaders, rock shovels, scrapers and conveyors; mechanical loading on 100 per cent basis; slope driving in beavy pitch and thick coal; description of drainage and ventilation.

NOVA SCOTIA. Nova Scotia's Coal Production. Can. Engr. (Toronto), vol. 58, no. 6, Feb. 11, 1930, p. 211. Total output for last year was 6,339,492 tons; outlook promising; substantial increase in gypsum production.

QUEBEC. The Rouyn District of Quebec. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 2, Jan. 10, 1930, pp. 38-39. Notes on progress of mines and smelter during 1929.

COLUMNS, CONCRETE

DESIGN. Design of Reinforced Concrete Columns Subject to Flexure, H. Cross. Am. Concrete Inst.—Jl., vol. 1, no. 2, Dec. 1929, pp. 157-169. Discussion of sources of flexure; bending moments in columns not integral with girders; design methods; designing for invariable moment and variable moment; use of high strength concrete; variation of column diameter; tensile reinforcement; flared column heads; allowable stresses.

CAST IRON CORES. Reinforced-Concrete Columns with Cast-Iron Cores. Eng. News-Rec., vol 104, no. 7, Feb. 13, 1930, pp. 277-278. Compilation of information on nature and service of Emperger type of reinforced-concrete column, used in McGraw-Hill Building, Chicago; reduced size for given strength is advantage in large buildings; solid and bollow cores; use and tests; building code provisions.

COMBUSTION

FURNACE. Calorific Value, Heat Balance, and Efficiency in Furnace Tecbnique (Heizwert, Waermebilanz und Wikungsgrad in der Feuerungstechnik), K. Rummel and G. Neumann. Arcbiv. fuer das Eisenhuettenwesen (Duesseldorf), vol. 3, no. 8, Feb. 1930, pp. 531-544, 1 fig. Relations between cbemical energy and calorific value for wet and dry fuels (solid, liquid, and gaseous); balances with upper and lower calorific value; advantages and disadvantages of upper and lower values.

CONCRETE

READY-MIXED. Ready-Mixed Concrete, S. Walker. Rock Products, vol. 33, no. 3, Feb. 1, 1930, pp. 87-90. Tendency towards use of finished materials; field for ready-mixed concrete; types of job; size of community necessary; location of plant; capacity of plant and investment; selection of type of equipment; dry batching plants; effect of transportation on quality. Paper presented before Nat. Sand and Gravel Assn.

CONCRETE TESTING

PERMEABILITY. Some Permeability Studies of Concrete, F. R. McMillan and I. Lyse. Am. Concrete Inst.—Jl., vol. 1, no. 2, Dec. 1929, pp. 101-142, 20 figs. Report on tests undertaken by Portland Cement Assn., for studying water-tightness of concrete mixtures; description of apparatus for determining resistance of concrete to penetration of water; leakage curves for concrete specimens; effect of method of moulding and of duration of test; effect of water-cement ratio, curing and age; characteristics of cement; effect of direction of pressure and amount of paste; effect of admixtures.

CONSTRUCTION INDUSTRY

CANADA. Vital Problems of the Construction Industry Discussed at Quebec Convention. Contract Rec. (Toronto), vol. 43, no. 6, Feb. 5, 1930, pp. 127-137. Report on proceedings of 1930 annual meeting of Canadian Construction Association; abstracts of discussions and resolutions on credits, group advertising, salesmanship, freight rates, five-day week, use of Canadian material; apprentice training survey, etc.

CONVEYORS

BOX. A Conveyor System that Handles Three Million Boxes a Year, T. A. Keefer. Machy. (N.Y.), vol. 36, no. 6, Feb. 1930, pp. 437-441, 8 figs. Discussion of conveyor system employed in plant of National Cash Register Co., Dayton, Obio, of which over eight miles are in use; installation served six buildings containing over 100,000,000 sq. ft. or 24 acres of floor space; vertical conveyors extend from basements to top floors; how boxes are dispatched and received; conveyor spirals permit temporary storing of boxes.

COPPER

GAS CONTENTS. A Theory Concerning Gases in Refined Copper, A. E. Wells and R. C. Dalzell. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 270, for mtg. Feb. 1930, 15 pp., 2 figs. Certain gases dissolve in molten copper, partly evolving on solidification; cuprous oxide, colloidally dispersed in molten copper, adsorbs certain gases; solidification liberates parts of adsorbed gases; porosity in cast copper is caused by gases from two sources; sulphur dioxide dissolves in molten copper, partly reacting witb it to form cuprous sulpbide and cuprous oxide, but only small quantities are produced in refined copper. Bibliography.

COPPER ALLOYS

COPPER-MAGNESIUM. Constitution of Magnesium-Copper Alloys, J. A. Gann and A. W. Winston. Am. Soc. for Steel Treating—Trans., vol. 17, no. 2, Feb. 1930, pp. 292-293, 1 fig. Equilibrium diagram and results of investigation of crystal structure and X-ray examination. Recommended Practice Committee release.

WELDING. Welding Facts and Figures, D. Richardson and E. W. Bircb. Welding Jl. (Lond.), vol. 26, no. 315, Dec. 1929, pp. 386-388. Properties of copper and nickel alloys are discussed; high copper alloys have excellent welding cbaracteristics combined witb good strength; analysis of nickel alloys and methods of welding taken up.

COPPER ORE TREATMENT

BRITISH COLUMBIA. The Allenby Concentrator of tbe Granby Company, H. R. Taylor. Eng. and Min. Jl., vol. 129, no. 4, Feb. 24, 1929, pp. 175-177, 4 figs. Brief outline of important steps in development of concentration practice; description of equipment and practice in present concentrator, with capacity 2,500 dry tons per day; flow sheets and milling data are given; consumption of flotation reagents; costs are not given.

QUEBEC. Twelve Months' Milling at Noranda, C. G. McLachlan. Can Min. and Met.—Bul. (Montreal), no. 214, Feb. 1930, pp. 237-258, 5 figs. Outline of operations at concentrator treating massive sulphide ore carrying copper and gold, and sometimes zinc; climatic difficulties; lack of flotation operators; tailings disposal; characteristics of ore; flow sheet; operating data; sampling and assaying practice; concentration of this ore by flotation is feasible, but is complex problem.

COPPER SMELTING PLANTS

MONTANA. Anaconda Copper's Washoe Plant, R. H. Bradford. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 4, Jan. 24, 1930, pp. 9-10. Brief account describing principal features of plant and changes that bave been made.

CRANES

ALUMINUM TRAVELLING. Travelling Crane is Built of Aluminum, F. V. Hartman and E. C. Hartmann. Iron Trade Rev., vol. 86, no. 6, Feb. 6, 1930, pp. 82-83, 2 figs. Description of 10-ton travelling crane recently installed in works of United States Aluminum Co., Massena, N.Y.

BRIDGE. Ore-Handling Bridges, A. C. Brown. Iron and Steel (A.S.M.E. Trans.), vol. 51, no. 25, Sept.-Dec., 1929, pp. 31-40, 30 figs. Development of bridge type of tramway; various methods proposed to secure stability and safety in ore bridges in order to withstand wind storms of high velocity; types of wind bracing; skewing bridges for avoiding twisting stresses when one end of bridge travels faster tban other; four mechanisms largely used; tracks and track wbeels; improvements in trolley design.

CUTTING TOOLS

STANDARDIZATION. Production Division. Soc. Automotive Engrs.—Jl. Reports of Divisions to Standards Committee (Section 2), Jan. 1930, pp. 30-49, 30 figs. Proposed American standard for milling cutters; nomenclature; definitions of milling cutters; proposed revision and extension of S.A.E. standard for woodruff key-slot cutters and gauges; proposed revision of S.A.E. recommended practice for plug and ring gauges; proposed American standard and revision of S.A.E. standard for cut and ground threads for taps; line cuts and dimensions given for different types of milling cutters, keyways, and gauges.

TESTING. Laboratory Tests Aid Tool Development, C. O. Herb. Machy. (N.Y.), vol. 36, no. 6, Feb. 1930, pp. 425-429, 9 figs. Description of physical testing and cbemical laboratories of Morse Twist Drill and Macbine Co., Bedford, Mass.

TUNGSTEN CARBIDE. Fixed Method Preferred to Free Hand Operations in Grinding Cemented Tungsten Carbide Tools, H. W. Wagner. Automotive Industries, vol. 62, no. 9, Mar. 1, 1930, pp. 370-373, 5 figs. As material to be ground is very valuable, wheel cost is of less importance than when bigh-speed steel is shaped; successful methods include compromises in grade, special devices and feeding skill; grinding resistance; General Electric Co. using grinding machines witb spring pressure between wheel and work; remedies suggested for grinding; pressure and feed; wet grinding; lapping and honing.

CYLINDERS

STRESSES IN. Approximate Theory of Cylindrical Sbell (Théorie approchée de l'enveloppe cylindrique épaisse). Génie Civil (Paris), vol. 95, no. 23. Dec. 7, 1929, pp. 566-568, 5 figs. Author proposes original mathematical analysis of stresses in cylindrical shells which approximate results of analysis based on theory of elasticity; application of tbis tbeory to case of non-cylindrical shells and shells made of reinforced concrete, also to cast-iron and concrete linings of mine shafts.

D

DAMS

SAFETY. How Can Safety be Attained in Dam Construction, A. Hazen. Water Works Eng., vol. 83, no. 1, Jan. 1, 1930, pp. 11-12, 44, 47-48 and 51-52, 2 figs. Causes of dam failures; analogy with rock slides; types of dams: tbeoretical triangle cannot be used in practice; stresses in masonry dams; factors of safety for arcb dams, buttress dams, rock-fill and earth dams; eartbquakes; how dams are to be made safe against sliding; table sbowing relative thickness of number of masonry dams. From paper read before World Eng. Congress.

UPLIFT PRESSURE. Hydrostatic Uplift Under Masonry Dams, H. de B. Parsons. Engineering (Lond.), vol. 129, no. 3344, Feb. 14, 1930, pp. 135-136, 11 figs. Hydrostatic uplifts for soil foundations under Colorado and Percho dams; author is unaware of any observations under dams, which do not record hydrostatic heads; recorded observations exhibit similar characteristics; hydrostatic uplift head under base of dam should be treated as independent force, like gravity and water pressure. (Concluded.)

DAMS, CONCRETE ARCH

STRESSES. Cantilever and Arch Resistance to Hydrostatic Loads of Single Arch Dams (La ripartizione del carico idrostatico fra travi ed archi nelle dighe di ritenuta a volta unica), E. Campini. Atti del Sindacato Provinciale Fascista Ingegneri di Milano (Milan), vol. 8, no. 11, Nov. 1929, pp. 343-369, 25 figs.; see also Energia Elettrica (Milan), vol. 11, no. 6, Nov. 1929, pp. 1093-1116, 25 figs. Theoretical matbematical analysis of distribution of loads and resistances in arch dams; study of tests of Stevenson Creek experimental dam in California, Amsteg dam in Switzerland, Salmon River dam in Alaska, and Pacoima dam in California.

DESIGN. Laminated Arcb Dams witb Forked Abutments, F. A. Noetzli. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 2, Feb. 1930, pp. 261-292, 11 figs. Mathematical theory of modified design avoiding complexities of thick arch and resulting in economies; design involved subdivision of total arch thickness into two or more separate arches; analysis of stresses by means of charts; principles of cone dam and of forked abutments; effect of sloping crown and of laminations; stepped water-level or fractional concrete arch dam at Marege, France, also Railroad Canyon (cone arch) Dam near Elsinore, Calif. are presented as examples.

DAMS, EARTH

SALUDA RIVER. Construction Features of the World's Largest Earth Dam. Contractors and Engrs. Monthly, vol. 2, no. 1, Jan. 1930, pp. 115-119 and 128, 9 figs. Report on construction of semi-hydraulic fill dam, on Saluda River, Columbia, S.C., 1½ mi. long and 208 ft. high; construction of concrete spillway and of power house.

DAMS, MULTIPLE DOME

COOLIDGE, ARIZ. Construction Metbods and Plant Layout for Coolidge Dam in Arizona, J. G. Tripp. Eng. and Contracting, vol. 69, no. 2, Feb. 1930, pp. 78-81, 3 figs. Planning of concrete plant and excavation; layout of concrete plant; distribution of concrete; choice of concrete mixers; general service problems. Indexed in Engineering Index 1929, from Am. Soc. Civil Engrs.—Proc., Nov. 1929.

DIESEL-ELECTRIC POWER PLANTS

GREAT BRITAIN. Supercharged Diesel Generator at Ashford. Gas and Oil Power (Lond.), vol. 25, no. 292, Jan. 2, 1930, pp. 61-62, 1 fig. Description of 1,350-hp. eight-cylinder Davcy Paxman oil engine set, for normal load of 600 kw., but capable of developing 900 kw., when supercharged; engine, wbicb bas Englisb-Electric single bearing alternator, is claimed to be first of its type installed in any electric station in Great Britain; supercbarger was constructed by British Brown-Boveri, Ltd.

DIESEL ENGINES

AUTOMOTIVE. Fuel Injection witb By-Pass Valve Control for Diesel Engines Developed by Linke-Hofmann-Busch, E. P. A. Heinze. Automotive Industries, vol. 62, no. 10, Mar. 8, 1930, pp. 398-400, 6 figs.

FUEL INJECTION IN. Injection Lags in a Common-Rail Fuel Injection System, A. M. Rotbrock. Nat. Advisory Committee for Aeronautics—Tecb. Notes, no. 332, Feb. 1930, 7 pp., 7 figs.

GREAT BRITAIN. British Compressorless Diesel Engines (Englische Kompressorlose Diesel-motoren), H. Mehlig. V.D.I. Zeit. (Berlin), vol. 74, no. 6, Feb. 8, 1930, pp. 171-172, 8 figs. Short note on engines of Crossley Brothers; Blackstone Co.; Davey, Paxman and Co.; Glenniffer Motors, Ltd.; Beardmore and Co.; some details of design are given.

DRILLING MACHINES

HEADS, DESIGN OF. Designing Multiple-Spindle Drilling Heads, A. M. Wasbauer. Machy. (N.Y.), vol. 36, no. 6, Feb. 1930, pp. 475-476 and 2 supp. sbeets 171 and 172. Application of data sheets to solutions of problems involved in designing drilling heads equipped witb drills of various sizes wbich must all feed at same rate; chart is given which has scale sbowing number of cubic inches of metal removed per minute by drills ranging from ⅛ to 1⅛ in. in diam. operated at feeds of from 1 to 12 in. per min.

SPEED STANDARDIZATION. Applicability of the VDW Standard Rules for Speed Changers in Drives of Machine Tools Used in Manufacture of Drilling Machines (Die Anwendbarket der VDW-Richtlinien fuer die Stufenspruenge der Getriebe von Werkzeugmaschinen bei dem Bobrmaschinenbau), R. Panzer. Werkstattstechnik (Berlin), vol. 23, Dec. 1, 1929, pp. 661-666, 5 figs. 157 drilling machines of German, English, and American manufacture bave been investigated and it is found that all speed changers come within limits of tbird VDW specification and that limits are enough; one example to determine total transmission ratio is given.

E

ECONOMIZERS

RECENT DEVELOPMENTS IN. The Economizer—Some Recent Developments, With Experimental Data and Conclusions, G. E. Tansley and O. Kubalek. S. Wales Inst. of Engrs.—Proc. (Cardiff, Wales), vol. 45, no. 6, Feb. 11, 1930, pp. 480-512 and (discussion) 512-519, 12 figs. Paper deals with some of more recent aspects of beat recovery from so-called waste gases, fuel economizer being taken as best known and most widely used appliances for this purpose; results on tests of economizers; discussion of various types of economizer surface; description of gilled-tube economizer; examples of calculation of saving effected by use of economizer.

ELECTRIC ARCS

CALORIMETRIC STUDY OF. The Calorimetric Study of the Arc, P. P. Alexander. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 2, Feb. 1930, pp. 138-141, 9 figs. Attempt to determine distribution of energy in electric arc by calorimetric metbod; total energy input was measured by specially calibrated watt-hour meter; energy dissipated at anode and at cathode was estimated by temperature rise of electrodes; presence of different fluxes alters distribution of energy between graphite electrodes; energy at anode was mucb higher tban that at catbode.

ELECTRIC CABLES

IONIZATION. Ionization Studies in Paper-Insulated Cables, C. L. Dawes and P. H. Humphries. Am. Inst. Elec. Engrs.—Advance Paper, no. 18, for mtg. Jan. 27-31, 1930, 7 pp., 11 figs. Value of maximum power factor and of voltage at whicb it occurs are shown to be very simple functions of three characteristic cable constants; fact tbat maximum power factor is independent of gas pressure, determined experimentally by E. S. Lee, is verified botb experimentally and analytically; general shape of power-factor curve is analyzed. Bibliograpby. Third paper of series previously indexed from Am. Inst. Elec. Engrs.—Jl., Jan. 1929.

ELECTRIC CIRCUIT BREAKERS

DESIGN. High Power Switchgear, L. C. Grant. Engineer (Lond.), vol. 149, no. 3864, Jan. 31, 1930, pp. 132-133, 2 figs.; see also editorial comment on p. 138. Arc stability produces greater consistency of distress symptoms than is possible witb ordinary oil switcb, and new step is to reduce amount of energy appearing at arc under given circuit conditions; reduction can take two forms; it would appear that there is no great difficulty in designing circuit breaker of quencbed-arc type to deal with two or three million kva. on 100 per cent service basis. Abstract of paper read before Instn. Elec. Engrs.

AIR. Deion Grids for Oil Breakers, J. Slepian, B. P. Baker and H. M. Wilcox. Elec. World, vol. 95, no. 5, Feb. 1, 1930, pp. 249-251, 6 figs. Extension of variation of Deion principle to conventional type of oil circuit breaker by relatively slight changes indicates vast field for attainment of improved breaker operation; theoretical considerations and test results reported. Paper read before Am. Inst. Elec. Engrs.

OIL. The Use of Oil in Arc Rupture, B. P. Baker and H. M. Wilcox. Am. Inst. Elec. Engrs.—Advance Paper, no. 45, for mtg. Jan. 27-31, 1930, 11 pp., 10 figs. Relationship of rupturing ability of oil circuit breakers to system stability problems; conclusions as to effectiveness with which oil must be used in arc rupture if requirements of stability are to be met; new device known as Deion-grid, developed to permit application of scientific principles to arc extinction in oil and its theory of operation; conclusions as to effectiveness of this device, which bears no relation to Deion air-break circuit breaker.

ELECTRIC CONDUCTORS

INDUCED VOLTAGES. Calculations of Induced Voltages in Metallic Conductors, H. B. Dwight. Am. Inst. Elec. Engrs.—Advance Paper, no. 10, for mtg. Jan. 27-31, 1930, 6 pp., 5 figs. Review of rules and procedure used in electrical engineering for calculation of induced voltages in metallic conductors, not including radiation effects.

ELECTRIC CONVERTERS

FREQUENCY. A 40,000-Kw. Variable-Ratio Frequency Converter Installation, E. S. Bundy, A. Van Niekerk, W. H. Rodgers. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 2, Feb. 1930, pp. 120-124, 5 figs. Installation of two 20,000-kw. adjustable-load, variable-ratio, frequency converters interconnecting 25-cycle and 50-cycle systems of Niagara, Lockport and Ontario Power Co. at Lockport Substation is described; function of various machines is explained; important features of control and interesting incidents in past 18 months of operation are pointed out.

ELECTRIC FURNACES

GERMANY. Electric Furnaces (Ueber Elektro-Oefen), V.D.I. Belani. Montanistische Rundschau (Berlin), vol. 21, no. 24, Dec. 16, 1929, pp. 479-483, 4 figs. Various types of furnaces built by Siemens and Halske A. G. are enumerated; uses to which they may be put and their special features; arc furnaces are used for production of sponge iron, of high-quality alloy steels, and of high-quality cast iron (in conjunction with cupola), for melting scrap, and for refining (in duplex process with open-hearth furnace or bessemer converter).

HEATING-TREATING. Electric Heat and Heat-Treating Alloy Steel, T. W. Hardy. Heat Treating and Forging, vol. 16, no. 1, Jan. 1930, pp. 53-58, 9 figs.

STEEL-MAKING. A Modern Electric Steel Plant (Ein neuzeltliches Elektro-Stahlwerk), K. Kerpely. Giesserei-Zeitung (Berlin), vol. 27, no. 4, Feb. 15, 1930, pp. 101-102, 4 figs. Description of new plant in Campia Turzii, Roumania, for production of iron and steelwire and wire products of all kinds; reasons are given for installing electric furnace, which is 3-phase arc type with capacity of 1 to 1.5 tons, equipped with 500-kva. 3-phase oil transformer with automatic hydraulic electrode regulation of Brown-Boveri system.

ELECTRIC GENERATORS

MANUFACTURE. Electric Heating Assists in Machine Assembly, E. L. Doty. Elec. Jl., vol. 27, no. 1, Jan. 1930, pp. 49-50, 3 figs. Electric space heaters are particularly useful in securing accurate expansion and compression adjustments necessary in erecting large structural machines, viz., water-wheel generators.

VENTILATION. Ventilation of Revolving-Field Salient-Pole Alternators, C. J. Fechheimer. Am. Inst. Elec. Engrs.—Advance Paper, no. 48, for mtg. Jan. 27-31, 1930, 25 pp., 49 figs. Experimental and analytical studies; in experimental study model of hard wood was used, with multiple of vent ducts of normal width of ⅜ in. each in stator, slots and teeth being of approximately average width; in appendices equations for resistance and volume distribution and method for allowing air flow through holes back of core for various fans and for external pressure drops, and equations for parabolic volume distribution, are given.

ELECTRIC LIGHT AND LIGHTING

ULTRA-VIOLET. Simulating Sunlight—A New Era of Artificial Lighting, M. Luckiesh. Am. Inst. Elec. Engrs.—Advance Paper, no. 33, for mtg. Jan. 27-31, 1930, 6 pp., 9 figs. Facts regarding health-giving properties of ultra-violet radiation from sun are outlined and production of similar radiation by artificial means is discussed; methods of obtaining desired rays are mentioned; information is given on new tungsten-filament mercury-vapour lamp which has been developed to provide this radiation conveniently and safely.

ELECTRIC LINES

CALCULATION. Development by Series of Impedance of Line with Uniformly Distributed Characteristics (Sur le développement en série de l'impédance d'une ligne uniforme), J. R. Pomey. Revue Générale de l'Electricité (Paris), vol. 27, no. 5, Feb. 1, 1930, pp. 163-164. Mathematical analysis; it is stated that calculations developed are of importance in telephone lines employing repeater relays with regard to quality of production.

ELECTRIC LINES, HIGH TENSION

LIGHTNING. Lightning Investigation on Transmission Lines, W. W. Lewis and C. M. Foust. Am. Inst. Elec. Engrs.—Advance Paper, no. 38, for mtg. Jan. 27-31, 1930, no. 38, 12 pp., 19 figs. Surge voltage investigations for 1926 and 1927 are briefly reviewed, and data given for 1928 and 1929; cathode-ray oscillograph has played prominent part in last two years work, and about 115 oscillograms have been obtained; new instruments were introduced in 1929; personnel, equipment, and technique are available for complete solution of problem, by means of field and laboratory studies.

Lightning Voltages on Transmission Lines, R. H. George and J. R. Eaton. Am. Inst. Elec. Engrs.—Advance Paper, no. 35, for mtg. Jan. 27-31, 1930, 8 pp., 11 figs. During summer of 1929 studies were made to determine characteristics of voltage transients set up on transmission lines by lightning; cathode-ray oscillograph and number of surge voltage recorders were connected to 140-kv. transmission line in such manner that lightning disturbances were recorded by instruments; equipment used, and results obtained from season's investigations. Bibliography.

Lightning Investigation on 220-Kv. System of the Pennsylvania Power and Light Company (1928 and 1929), N. N. Smeloff and A. L. Price. Am. Inst. Elec. Engrs.—Advance Paper, no. 51, for mtg. Jan. 27-31, 1930, 10 pp., 18 figs. Results of investigation on 114 circuit miles of 220-kv. system located in territory where severe lightning storms are frequent; number of devices was used successfully, such as surge-voltage recorders, cathode-ray oscillographs, electric field-intensity recorders, and lightning-stroke recorders; data on operating characteristics and constants are given. Bibliography.

Lightning on Transmission Lines, J. H. Cox, E. Beck. Am. Inst. Elec. Engrs.—Advance Paper, no. 22, for mtg. Jan. 27-31, 1930, 9 pp., 16 figs. Work done and results obtained in Norinder-type cathode-ray oscillograph studies of lightning on transmission lines during 1929; various installations and methods of test are described; wave shapes recorded are illustrated and their meaning discussed; preliminary description of artificial lightning investigation, using portable 1,000,000-volt surge generator and portable cathode-ray oscillograph.

GROUNDING. The Effect of Corona on Ground-wire Protection of Power Transmitting Circuits, E. M. Hunter. Gen. Elec. Rev., vol. 33, no. 2, Feb. 1930, pp. 100-103, 2 figs. Early calculations neglecting corona; test results indicate better protection; subsequent calculations accounting for corona; check of test results.

ELECTRIC MACHINERY

THEORY. Generalized Theory of Electrical Machinery, G. Kron. Am. Inst. Elec. Engrs.—Advance Paper, no. 9, for mtg. Jan. 27-31, 1930, 18 pp., 29 figs. Electric machinery is analyzed from new point of view; analytical quantities like magnetizing current, armature reaction leakage flux, transient reactance are not introduced; only such quantities are used as actually exist in machine at one particular load; thereby theory of electric machinery is expressed in terms of minimum possible number of quantities; no hypothetical currents or fluxes are used and no actual physical quantity is left out. Bibliography.

INDUCED VOLTAGES. Induced Voltage of Electrical Machines, L. V. Bewley. Am. Inst. Elec. Engrs.—Advance Paper, no. 11, for mtg. Jan. 27-31, 1930, 11 pp., 5 figs. Discussion of general equation for induced voltage of electric machines having parallel coil sides, and which includes as special cases single and polyphase induction motors, synchronous generators, d.c. generators, synchronous converters, and static transformers; tables and curves for comparing effects of skew, pitch, distribution, and phase connection harmonic reduction factors; method for summing finite series of distribution summations is given in Appendix.

SYNCHRONOUS. Three-Phase Short Circuit Synchronous Machines, R. E. Doherty and C. A. Nickle. Am. Inst. Elec. Engrs.—Advance Paper, no. 5, for mtg. Jan. 27-31, 1930, 15 pp., 16 figs. Analysis is divided into three parts covering; case of short circuit at no-load when resistance is negligible in determining magnitude of current and same case where resistance does affect magnitude of current, and case of short circuit under load when resistance is negligible. Bibliography.

Transient Torque-Angle Characteristics of Synchronous Machines, W. V. Lyon and H. E. Edgerton. Am. Inst. Elec. Engrs.—Advance Paper, no. 21, for mtg. Jan. 27-31, 1930, 13 pp., 10 figs. Problem of sudden load on non-salient pole alternator is solved by integraph for enough different conditions so that performance of practically any machine of this type may be easily predicted from compiled results; simplest type of equation representing an ideal synchronous machine is solved; integraph is capable of solving problems of much more complicated nature than those presented.

ELECTRIC MANUFACTURING PLANTS

TESTING LABORATORIES. A High Voltage Testing Laboratory. Engineer (Lond.), vol. 149, no. 3865, Feb. 7, 1930, pp. 155-157, 10 figs. In cable-testing department of Siemens Brothers and Co., of Woolwich, English Electric Co., has installed plant for testing single-core cables for working pressures up to 76 kv. to earth suitable for 132-kv. three-phase systems and of three-core cables designed to operate at 66-kv. between cores.

ELECTRIC MOTORS

ALTERNATING CURRENT, TRANSIENTS. Power Transients in A.-C. Motors—A Watt-Oscillograph Study, L. E. A. Kelso and G. F. Tracy. Am. Inst. Elec. Engrs. —Jl., vol. 49, no. 2, Feb. 1930, pp. 102-106, 10 figs. Application of watt-oscillograph to study of performance of rotating a.c. machinery under transient conditions; some typical transient cases are presented with view to illustrating possibilities of such application; analysis of film taken with watt-oscillograph yields not only power but current and power factor also; watt elements of oscillograph developed for this study; method of analyzing oscillograms is given.

INDUCTION. Quiet Induction Motors, L. E. Hildebrand. Am. Inst. Elec. Engrs. —Advance Paper, no. 3, for mtg. Jan. 27-31, 1930, 5 pp., 4 figs. Magnetic noise in induction motors is caused by vibration of magnetic parts; torsional vibration is caused by unbalanced windings or applied voltages; vibration of stator by distortion from circular shape results from presence of other simple combinations of fields; magnetic noise produced by motor can be predicted from qualitative analysis of air-gap field and stiffness of parts. Bibliography.

ELECTRIC NETWORKS

ALTERNATING CURRENT. Low-Voltage A.C. Networks of the Standard Gas and Electric Company's Properties, R. M. Stanley and C. T. Sinclair. Am. Inst. of Elec. Engrs.—Jl., vol. 49, no. 2, Feb. 1930, pp. 116-120, 2 figs. Low-voltage a.c. network utilizing secondary network protectors adopted Standard Gas and Electric Co. for service in areas of high-load density; system has been applied to cities of second class and smaller, although load density in certain cases is high; each individual installation was made after study of conditions involved; underlying principles of designs and operating experience.

DESIGN. Calculation of Diversity Factor (Die Berechnung des Verschiedenheitsfaktors), S. Prochoroff. Elektrotechnische Zeit. (Berlin), vol. 51, no. 7, Feb. 13, 1930, pp. 230-232, 2 figs. Nomogram is developed on basis of probability calculations and maximum load of network is determined under assumption that its value is maintained for certain duration, for instance, adjusting time of relay; load impulses of short duration are not considered.

LOAD CONTROL. Controlling Power Flow with Phase-Shifting Equipment, W. J. Lyman. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 2, Feb 1930, pp. 97-101, 8 figs. Case of load control where closed rings or parallel path circuits are involved, are discussed; principles of voltage phase angle and power flow; actual tests performed on very large interconnected system with 250-mi. transmission loop, involving five power companies and total generator capacity well over 1,000,000 kw.; results are analyzed for checking theoretical against actual values and forming basis for solution of problems of similar nature.

VOLTAGE REGULATION. Induction Regulators, A. H. Altmann. AEG Progress (Berlin), vol. 6, no. 1, Jan. 1930, pp. 1-5, 7 figs. Theoretical considerations; external and internal apparent power; magnetizing current; vector diagrams of ideal single-induction regulator; circle diagram showing construction of actual rotor current; connection diagrams; design of induction regulator.

ELECTRIC POWER SUPPLY

BERLIN. Past and Future Developments of Power-Supply System of BEWAG (Entwicklung der Strombersorgung der BEWAG in Vergangenheit Gebenwart und Zukunft), M. Rehmer and E. Krohne. Elektrizitaetswirtschaft (Berlin), vol. 29, nos. 499 and 500, Jan. 1, 1930, pp. 1-7 and Jan. 2, 1930, pp. 36-39, 15 figs. Review and historical development up to 1929; future developments are to be simplification of 30-kv. distribution network and of 100-kv. loop line; it is contemplated to introduce distribution system applying two voltages for districts of highload density and one with three voltages and small transformer stations for low-load density sections; comparison with some American systems.

CHICAGO. System Connections and Inter-Connections Chicago District, G. M. Armbrust and T. G. LeClaid. Am. Inst. Elec. Engrs.—Advance Paper, no. 13, for mtg. Jan. 27-31, 1930, 15 pp., 13 figs. Characteristics of Chicago territory and power system which has been planned to supply this region; extent and nature of territory, loads, and service standards are outlined; 25-cycle and 60-cycle systems, including voltages up to 132 kv. are described; protective and control features are discussed, as well as operating procedure; service record and developments being planned for future.

PHILADELPHIA. Fundamental Plan of Power Supply in the Philadelphia Area, R. Bailey. Am. Inst. Elec. Engrs.—Advance Paper for mtg., Jan. 27-31, 1930, no. 14, 8 pp., 6 figs. Service requirements for various kinds of load demands in Philadelphia area; territory served and distribution of load in it; fundamental plan of system of Philadelphia Electric Co.; various reasons and conditions which has led to development of system are explained; interconnections with other electric utilities; operating procedure, relating particularly to allocation of load to various generating stations, reserve capacity, and frequency control; basic principles followed.

ELECTRIC SWITCHGEAR

METAL-CLAD. The Metal-Clad Switchgear at State Line Station, A. M. Rossman. Am. Inst. Elec. Engrs.—Advance Paper for mtg. Jan. 27-31, 1930, 4 pp., 8 figs. Two-kv. metal-clad outdoor-type switchgear is described; design is departure from customary engineering practice in that all live parts are immersed in oil and enclosed in metal housings with each phase in its own independent compartment; switchgear insures maximum safety to operating and maintenance personnel and reduces construction costs for power-station switching; design is adapted to mass production.

ELECTRIC TRANSFORMERS

AUTO. Inversion Currents and Voltages in Auto-Transformers, A. Boyajian. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 2, Feb. 1930, pp. 142-145, 5 figs. Analysis of 7,500-kv.a., three-phase units at Detroit for various possible connections and conditions of operation; novel theory and method of auto-transformer circuit representation is developed; fact is brought out and explained that fault currents to ground on secondary lines of auto-transformer may be larger when stepping-up than when stepping-down which prediction has been verified by test.

DISTRIBUTION. Distribution Transformers and Their Connections, J. Showalter. Elec. News, vol. 33, nos. 4 and 5, Feb. 15, 1930, pp. 46-48, Mar. 1, 1930, pp. 43-45 and (discussion) 45-46, 21 figs. General outline of equipment and its characteristics; terms used in transformer practice; standard voltage needed; expensive wattless current; single-phase service; three-phase distribution; protection; transformer performance.

LOADING. Loading Transformers by Temperature, V. M. Montsinger. Am. Inst. of Elec. Engrs.—Advance Paper for mtg. Jan. 27-31, 1930, no. 27, 15 pp., 21 figs. Safe loading of transformers by temperature requires not only knowledge of thermal laws but also knowledge of what is safe temperature limit to be maintained; author questions advisability of loading transformers continuously up to present A.I.E.E. Limit of 105 deg. cent. hot spot and argues for establishment of differential of 10 deg. cent. between limit to be maintained continuously by means of overloads and limit to be reached occasionally with rated load.

OPERATION. Operating Transformers by Temperature, W. M. Dann. Am. Inst. Elec. Engrs.—Advance Paper, no. 2, for mtg. Jan. 27-31, 1930, 4 pp. Proposal, sponsored by Transformer Subcommittee of Committee on Electrical Machinery, which is intended to serve as guide in operating transformers by temperature rather than in accordance with their nameplate ratings.

TAP CHANGERS. Tap Changing Under Load for Voltage and Phase-Angle Control, H. B. West. Am. Inst. Elec. Engrs.—Advance Paper, no. 7, for mtg. Jan. 27-31, 1930, 7 pp., 17 figs. Connections employed and equipment used in connection with static transformers for purposes of voltage and phase-angle control are briefly discussed.

ELECTRIC WELDING

STRUCTURES UNDER DYNAMIC STRESS. Electrically Welded Structures Under Dynamic Stress, M. Stone and J. G. Ritter. Am. Inst. Elec. Engrs.— Advance Paper, no. 17, for mtg. Jan. 27-31, 1930, 6 pp., 18 figs. It is shown that by properly considering such factors as maximum working stress, residual welding stresses, and stress concentration, it is possible to weld any type of structure without fear of trouble; many cases of such structures are described as to their method of fabrication and success of operation.

ARC. Cathode Energy of the Iron Arc, G. E. Doan. Am. Inst. Elec. Engrs.—Advance Paper, no. 6, for mtg. Jan. 27-31, 1930, 9 pp. Available energy at cathode of iron arc for welding in air and disbursement of this available energy to cathode process are analyzed.

RESISTANCE. Resistance Welding, B. T. Mottinger. Am. Inst. Elec Engrs.—Advance Paper, no. 36, for mtg. Jan. 27-31, 1930, 7 pp., 11 figs. Paper is directed to engineers interested in application of resistance welding to industries; discussion foreshadows some of latest tendencies of development; it deals with some fundamentals of design though it is not written as complete treatise on subject, nor especially for those engaged in designing of resistance welding machinery.

ENGINEERING

CANADA. Engineering Achievements of 1929. Can. Machy. (Toronto), vol. 40, no. 26, Dec. 26, 1929, pp. 223 and 227-233, 19 figs. Engineering accomplishments in Canada are outlined; Ambassador Bridge as well as tunnel between Windsor and Detroit; Welland Canal; Chats Falls and Back River power development; nickel research; Hudson Bay Railway; oil-burning locomotives.

EVAPORATION FORMULAE

STREAM-FLOW. A New Method of Estimating Stream-Flow Based Upon a New Evaporation Formula, J. A. Folse. Carnegie Inst. of Wash.—Pub., no. 400, 1929, 230 pp., 21 maps on supp. plates. Part I deals with investigation of laws of evaporation from observations on Great Lakes; how investigation was made and how final evaporation formula was derived; evaporation formula derived is used in establishing formulae of relationship between daily flow of perennial stream in moist climate and rainfall, snowfall, vapour pressure, air temperature, and wind velocity observed on its watershed.

F

FANS

TESTING. Tests of Disc and Propeller Fans, A. I. Brown. Heat, Piping and Air Conditioning, vol. 2, no. 2, Feb. 1930, pp. 157-163, 1 fig.

FEEDWATER TREATMENT

SOFTENING. Some Notes on Water Softening, J. Gordon. Gas World (Lond.), vol. 92, no. 2370, Jan. 4, 1930, pp. 10-13 (Coking section), 1 fig. Power plant at Lambton consists of six Lancashire boilers, each 30 ft. long by 8 ft. in diameter; four are heated by gas and waste heat from ovens and two are hand-fired; total evaporation of water per day is about 50,000 gal.; boiler water tests; softening inside boiler; chemistry of softening by caustic soda; lime and soda ash treatment; amount of sludge and of evaporation. Paper read before Coke Oven Managers' Assn.

Water Softening Practice in Great Britain, D. Brownlie. Combustion, vol. 1, no. 7, Jan. 1930, pp. 39-44, 10 figs. Description of improved types of reagent feed gear and combined lime and soda ash and base-exchange treatment, chief features for boiler feedwater; description of typical installation and four systems that are used most intensively.

FLIGHT

[*See Gliding.*]

FLOW OF GASES

NATURAL GAS PIPE LINES. Determination of Friction Coefficient of Long-Distance Gas Pipe Lines (Zur bestimmung der Reibungszahl in. Ferngasleitungen), E. Guman. V.D.I. Zeit (Berlin), vol. 74, no. 4, Jan. 25, 1930, pp. 107-110, 3 figs. Theory of flow of gas through pipe lines; results of six months observations and measurements on flow of natural gas through 48 km. of 25.3 cm. pipe line between Sarmas and Turda, in Roumania; measurements indicate variation of friction coefficient with Reynolds number.

FORGINGS

HEAT TREATMENT. Heat Treating in a Modern Forge Shop, M. J. Gorman. Heat Treating and Forging, vol. 16, no. 1, Jan. 1930, pp. 41-42, 3 figs. Description of heat-treatment equipment of Moore Drop Forging Co., which consists of four continuous ranging in sizes from 13 to 21 ft. long and 6 ft. wide; handling quenching mediums; typical results of heat treatment; hardening forging and header dies.

FURNACES

METALLURGICAL. The Application of Pulverized Fuel to the Malleable Iron Foundry. Iron and Steel Industry (Lond.), vol. 3, no. 4, Jan. 1930, pp. 120-121 and 128, 2 figs. Use of pulverized coal in melting furnaces for production of malleable cast iron, and savings obtained discussed; advantages of using pulverized coal in annealing furnaces.

NORMALIZING. Recent Developments in Normalizing Sheet Steel, E. S. Lawrence. Fuels and Furnace, vol. 8, no. 2, Feb. 1930, pp. 191-194. Discussion of major mechanical, mechanical-metallurgical, and metallurgical improvements of continuous sheet-normalizing furnace; correctly constructed cooling chamber wherein time and rate of cooling sheets are emphasized. Abstract of Paper presented before Am. Soc. Steel Treating.

FOUNDRIES

RESEARCH IN. Research in the Foundry, E. E. Griest. Am. Foundrymen's Assn.—Trans. and Bul., vol. 1, no. I, Jan. 1930, pp. 79-86.

G

GAUGES

ELECTRIC. Electric Precision Gauge of Great Accuracy. Machy. (N.Y.), vol. 36, no. 6, Feb. 1930, pp. 435-436, 3 figs. Description of electric gauge designed to meet demand for accurate gauging device that has minimum of moving parts and that will permit routine gauging operations to be conducted with greater rapidity; with amplification factor of 10,000, this gauge, independent of human touch, makes possible measurements to 0.00005 in.; gauge may be used for both inside and outside measuring.

The Electric Gauge, A. V. Mershon, J. W. Matthews and B. C. Waite, Jr. West. Machy. World, vol. 21, no. 1, Jan. 1930, pp. 10 and 30, 3 figs. Description of electric gauge developed to meet demands for accurate gauging device for quantity inspection purposes; gauge is independent of human sense of touch; simple and rapid to manipulate; amplification factor 10,000 times.

OPTICAL. Optics in Measuring Technique (Die Optik in der Messtechnik), Berndt. Deutsche Optische Wochenschrift (Weimar), vol. 16, no. 1, Jan. 5, 1930, pp. 2-4, 15 figs. Description of instrument for gauging machine tools, drills, screw threads, gear teeth, etc.

Optical Measuring Machines. Engineering (Lond.), vol. 129, no. 3344, Feb. 14, 1930, pp. 236-237, 11 figs. Measuring machine made by C. Zeiss, of Jena, dispenses with use of micrometer screws and gauge blocks, which are subject to slow molecular changes, and of hydraulic feelers, which must exert some pressure, and is based upon comparator principle; optical system of optimeter is explained by diagram.

GEOLOGY

ONTARIO. Geological Structure of the Southwest Portion of the Sudbury Basin, E. S. Moore. Can. Min. and Met.—Bul. (Montreal), no. 216, March 1930, pp. 351-361, 2 figs. Ore deposits in basin are attributed to faulting that split basin parallel to its long axis; various early geological reports are cited; outline of geological history of area; dikes and other minor intrusions; discussion of faulting; nickel-copper and zinc-lead deposits are mentioned. Bibliography.

GLIDING

SAILPLANING. Sailplaning, H. Hartshell. Aero Digest, vol. 16, no. 1, Jan. 1930, pp. 113-115, 3 figs. Prediction of how sailplaning may be practised in future and principles in which sailplane may be flown; monoplane glider is chosen with high aspect ratio and safely controllable flying speed as low as 20 to 25 m.p.h.; velocities acting on sailplane are calculated; forces and velocities projected in transverse vertical plane; no glider built like airplane can soar effectively.

GOLD ORE TREATMENT

LABORATORY INVESTIGATIONS. Testing Ores for Recovery of Gold Content, O. D. Welsch. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 3, Jan. 17, 1930, pp. 60-61, 1 fig. Discussion of laboratory investigations to determine process or combination of processes to which ore sample submitted will lend itself most profitably; processes most generally used for recovery of gold are amalgamation, cyanidation by agitation or by percolation, gravity concentration, and concentration by flotation.

CANADA. Gold Milling in Canada, J. J. Denny. Can. Min. and Met.—Bul. (Montreal), no. 213, Jan. 1930, pp. 105-120, 7 figs. Purpose of paper is to present brief outline of Canadian practice in milling of gold-bearing ores, not, however, including those auriferous ores which are mined and milled primarily for their content of some other metal; tabular gold production statistics; mill structure; crushing; classification; concentration; chlorination; flow sheets are given. Advance publication for mtg. Mar. 1930.

H

HANGARS, CONCRETE

MONTREAL. Montreal Has First Concrete Arch Hangar Built in North America. Contract Rec. (Toronto), vol. 44, no. 5, Jan. 29, 1930, p. 94. Description of hangar at Point aux Trembles Airport, Montreal, Que., measuring 100 by 100 ft.; 11 arch ribs have reinforced-concrete beams tying them across bottom of each arch; total cost $39,000.

HARBOUR IMPROVEMENTS

FORT CHURCHILL, MANITOBA. Harbour Development Works at Fort Churchill on the Hudson Bay Railway. Engineering (Lond.), vol. 49, no. 3340, Jan. 17, 1930, p. 71. Works in hand include construction of wharf 1,600 ft. in length, of concrete cribwork, with depth of water permitting vessels of 30 ft. draft to lie alongside at low tide; work to be done includes dredging of area 1,600 ft. by 60 ft. to depth of 32 ft. below low-water level, requiring removal of quarter of million yards of material.

HARDNESS TESTING

BRINELL. Brinell Indentations with Different Testing Loads (Brinelleindruecke bei verschiedener Prueflast), P. W. Doehmer. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 1, Jan. 1930, pp. 31-32, 3 figs. Author claims that for practical testing purposes, conversion of ball-impression diameters obtained with specific load into diameters obtained with other loads is not possible without knowledge of N-value of material; it is simpler to actually measure desired ball-impression with other testing loads instead of calculating it; some results of practical calculations are listed.

HEAT CONDUCTIVITY

MEASUREMENT. Measurement of Heat Conductivity by Suitable Variation of Kohlrausch Method for High Temperatures (Waermeleitfaehigkeitsmessung nach einer fuer hohe Temperaturen geeigneten Variation der Kohlrausch-schen Methode), R. Holm. Zeit. fuer Technische Physik (Leipzig), vol. 10, no. 12, 1929, pp. 621-623, 2 figs. Description of method, measurements on platinum and control test on Holm's contact theory.

HEAT-INSULATING MATERIALS

PROPERTIES OF. Heat Insulators, E. Griffiths. Dept. of Scientific and Indus. Research—Food Investigation (Lond.), no. 35, 1929, 96 pp., 37 figs. Definition of thermal conductivity; design of apparatus for conductivity tests; temperature measurements; typical example of thermal conductivity experiment; convection currents in granular materials; description of materials tested, and values of their thermal conductivity; moisture absorbing capacity of insulating materials; temperature of combustion of various insulators; calculation of heat flow in complex structures; determination of specific heats of insulating materials.

HEAT TRANSMISSION

PARALLEL PLATES TO FLOWING AIR. Heat Transfer to Air Between Two Plane Parallel Plates in Eddy Current (Der Waermeuebergang an Luft zwischen zwei ebenen parallelen Platten bei Wirbelstroemung), W. Haucke. Archiv. fuer Waermewirtschaft (Duesseldorf), vol. 11, no. 2, Feb. 1930, pp. 53-58, 7 figs. Experimental study of heat transfer of two parallel plates 48 mm. apart to air current flowing between them; evaluation of results.

HEAT TREATMENT

Economics of. Economics and Economies of Heat-Treating, R. M. Keeney. Am. Mach., vol. 72, no. 5, Jan. 30, 1930, pp. 225-227, 3 figs. Selection of source of heat for industrial heat-treatment of metals discussed; items influencing overall cost; various applications of annealing furnaces in Connecticut; fuels for annealing brass; measurable progress has been made in atmospheric control of electric furnaces for bright-annealing copper; for annealing nickel-silver stampings, electric furnaces increasingly used. Abstract of paper read before Am. Soc Steel Treating.

HOISTS

Electric, for Freight Cars. Special Safety Devices Built into Electric Freight Car Hoist. Iron Trade Rev., vol. 86, no. 3, Jan. 16, 1030, pp. 44-45, 1 fig. Description of 200-ton freight car hoist recently erected for new power station of Dusquesne Light Co., Pittsburgh; complete machinery and all auxiliary apparatus enclosed in structural steel shaft tower of guide type erected at end of elevated railroad siding; gates, counter-weights and hydraulic buffers provided on 50-ft. hoist with capacity of 400,000 lbs.

HYDRAULIC TURBINES

Draft Tubes. Diffusors of Modern Hydraulic Turbines (I moderni diffusori nelle turbine idrauliche), G. Buechi. Energia Elettrica (Milan), vol. 6, no. 12, Dec. 1929, pp. 1201-1210, 32 figs. Outline of Prasil theory of draft tubes; theory and features of conical draft tubes, circular diffusors, Kaplan curved axis diffusor, White and Moody hydraucone regainer; Voith, Escher Wyss curved and partitioned draft tubes, etc.

Propeller. On the Hydraulic Efficiency of Propeller Turbines and Propeller Pumps. F., Numachi. Soc. of Mech. Engrs.—Jl. (Tokyo) vol. 32, no. 152, Dec. 1929, pp. 483-493, 15 figs. Paper deals with theoretical study of variations of hydraulic efficiency of propeller turbine and of propeller pump with respect to following coefficients: peripheral velocity of rotation; axial velocity of flow, and ratio of of outer diameter to inner diameter of wheel; graphical representations of results service to give information to select suitable values of coefficients. (In English.)

HYDRO-ELECTRIC POWER DEVELOPMENTS

British Columbia. Developing Northern B.C. Power, D. Anderson. Elec. News (Toronto), vol. 39, no. 1, Jan. 1, 1930, pp. 37-40, 8 figs. Subsidiary of Power Corp. of Canada is developing power resources in Prince Rupert region; new plant at Falls River to have ultimate capacity of 32,000 hp.; resources of district; Falls River development; general layout; transmission-line data; 8,000 ft. Skeena river crossing.

Canada. Canada Adds 378,400 Hp. Elec. World, vol. 95, no. 7, Feb. 15, 1930, p. 342. Canada added 378,400 hp. to its hydro-electric installations in 1929, bringing total for whole Dominion to 5,727,600 hp., according to annual review prepared by Dominion Water Power and Reclamation Service, issued as Bulletin no. 1353; list of hydro plants completed in 1929 or planned for early start is given.

Current Canadian Hydro-Electric Development. Chem. and Industry (Lond.), vol. 49, no. 3, Jan. 17, 1930, pp. 56-58. Estimated hydro-electric power in Canada, at close of 1928, was 5,349,232 hp., as compared with 2,327,955 in 1918; general summary of more recent activities, covering work which has just been completed, under construction, and major projects contemplated in immediate future.

Hydro-Electric Progress in 1929. Elec. News (Toronto), vol. 39, no. 1, Jan. 1, 1930, pp. 29-36, 11 figs. Many large developments commenced in 1929; over 378,000 hp. placed in operation, making Canada's total 5,727,600 hp.; short notes on progress arranged according to provinces.

Quebec. Progress at Chute à Caron, S. Rivett. Power House (Toronto), vol. 23, no. 23, Dec. 5, 1929, p. 31, 4 figs. Brief discussion of development carried on by Alcoa Power Co.; sketch of hydro-electric development work being carried out at Chute-à-Caron, Quebec.

HYDRO-ELECTRIC POWER PLANTS

Construction. Construction Plant and Methods for Hydro-Electric Installations. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 8, Oct. 1929, p. 2049. Abstract of committee report; shipping schedules to control arrival of different parts of machinery as needed; erection schedules for waterwheels, generator and electrical installations.

Montreal. Back River Power Development Has Many Special Features. Contract Rec. (Toronto), vol. 44, no. 7, Feb. 12, 1930, pp. 163-169, 11 figs. General layout and description of equipment of 120,000-hp plant of Montreal Island Power Co., near Montreal; details of 12,000 hp. movable blade turbines for variable flow and head and of 12 sided welded stator frames; turbines are rated 7,150 to 12,000 hp. between 18 and 26 ft. head; notes on electric equipment.

Ice Control. Forming of Troublesome Ice Prevented by Jets of Compressed Air, J. S. Meehan. Compressed Air Mag., vol. 35, no. 3, Mar. 1930, pp. 3045-3049, 13 figs. Description of equipment and practice at Station No. 1, of Turner Falls Power & Electric Co. on Connecticut River, in township of Montague, Mass.; line of 1¼ in. pipe hung on wall of canal at depth of 12 ft.; brass plugs with 1-64 in. holes at 3 ft. intervals deliver air bubbles at average pressure of 10 lb., preventing formation of shell ice; other parts of intake system were protected in similar manner.

I

ICE

Heat Conductivity of. Thermal Conductivity of Ice Between 0 and 125 Deg. (Die Waermeleitfaehigkeit von Eis zwischen 0 and 125 deg.), M. Jakob and S. Erk. Zeit. fuer die gesamte Kaelte-Industrie (Berlin), vol. 36, no. 12, Dec. 1929, pp. 229-234, 5 figs. Report from experiments made to determine conductivity of ice; thermo-elements were frozen in cakes of ice and constants computed from readings; table of constants obtained and description of apparatus used.

IMHOFF TANKS

Design. Results of Tests on Sewage Treatment, H. E. Babbitt and H. E. Schlenz. Univ. of Illinois Eng. Experiment Station.—Bul., no. 198, Dec. 3, 1929, 95 pp., 38 figs. Report on tests to study sludge digestion in shallow Imhoff tanks with view of reducing expense and difficulties of deeper tanks; effectiveness of roofs in hastening drying of sludge; drawing sludge into drying beds in cold weather; factors affecting sedimentation and reduction of suspended particles in sewage; heating sludge compartments of Imhoff tanks to increase quantity of gas produced; effect of circulating tank-liquor in preventing scum formation.

IMPACT TESTING

Notched-Bar. Stresses in Fatigue Impact Testing (Zur Frage der Beanspruchung beim Dauerschlagversuch), A. Thum and S. Berg. V.D.I. Zeit. (Berlin), vol. 74, no. 7, Feb. 15, 1930, pp. 200-204, 12 figs. Condensed report on experimental study made at Darmstadt Institute of Technology; effect of elastic hysteresis and notching on magnitude of stresses caused by impact with special reference to maximum stresses; lines of force at abrupt changes in cross-sections of specimens; diagrams of distribution of stress intensities at notches; photographs of fractures. Full report published in Bul. No. 331, Forschungsarbeiten auf dem Gebiete des Ingenieurwesens.

INDUSTRIAL PLANTS

Purchased vs. Generated Power. A Discussion Comparing Costs of By-product and Purchased Power, A. L. Rogers. Power, vol. 71, no. 7, Feb. 18, 1930, pp. 253-255, 4 figs. Comparative cost data is given for two industrial plants, one in which process steam is used for power generation and for mill purposes and other in which management purchases electric power, but all steam required for manufacturing purposes is generated in low pressure boiler plant.

INLAND WATERWAYS

Operation. Waterway Transportation from the Viewpoint of Operation, T. Q. Ashburn. Am. Soc. Civil Engrs.—Proc., vol. 52, no. 3, Mar. 1930, pp. 546-560, 4 figs. Discussion and comparison of private, contract, and common carriage, as well as common carriage under joint rail and water rates, on three types of inland waterways: Lake type (Great Lakes and connecting channels), per ton-mile cost, 0.64 mill; lock-canal type, closed by ice part of year (New York Barge Canal), per ton-mile cost, 3 mills; and river type, adequate channel open year round (Mississippi River, St. Louis and South), per ton-mile cost, 1.07 mills.

INTERNAL-COMBUSTION ENGINES

Efficiency. Energy Charts for the Calculation of Standard Efficiencies of Internal Combustion Engines. W. J. Goudie. Instn. of Engrs. and Shipbldrs. in Scotland, vol. 72, 1928-1929, pp. 440-485 and (discussion) 485-495, 14 figs. Energy chart described in this paper is attempt to provide graphical substitute for involved calculation, by means of which absolute thermal efficiency of any internal-combustion engine can be obtained to close degree of approximation by simple process of projection; it takes account fully of effect, on ideal efficiency of fuel composition, air-fuel ratio, variation of specific heat.

Problems. Problems of Internal-Combustion Engine (Problemedes Verbrennungsmotors), L. Richter. Zeit. fuer Technisches Physik (Leipzig), vol. 10, no. 11, 1929, pp. 573-579, 5 figs. Theory and practice; ignition and combustion; two and four-cycle engines; exchange of mixture and heat transmission; cycle processes; combustion mechanical and thermal problems of power-engine design. Bibliography.

[*See also Airplane Engines; Diesel Engines.*

IRON AND STEEL PLANTS

Germany. Blast Furnaces and Metallurgical Work of Essen-Borbeck (Hochofen- und Huettenwerk Essen-Borbeck). V.D.I. Zeit. (Berlin), vol. 74, no. 2, Jan. 11, 1930, pp. 33-43, 17 figs. Description of Krupp iron and steel plant having two blast furnaces; 70 to 80 per cent of ore arrive by water; details of river harbour and railroad ore-handling equipment; blast furnaces having useful capacity of 660 cu. m.; charging equipment and steam electric power plant equipped with two 14,000-kw. turbo-generators.

Sweden. Sandvik, one of the World's Foremost Makers of Fine Steel. Swedish Export (Stockholm), vol. 14, no. 1, Jan. 1930, pp. 4-6, 3 figs. Description of steel works in Sweden manufacturing highly refined grades of Bessemer and open-hearth steel, seamless steel tubes, wire rods, tool steel, and cold rolled steel, plant makes broadest strip of cold rolled, hardened steel so far manufactured, 600 mm.; and has record for making thinnest strip, 0.003 mm. (In English.)

IRON CASTINGS

Chilled, Hardness Testing of. Hardness Testing of Hard Chill Castings (Die Pruefung der Haerte von Schalenhartguss), O. Keune. Kruppsche Monatshefte (Essen), vol. 10, Dec. 1929, pp. 200-203, 2 figs. Features of Brinell and scleroscope hardness-testing methods; it is shown, on basis of various measurements, that last-mentioned method gives widely deviating results in case of hardness testing of hard-chill castings; on the other hand test results check in case of hardened steel; method for calibration of scleroscope.

J

JIGS AND FIXTURES

Welded. Advantages of Arc Welded Jigs, Fixtures, and Machine Tools Demonstrated in Westinghouse Manufacturing Plant, J. R. Weaver. Automotive Industries, vol. 62, no. 6, Feb. 8, 1930, pp. 186-188, 5 figs.

L

LATHES

Cutting Pressures. Measurement of Cutting Pressure on Lathe by Means of Electric Dynamometer (Schnittdruckmessungen an der Drehbank mit einer elektrischen Messdose), W. Mauksch. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 8, no. 2, July 8, 1929, pp. 130-136, 6 figs. Practical application of condenser principle for measuring of cutting pressure and its practicability is indicated by experiments by which laboratory equipment and standard lathe have been used.

LEAD

Properties of. Physical Constants of Lead, J. E. Harris. Am. Soc. for Steel Treating —Trans., vol. 17, no. 2, Feb. 1930, pp. 282-287. Constants given are atomic weight, isotopes, allotropic modifications, density, crystal form, melting point, boiling point, critical temperature, heat of fusion, heat of vaporization, thermal conductivity, electrical resistivity, electrode potential, viscosity, optical properties, tensile strength, elongation and hardness, elastic limit and Youngs' modulus. Bibliography. Recommended practice committee release.

LEVELLING

Indirect Method. Indirect Levelling Method on River Bank, A. G. Ashford. Can. Engr., vol. 58, no. 6, Feb. 11, 1930, pp. 209-210, 2 figs. Method of surveying eroded river bank where direct measurements were impossible on account of liquid state of mud; target was tied at centre of cord, twice length of longest line, and being operated by assistant at each end of cord, was held with its base just touching mud at each point, at which it was desired to get level.

LIGHTNING ARRESTERS

Thyrite. Thyrite: a New Material for Lightning Arresters, K. B. McEachron. Gen. Elec. Rev., vol. 33, no. 2, Feb. 1930, pp. 92-99, 15 figs. Characteristics of ideal arrester are outlined; thyrite and its properties and operating characteristics are discussed; equipment is described. Paper read before Am. Inst. Elec. Engrs.

LOCOMOTIVE TERMINALS

Toronto. Toronto Locomotive and Car Facilities, Canadian Pacific Railway. Can. Ry. (Toronto), no. 382, Dec. 1929, pp. 733-734, and 740-743, 8 figs. Brief illustrated description of locomotive house, coaling plant, turntable, steel water tank, building, passenger-car yards, etc., being built by Canadian Pacific Railroad; general layout map illustrating locomotive and car facilities.

LOCOMOTIVES

Diesel. Completion of the First 1,200-Hp. Diesel Locomotive for the German Governmental Railroad (Die Fertigstellung der ersten 1,200 PS-Diesel-Lokomotive fuer die Reichsbahn), Witte. Glasers Annalen (Berlin), vol. 106, no. 3, Feb. 1, 1930, pp. 35-39, 3 figs. Diesel compressed-air-2-C-2 locomotive is described in some detail; Diesel engine is of M.A.N. type 1,000 to 1,200-hp. at 450 r.p.m.; water cooling is used; driving gear operated by compressed and heated air of 7 atmos. and 350 deg.; length of engine is 75.8 m., weight in operating conditions is 126 tons; simplicity of operation is featured.

Developments in Diesel Traction. Gas and Oil Power (Lond.), vol. 25, no. 292, Jan. 2, 1930, pp. 63-64, 1 fig. Recent development in locomotive history has been effected by German State Railways, who have constructed 1,200-hp. Diesel-engined locomotive employing compressed-air drive; air pressure of 103 lbs. per sq. in., heated by exhaust of Diesel, and then actuates normal locomotive cylinders; comparison with Diesel-electric drive; table giving operating cost; comparison of performance of Diesel-electric and steam locomotives.

Railway Traction by Oil-Engines, A. E. L. Chlorlton. Instn. Civil Engrs. —Minutes of Proc. (Lond.), no. 4716, 1929, 32 pp. 10 figs. Discussion of Diesel propulsion for railroad traction; comparison of efficiencies; suitability for railway service; table giving comparative prices of coal, fuel oil, and Diesel oil per ton; comparative test results of several Diesel locomotives; table of costs of operation of steam and oil-electric locomotives; typical oil-electric equipments.

ELECTRIC. French Railway Adopts 5,300-Horsepower Electric Locomotives, M. Japiot. Ry. Age, vol. 88, no. 7, Feb. 15, 1930, pp. 427-429, 3 figs. Paris, Lyons, Mediterranean railway using unusually large single-cab electric passenger experimental locomotives of singular design; engines designed to fit particular needs of high-speed service on Mont-Cenis line; electrical apparatus; driving wheels, 63 in.; total locomotive wheelbase 68 ft. 3 in.; total weight of locomotive 351,000 lbs.; continuous rating of tracting force 28,700 lbs.; maximum speed 81 m.p.h.

HIGH-PRESSURE. British Build 4-6-4 Type Locomotive of Novel Design. Ry. Age, vol. 88, no. 8, Feb. 22, 1930, pp. 473-474, 4 figs. Engine just completed on London and North Eastern Railway to designs of H. N. Gresley is for express passenger work, has four compound cylinders and boiler pressure is 450 lbs. per sq. in.; cylinders, 12 by 20 by 26 in.; weight of engine, in working order, 103.6 tons; total engine wheelbase 40 ft. 0 in.; rated maximum tractive force 40,040 lbs.; description of boiler auxiliaries, running gear and tender.

IMPROVEMENTS IN. On the Question of Improvements in the Steam Locomotive (Subject VI for Discussion at the eleventh Session of the International Railway Congress Association), H. N. Gresley. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 11, no. 11, Nov. 1929, pp. 2689-2819, 23 figs. Contents of report divided into following chapters: increased boiler pressure; superheating; feed-water heating; air preheating; valves and valve gear; arrangement of front end.

On the Question of Improvements in the Steam Locomotive (Subject VI for discussion at the eleventh session of the International Railway Congress Association) T. Bals. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 11, no. 11, Nov. 1929, pp. 2421-2497, 29 figs. Increased pressures and high superheats; improvements in design of superheaters and parts connected with superheating; feed water heating and air preheating; improvements of valve gears.

NEW TYPES. On the Question of Locomotives of New Types; in Particular Turbine Locomotives and Internal Combustion Motor Locomotives (Subject V for Discussion at the Eleventh Session of the International Railway Congress Association), Cossart. Int. Ry. Congress Assn.—Bul. (Brussels), vol. 11, no. 11, Nov. 1929, pp. 2397-2420. Discussion of turbine and Diesel locomotives; high-pressures locomotives; general considerations; report covers Belgium, France, Italy, Portugal, Spain, and their Colonies.

REPAIR SHOPS. Canadian National Builds Large Shop at Montreal. Ry. Age, vol. 88, no. 9, Mar. 1, 1930, pp. 549-555, 7 figs. Canadian National Railways build locomotive erecting and machine shop at Point St. Charles, Montreal; building is 1,056 ft. long by 265 ft. wide; shop incorporates many unique features of construction, arrangement and operation.

VALVE GEARS. 4-6-0 Type Four-Cylinder Locomotive Fitted With Beardmore-Caprotti Valve Gear. Engineering (Lond.), vol. 129, no. 3342, Jan. 31, 1930, pp. 132-134, 8 figs.; see also Engineer (Lond.), vol. 149, no. 3864, Jan. 31, 1930, p. 132, 13 figs. Details of modification carried out on London and North-Eastern Railway system; whole of valve gear works in oil baths; closing of steam and exhaust valves is controlled by springs.

Method for Standardization of Valve Gear of Reciprocating Steam Locomotives (Ein weg zur Vereinheitlichung der Steuerungen gefeuerter Kolben Dampflokomotiven), K. Ewald. Glasers Annalen (Berlin), vol. 106, nos. 1 and 2, Jan. 1, 1930, pp. 3-7, and Jan. 15, pp. 15-19, 6 figs. Jan. 1: Mathematical design analysis pertaining to Walschaert Heusinger valve gear. Jan. 15: Standardized piston valves; internal and external valve gears.

LUBRICATION

RESEARCH. Friction-Coefficient Research, L. Ollmer. Soc. Automotive Engrs.—Jl., vol. 26, no. 1, Jan. 1930, pp. 67-86, 18 figs. Experimental result of different investigators correlated and principles common to all tests in which frictional resistance depends primarily upon fluid shear established; behaviour during starting; viscosity determinations; maximum contact factors; journal test discussed; little research directed to friction losses as found in automobile-crankshaft bearings; lack of efficient lubrication of drives responsible for colossal motive-power losses; reasonably reliable method for predetermining certain kinds of friction losses.

THEORIES. Modern Theories of the Structure of Lubricating-Oil Films (Neuere Theorien ueber den Aufbau des Schmiero elfilmes), A. V. Blom. Petroleum (Berlin), vol. 25, no. 46, Nov. 13, 1929, (Supp.), pp. 3-6, 2 figs.

M

MACHINE TOOLS

CUTTING PRESSURE. Researches on the Cutting Force, M. Okoshi. Inst. Phys. and Chem. Research—Sci. Papers (Tokyo), vol. 12, no. 220, Jan. 15, 1930, pp. 167-192, 22 figs. Description of ordinary methods for measuring cutting force of machine tools, including brake, work-done, balance, diaphragm, and capacity-change methods; new measuring methods outlined include preliminary test, strength of quartz, planing-tool dynamometer, improved lathe-tool dynamometer, improved drill dynamometer; improved milling-tool dynamometer; switch mechanism; method of measuring piezoelectric charge.

[*See also Automobile Plants.*]

MACHINERY

MANUFACTURE, TEMPERATURE EFFECT ON LARGE PIECES. Influence of Difference in Temperature on Change in Shape of Large Workpieces (Der Einfluss von Waermeunterschieden auf die Formaenderung grosser Werkstuecke), C. Krug. Werkstattstechnik (Berlin), vol. 24, no. 1, Jan. 1, 1930, pp. 11-13, 4 figs. Relations between temperature difference, degree of density and precision of fit in machining are mathematically analyzed.

TUNGSTEN CARBIDE OVERLAYS. Welded-On Overlays in Machine Design, M. C. Smith. Am. Mach., vol. 72, no. 6, Feb. 6, 1930, pp. 265-267, 11 figs. Discussion of how tungsten carbide and similar materials can be deposited by welding torch or arc to form local wear-resistant surfaces on machine parts.

WELDED, DESIGN OF. General Principles of Welded Designs, A. M. Candy. Nebraska Blue Print, vol. 29, no. 4, Jan. 1930, pp. 114-117, 12 figs. Maximum advantages inherent in using arc welding can only be gained by designing work specifically for welding; designs of welded piece for bedplate, welded rotor and other parts are discussed; continuity of beam.

MATERIALS HANDLING

CARGO HANDLING. Lowers Cost of Cargo Handling, H. E. Stocker. Mar. Rev., vol. 60, no. 3, Mar. 1930, pp. 50-51 and 60, 7 figs. Types of mechanical cargo-handling equipment recently installed at New York terminal of American Hawaiian Steamship Co., where total of approximately 600,000 tons of cargo are handled annually.

LUMBER MILLS. Hoisting Apparatus and Bulk Conveyors (Hebezeuge und Massenfoerderer). Foerdertechnik und Frachtverkehr (Wittenberg), vol. 23, no. 4, Feb. 14, 1930, pp. 74-77, 15 figs. Discussion and description of hoisting and transport apparatus used in saw mills and lumber storage yard; tower slewing, travelling crane, log handling cranes, and conveyors are shown in some detail.

SHEET-METAL WORKING. Materials Handling in the Stamping Plant, A. K. Burditt and W. F. Schaphorst. Metal Stampings, vol. 3, no. 2, Feb. 1930, pp. 113-117, 8 figs. Description of various types of trucking equipment and platforms, together with their specific applications and advantages for handling and storage of stampings.

METALS

CUTTING, THEORY OF. Cutting Theory (Ueber die Zerspannungstheorie), H. Friedrich. Maschinenbau (Berlin), vol. 9, no. 2, Jan. 16, 1930, pp. 47-51, 2 figs. Methods of scientific investigation and application; comparison with modern methods of research for cutting resistance and cutting speed, limiting values as basis for conformity of theory and practice.

DRAWING. The Testing of Thin Sheet Metal, E. Siebel and A. Pomp. Metallurgist (Supp. to Engineer, Lond.), Jan. 31, 1930, pp. 6-7. With view to overcoming difficulties of ordinary tensile test as applied to thin sheet metal, and at same time affording measurements of ductility of material, authors have devised new form of cupping which is described. Review of paper indexed in Engineering Index, 1929, from Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforchung, vol. 11, 1929.

ELONGATION. Significance and Evaluation of Elongation of Metals (Zur Deutung und. Bewertung der Bruchdehnung bei Metallen) W. Kuntze. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 1, Jan. 1930, pp. 14-22, 17 figs. It is claimed that maximum elongation is not proof of resistance to rupture; results of tests in which influence of elongation under bending and torsion, and its relation to strain hardening and decay of material relations between elongation and notch touchness, etc., are determined.

FATIGUE. Derivation of Vibration Strength from Tensile and Cohesive Strength (Berechnung der Schwingungsfestigkeit aus Zugfestigkeit und Trennfestigkeit), W. Kuntze. V.D.I. Zeit. (Berlin), vol. 74, no. 8, Feb. 22, 1930, pp. 231-234, 3 figs.

The Failure of Steel Castings and Forgings Through Fatigue. Nor-East Coast Inst. of Engrs. and Shipbldrs.—Advance Paper (Newcastle-Upon-Tyne), for mtg. Jan. 24, 1930, 14 pp., 4 figs. on supp. plates. Rather loose application of term fatigue is discussed; one type of fracture only is classed as fatigue fracture others described being barred; erroneous conceptions of fatigue are discussed and its mechanism is described; metallurgical and mechanical aspects are dealt with, and ways avoiding fatigue are suggested; number of examples of fatigue failures are briefly described.

TEMPERATURE EFFECTS. Effect of Small Changes in Temperature on the Properties of Bodies, M. D. Hersey. U.S. Bur. of Standards—Jl. of Research, vol. 4, no. 1, Jan. 1930, pp. 137-156. After reviewing usual methods of solution, general mathematical treatment of problem is given, from which two additional methods are derived that can sometimes be usefully applied: (1) simple calculation, made possible by theory of dimensions, which does not require detailed formula for property in question; and (2) combined theoretical and experimental solution, in which experimental factors have been reduced to minimum; stiffness of steel spring is taken as example.

WEAR TESTING. Recent Results of Research on Wear of Materials (Neuere Ergebnisse der Abnutzungsforschung), M. Fink. V.D.I. Zeit. (Berlin), vol. 74, no. 3, Jan. 18, 1930, pp. 85-87, 4 figs. Features of Amsler wear-testing machines; results of recent research in Germany, Great Britain, and United States on such subjects as rusting of steel, mechanical production of oxidation in rolling, rail corrugations, etc.

MINES AND MINING

CANADA. Mineral Production of Canada during 1929. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 2, Jan. 10, 1930, pp. 34-35. Brief statistical review, with estimated total value of $303,876,000 for metallics, fuels, miscellaneous non-metallics, clay products, and other structural materials.

New Record Output in Canada, S. J. Cook. Eng. and Min. Jl., vol. 129, no. 3, Feb. 8, 1930, pp. 141-142. General review for 1929, with production estimated; new records were established in output of asbestos, cement, clay products, copper, gold, gypsum, lime, nickel, petroleum, salt, stone, sand and gravel, and zinc; total increase in value of mineral output in Canada in 1929 as compared with figures for 1928 was $28,887,000.

N

NICKEL INDUSTRY

BRIEF REVIEW. Nickel, T. W. Gibson. Eng. and Min. Jl., vol. 129, no. 3, Feb. 8, 1930, p. 123. Brief review for 1929; mines of Sudbury district furnish 10 per cent of world's supply; balance is chiefly from New Caledonia; Canadian properties are largely owned and operated by International Nickel Co. of Canada, Ltd. which recently took over properties of Mond Nickel Co.; about 2,000,000 tons smelted in 1929, with nickel content about 58,000 tons; notes on construction activities; exports of 2 companies from New Caledonia show decrease in production.

NITRIDATION

EUROPEAN PRACTICE. Nitriding of Steel in European Practice, J. W. Urquhart. Heat Treating and Forging, vol. 16, no. 1, Jan. 1930, pp. 48-50 and 52. Ammonia-heat, method of producing intense local hardness is reviewed; aluminum content is indispensable; hardness of case is comparable to bort; properties of nitrided steel surface; low temperature advantages of nitriding; depth of nitrided zone; preparation of nitralloy steels; steels suggested for nitriding; firing boxes for nitriding; electric resistor furnace used in Europe for nitriding.

NOTCHED BARS

STRESSES IN. Danger of Notched Sections (Ueber die Kerbgefahr), W. Kuntze. V.D.I. Zeit. (Berlin), vol. 74, no. 3, Jan. 18, 1930, pp. 78-82, 11 figs. Report from Materials Testing Office of Germany giving results of new series of tests; effect of shape and depth of notch on stresses; variable effect of maximum notch stresses in tension and bending upon resistance of test specimen; value of quality of materials for safety of notched sections.

NOZZLES

DISCHARGE. Coefficients of Flow of Standard Nozzles, H. Mueller and H. Peters. Nat. Advisory Committee for Aeronautics—Tech. Memo., no. 549, Jan. 1930, 6 pp., 3 supp. figs. Results of experiments in hydraulic laboratory of Munich Institute of Technology; two standard nozzles for pipes of 2.76 and 6.89 in. in diam. tested, using water as flowing medium; results compared with those of Jacob, Kretzschmer, and Witte; with use of pitot tubes in irregular flow, calculations made with greater error; present flow coefficients apply only to plants geometrically similar to author's.

O

ORE DEPOSITS

THEORY. Relation of Electrode Potentials of Some Elements to Formation of Hypogene Mineral Deposits, B. S. Butler and W. S. Burbank. Am. Inst. Min. and Met.—Trans. 1929, pp. 341-353 and (discussion) 353-356. Paper is attempt to set forth some of geologic and chemical relations of minerals, with particular reference to some ore deposits in Colorado that show sharp changes in mineralogy and metal content of primary ore with change in depth. Article indexed in Engineering Index, 1929, from Am. Inst. Min. and Met.—Tech. Pub. 166, Feb. 1929.

ORE TREATMENT

PROGRESS IN. Progress in Cyaniding and Ore Dressing, A. James. Eng. and Min. Jl., vol. 129, no. 1, Jan. 9, 1930, pp. 13-16, 2 figs. General remarks of filtration, roasting, fine grinding, slime leaching, and flotation; comments on mining investments and other subjects.

P

PAVEMENTS, ASPHALT

Economic Value. Economic Value of Asphalt Surfacing, G. W. Craig. Can. Engr. (Toronto), vol. 58, no. 5, Feb. 4, 1930, pp. 187-188. Surfacing of cement concrete pavements; asphalt wearing surfaces; maintenance; surfacing of concrete bases; ultimate cost at end of 40 yrs. Paper read before Eighth Annual Asphalt Paving Conference.

Construction. Paving Plant Equipment and Methods, J. W. Devitt. Can. Engr. (Toronto), vol. 58, no. 4, Feb. 4, 1930, pp. 193-194. Improvements in construction and operation of asphalt paving plants; paper presented at annual asphalt paving conference; road drying units; types of oil burners; power for plant operation; mixing boxes; proportioning materials; adding mineral filler; heating asphaltic cement. Paper read before Eighth Annual Asphalt Paving Conference.

PAVEMENTS, CONCRETE

Curing. The Arlington Curing Experiments, L. W. Teller and H. L. Bosley. Pub. Roads, vol. 10, no. 12, Feb. 1930, pp. 213-225 and 28, 16 figs. Effects of various curing treatments on concrete pavement slabs; tests show that curing condition affects slab length; black coating caused higher temperatures; early burlap and transverse joints reduced cracking; subgrade friction; slab curling; movement of slabs due to swelling of subgrade; method of curing and surface hardness; loss of moisture; effect of steel reinforcing on frequency and width of cracks.

PAVEMENTS, GRANITE

Heavy Traffic. Granite and Cement for Heavy Traffic, E. A. Slater. Surveyor (Lond.), vol. 77, no. 1983, Jan. 24, 1930, p. 88. Author recommends special type of road consisting of concrete foundation and granite sett paving.

PENSTOCKS

Jet Dispersers. Hydraulic Jet Dispersers for the Arapuni Power Plant. Engineering (Lond.), vol. 129, no. 3342, Jan. 31, 1930, p. 137, 2 figs. Pipe lines are each being fitted at lower end with Glenfield energy disperser; by means of these, energy of 3,000 cusecs of water escaping from each of jets, and amounting to nearly 50,000 hp. will be harmlessly disposed of, water falling on surface of river in form of heavy rain.

PIPE

Oxyacetylene Welding. Fabrication of Welded Piping Designs. Linde Air Products Publication, published by Union Carbide and Carbon Corp., 30 E. 42nd St. New York, N.Y., 84 pp., 35 figs. Procedure control for oxyacetylene welding line joints in steel or wrought iron pipe; procedure control for fabrication of oxwelded pipe fittings; templet layout for pipe fittings; tables for estimating costs.

PIPE, CONCRETE

Centrifugal Casting. Centrifugally Cast Concrete Pipe for Water Supply (Schleuderbetonrohre fuer Trinkwasserversorgung), Keller. Gas und Wasserfach (Munich), vol. 72, no. 46, Nov. 16, 1929, pp. 1115-1118, 5 figs. Composition of mix and methods of casting of Hume, Vianini, and other patented types of centrifugal concrete pipe; results of tests, including resistance to chemical corrosion; systems of reinforcement and joints.

PIPE FITTINGS

Standardization. Influence of Standardization in the Heat and Power Industry, A. M. Houser. Mech. Eng., vol. 52, no. 3, Mar. 1930, pp. 210-211. Author illustrates functioning of sectional committees organized under procedure of American Standards Association by reference to activities of Sectional Committee on Pipe Flanges and Fittings; refers more specifically to standardization of cast-iron flanged fittings as example of this work.

X-Ray Analysis. X-Raying Large Steel Castings, A. St. John and H. R. Isenburger. Iron Age, vol. 125, no. 7, Feb. 13, 1930, pp. 499-501, 9 figs. Further information given about X-ray inspection of heavy cast-steel pipe fittings for high pressure service, some of which were recently examined on job instead of at laboratory; castings for 1,200-lbs. pressure steam plant; how current for X-rays was produced; X-ray pictures hard to reproduce.

PIPE JOINTS

Welded. Welded Line Joints for Steel Pipe, W. I. Gaston. Iron Age, vol. 125, no. 6, Feb. 6, 1930, pp. 435-437, 9 figs. Types of welded line joints used today, are considered from standpoints of strength, flow conditions and economy; Vee butt joint is all-purpose joint; square ends preferred on thin walls; closed Vee usable for low-pressure work; couplings sometimes welded to prevent leaks; use of liners.

PLATES

Rectangular, Stresses in. Transversal Oscillations of Rectangular Plates with Special Regard to Buckling (Transversalschwingungen rechteckiger Platten mit besonderer Ruecksicht der Knickung), H. Grauers. Ingeniors Vetenskaps Akademien (Stockholm), no. 98, 1929, 68 pp., 16 figs. Thorough treatise on strains in rectangular plates subjected to various loadings; it is shown how to find magnitude of evenly distributed external forces, that make equilibrium labile and conditions to which edges are subjected; formulae are derived and diagrams are worked out for various conditions. (In German.)

PRESSURE VESSELS

Welding. Welded Boilers, E. R. Fish. Am. Welding Soc.—Jl., vol. 8, no. 10, Dec. 1929, pp. 24-35, 6 figs. General discussion of methods of welding boilers, both high- and low-pressure; including forge or hammer welding, autogenous or fusion welding, electric resistance welding, and thermit welding; X-ray examination; defects in line welds, girth seams or structural joints may be detected by use of stethoscope.

PUMPING STATIONS

Costs. Pumping and Filtration Costs of a Small Town Water System, W. S. Davis. Am. Water Works Assn.—Jl., vol. 22, no. 1, Jan. 1930, pp. 99-102. Operating cost data for low-service and high-service centrifugal pumps, pumping against head up to 340 ft., serving 1,000 customers.

Electric vs. Steam. Comparative Data on Steam and Electric Pumping Stations, J. F. Laboon. Am. Water Works Assn.—Jl., vol. 21, no. 12, Dec. 1929, pp. 1640-1648. Electrically driven pumps are most advantageous where reservoir or standpipe storage is available; electric power economical at Wheeling, W. Va.; results of Nashville, Tenn.; comparison between Nashville and Erie plants; costs of electric and steam-driven plants.

Piping. Pump Discharge Headers and Pump Piping for Water Works Stations, F. G. Cunningham. Am. Water Works Assn.—Jl., vol. 22, no. 1, Jan. 1930, pp. 1-12 and (discussion) 12-16. Meeting maximum demand; functions of good discharge system; header layouts and details; suction connections; check valves. Indexed in Engineering Index, 1929, from Mun. News, July 1929.

Electric, Newport, R.I. Changes in Power for Pumping at Newport, R.I., H. Watson. New England Water Works Assn.—Jl., vol. 43, no. 4, Dec. 1929, pp. 410-415. Replacement of steam pumping equipment with modern electrically driven centrifugal pumps of double-suction type, with motors mounted on common base; motors are all of squirrel-cage induction type operating directly from 2,300-volt line, at which voltage all current is metered; maximum pump capacity 6 m.g.d. against head of 158 ft.

PUMPS

Feedwater. Centrifugal Pump as a Feedwater Pump (Die Kreiselpumpe als Kesselspiesepumpe), L. Klein and Gossmann. Foerdertechnik u. Frachtverkehr (Wittenberg), vol. 22, nos. 24 and 25, Nov. 22 and Dec. 6, 1929, pp. 459-461 and 486-487, 14 figs. Advantages and suitability of centrifugal pumps as feedwater pumps; design of several makes of pumps is shown; details of stuffing boxes.

PUMPS, CENTRIFUGAL

Design. Studies of Regulation, Theoretical and Actual Pumping Heads of Centrifugal Pumps (Untersuchungen ueber Regelung, theoretische und workliche Foerderhoehe von Kreiselpumpen), W. Siebrecht. V.D.I. Zeit. (Berlin), vol. 74, no. 3, Jan. 18, 1930, pp. 87-88, 3 figs. Excerpts from Bulletin No. 321 of Forschungsarbeiten auf dem Gebeite des Ingenieurwesens, on tests made at Braunschweig Institute of Technology, on regulation by admitting of air into suction of pump, effect of various positions of buckets, etc.; discussion of Pfleiderer method of computation for design of centrifugal pumps.

Deep Well. Deep-Well Centrifugal Pumps (Tiefbrunnen-Kreiselpumpen), W. Schulz. V.D.I. Zeit. (Berlin), vol. 74, no. 8, Feb. 22, 1930, pp. 235-238, 9 figs. Hydraulic characteristics of deep wells, particularly drilled wells, and adaptation of pump construction to meet special conditions of deep well pumping; features of semi-axial types of multi-stage pumps with as many as 12 stages, manufactured by Klein, Schanzlin & Becker; description of several devices for protection of pumps against sand carried in water pumped; economic considerations.

PUNCH PRESSES

Carry-Motion. The Carry-Motion Press and its Work, F. R. Daniels. Machy. (N.Y.), vol. 36, no. 5, Jan. 1930, pp. 354-358, 6 figs. Features of press equipped with magazine feed, multiple dies, and automatic transfer machanism are described; tooling arrangement for hinges; forming hinge-pin eye; broaching inner faces of hinge-pin eyes; operations for making formed bushings; materials used for tools.

Q

QUANTITY SURVEYING

Uniform System. Uniform System of Quantity Survey. Can. Engr. (Toronto), vol. 58, no. 7, Feb. 18, 1930, pp. 229-230. Features of proposed American system to aid in development of scientific method of quantity survey for purpose of bringing about more economical results in estimating, bidding and contract awarding procedure.

R

RAIL MOTOR CARS

Maintenance and Repair. Maintaining Rail Motor Cars on the New Haven, E. O. Whitfield. Ry. Mech. Engr., vol. 104, no. 1, Jan. 1930, pp. 28-34, 16 figs. Description of methods used in administration of automotive division of New York, New Haven and Hartford; unit replacement programme, in which complete spare assemblies are kept on hand ready for application; number, type and age of rail motor cars in service; record of failures chargeable to different mechanisms during 1928 and 1929; tools and fixtures for repair work.

North America. The 1929 Rail Motor-Car Orders, C. B. Peck. Ry. Age, vol. 88, no. 1, Jan. 4, 1930, pp. 99-101, 5 figs. Capacity of engine units has reached 500 hp.; trend continues toward greater power plant capacities and weights; power-plant capacity of rail motor cars, United States and Canada; list of orders for rail motor cars and trailers arranged alphabetically by purchasers.

Oil-Electric. F.I.A.T. Rail Car with Airless-Injection Engine. Engineering (Lond.), vol. 129, no. 338, Jan. 3, 1930, pp. 7-9, 8 figs. There is seating accommodation for 8 persons in first-class and for 30 persons in third-class compartment; engine is of six-cylinder type operating on four-stroke cycle; cylinders have bore of 7.84 in. and piston stroke is 10.7 in.; generator is of separately excited type, and has six main and six commutating poles.

Steam. Oil-Fired, Superheated Steam Rail Motor Cars (Heissdampftriebwagen mit Oelfeuerung), O. Guenther. V.D.I. Zeit. (Berlin), vol. 74, no. 4, Jan. 25, 1930, p. 118, 1 fig. Type developed by Esslingen Machine Works of Venezuelan railroads; car weighs 35 kg. tons and has 42 seats; trailer has 32 seats and weighs 16 tons; Venezuelan oil was used on test stand for average loading at 30.2 km. per hr.; 130 kg. was fired without leaving residues; steam is superheated 340 to 380 deg. cent.; 135 hp. developed, yielding tractive effort of 1,205 kg.; operating speed approximately 50 km. per hr.

Switzerland. Rail Motor Car of Bern-Neuenburg Railroad (Die Triebwagen der Bern-Neuenburg-Bahn), A. E. Mueller. Elektrotechnische Zeit. (Berlin), vol. 50, no. 51, Dec. 19, 1929, pp. 1841-1844, 7 figs. Design, details and first operating experience of 1,440-hp. 15,000-volt 16 ⅔-cycle car, weighing 59.5 tons, 20.9 m. long and carrying 5 tons of passengers and freight, continuous speed is 50 km. per hour.

RAILROAD ELECTRIFICATION

Buenos Aires. Buenos Aires Electrified Interurban System. Traction Shop and Roadway, vol. 3, no. 1, Jan. 1930, pp. 1-2, 3 figs. Central Argentine Railway completes electrification in order to improve service and economize on operating expenses; description of three routes; new rolling stock; map of Buenos Aires interurban system.

France. Electrification of the French Railroad, D. C. Woods. Commerce Reports, no. 2, Jan. 13, 1930, pp. 113-115. Development of interest in electrification; 1930 programme; progress and prospects of Midi railway; Paris-Orleans second in progress; state railway, Paris, Lyons and Mediterranean.

United States. Much Construction Work Features Heavy Electric Traction in 1929. Elec. Ry. Jl., vol. 74, no. 1, Jan. 1930, pp. 46-47, 1 fig. Brief discussion of railroad-electrification work carried on during past year; table of installations of electrical operation of steam railroads in United States; curves showing mileage of steam railroads electrified and total weight of active electric locomotives.

RAILROAD REPAIR SHOPS

Equipment. Old Engines and Generators Rebuilt for Compressors, F. E. Estling. Power, vol. 71, no. 5, Feb. 4, 1930, pp. 169-170, 3 figs. Brief description change-over in Canadian National Railways shops in Winnipeg, Canada; steam engines to compressors and generators to motors for driving them.

RAILROAD SIGNALS AND SIGNALING

Central Control. Trains Operate by Signal Indications on the Paducah and Illinois, J. H. Schubert. Ry. Age, vol. 88, no. 2, Jan. 11, 1930, pp. 141-143, 5 figs. Engire railroad, involving five junctions and bridge over Ohio River, included in dispatcher-controlled system; operation of dispatcher-controlled signal system; outside construction.

RAILROAD STATIONS

Baggage Service. New Baggage Service Sheds of the Austerlitz Railroad Station in Paris (Les nouvelles halles du service des messageries de la gare de Paris-Austerlitz), C. Dantin. Génie Civil (Paris), vol. 96, no. 2, Jan. 11, 1930, pp. 29-33, 7 figs. General layout of tracks and platforms; sheds 300 m. long, by 60 m. wide, have reinforced-concrete arch ribs of 16 to 25 m. in span; structural details of roof arches; equipment and method of operation of baggage service.

RAILROAD TERMINALS, FREIGHT

Construction. Economical Methods on Freight Depot Construction. Am. Contractor, vol. 51, no. 7, Feb. 15, 1930, pp. 11-15, 5 figs. Report on methods used in construction of Pittsburgh freight terminal project; track facilities on site used to expedite steel erection and material delivery.

Hamilton, Ont. Canada Steamship Lines, Limited, New Terminals at Hamilton. Can. Ry. (Toronto), vol. 382, Dec. 1929, pp. 785-786, 1 fig. Canada Steamship Lines, Ltd., has under construction freight terminal on waterfront property being located conveniently for movement of freight by ship, rail and truck; general description of new terminal; layout and cross-section illustration of new terminal.

REFRACTORY MATERIALS

Heat Conductivity. Measuring Thermal Conductivity of Refractory Materials at High Temperatures (Waermeleitfachigkeitsmessungen und Feuerfesten Materialien bei Hohen Temperaturen), A. Eucken and H. Laube. Tonindustrie Zeitung (Berlin), vol. 53, no. 91, Nov. 14, 1929, pp. 1599-1602, 4 figs. Spherical heating element wound with platinum wire is used; material to be tested is made into two hemispheres surrounding heating elements; thermocouples are embedded in concentric grooves and lead wires are brought to surface at considerable distance from junctions.

RAILROAD TRAIN CONTROL

Great Britain. Train and Traffic Control on the L.N.E.R. Ry. Gaz. (Lond.), vol. 52, no. 2, Jan. 10, 1930, pp. 48-50, 1 map. Control methods are widely adopted on London and North Eastern Railway; particulars of controls, arranged in order in which they were opened, are given.

RAILROADS

Single Track. The Operation of Single Lines of Railway. Ry. Gaz. (Lond.), vol. 52, no. 2, Jan. 10, 1930, pp. 59-60, 2 figs. and no. 3, Jan. 17, 1930, pp. 84-85, 1 fig. Jan. 10: Continued description of methods in use in India; Indian requirements as to token instruments. Jan. 17: Illustrated description showing how double line of railway can, with single-line methods of operation, be made almost equivalent of four tracks; unidirectional single-line method. (Continuation of serial.)

REFRIGERATING COMPRESSORS

Multiple Effect. A Study of Multiple Effect Compression, H. Sloan. Refrigeration, vol. 47, no. 1, Jan. 1930, pp. 39-42, 6 figs. Illustrated description of multiple-effect cycle; calculating capacity; table giving multiple-effect compressor and receiver data; illustrating operation.

REFRIGERATING ENGINEERING

Present Trends. Present Trends in the Practice of Refrigerating Engineering, F. Ophuls. Refrig. Eng., vol. 19, no. 1, Jan. 1930, pp. 1-2 and 16. Brief review of past developments in refrigeration; increasing scope of art; general outlook in refrigerating engineering; brief consideration of Mechanical Refrigeration Safety Code.

REFRIGERATING PLANTS

Pumps. Pumps for Ice Plants and Refrigerating Plants, J. J. Alden. Southern Power Jl., vol. 48, no. 2, Feb. 1930, pp. 79-87, 11 figs. Discussion of pumping requirements for ice-making plants; variable speed drives; curves showing combined capacity of centrifugal pumps operating parallel; direct acting steam pumps; provision for testing; straight line diagram for use in solution of pump problems; angle of impeller vanes.

REFRIGERATION

Heat Transmission and. Heat Transmission and Refrigeration, C. S. Keevil. Refrig. Eng., vol. 19, no. 2, Feb. 1930, pp. 41-44, 3 figs.

Low-Temperature. Developments in Application of Low-Temperature Brine Freezing. Cold Storage (Lond.), vol. 32, no. 381, Dec. 19, 1929, pp. 391-392, 3 figs. Development of quick freezing brings nearer, for all connected with production, preparation, marketing, and consumption of perishable foods, facility which bids fair to place them on even footing with producers and manufacturers of non-perishable goods; survey of quick-freezing methods.

Periodical Absorption. Periodical Absorption Refrigerating Machines (Ueber Periodische Absorptionskaeltemaschinen), K. Linge. Zeit. fuer die gesamte Kalte-Industrie, (Berlin), vol. 8, no. 36, August 1929, pp. 149-157, 8 figs. Influence of condensation and evaporation temperature on dry and wet absorption machines is investigated for commercial machines and ideal machines; results show that dry machines using caclium chloride ammonia have marked advantage over wet machines using hydraulic ammonia.

Tendencies in. A Survey of Tendencies in Modern Refrigerating Design, B. C. Oldham. Cold Storage (Lond.), vol. 32, no. 382, Jan. 16, 1930, pp. 8-11, 3 figs.

REFRIGERATORS

Electric. The Heat Pump, T. G. N. Haldane. Elec. Rev. (Lond.), vol. 105, no. 2718, Dec. 27, 1929, pp. 1161-1162. Suggested economical method of producing low-grade heat from electricity; reversible heat engine has been treated simply as heat pump, most familiar type of which is refrigerator.

REFUSE DISPOSAL

United States. Garbage—Is it a City Asset or Liability? West. City, vol. 6, nos. 1 and 2, Jan. 1930, pp. 42-43 and Feb., pp. 42-43. Condensed information on collection and disposal methods and costs as practiced in 23 representative western municipalities ranging from metropolitan cities to cities of less than 10,000 population. (Continuation of serial.)

REFUSE INCINERATORS

Baltimore. Reclaiming and Disposing of a City's Trash, W. Viessman. Am. City, vol. 42, no. 1, Jan. 1930, pp. 109-110, 5 figs. Features of five new municipal Davis-type incinerators built by city of Baltimore at cost of $500,000; salvaging equipment and methods; operating data for plants; revenue from salvaged material, 1928.

RESEARCH

Ontario. Progress of the Ontario Research Foundation, O. E. Ellis. Can. Machy. (Toronto), vol. 40, no. 26, Dec. 26, 1929, pp. 277-282, 3 figs. Important part which Ontario Research Foundation already bears in growth and development of province of Ontario; metallurgical division; new laboratories; hardness testing machines; furnace room; photomicrograph equipment; search for existing information; results depend on industry.

RESERVOIRS

Discharge Measurements. Graphical Methods for Measuring of Discharge, etc. (Procéde graphique pour la mesure des débits, etc.), C. Chaudoir. Génie Civil (Paris), vol. 96, no. 2, Jan. 11, 1930, pp. 44-45, 3 figs. Author outlines graphical method of determining discharge from water supply distribution reservoirs, or larger equalizing reservoirs, from continuous graphical record of water-level heights in such reservoirs.

Protection. Enforcement with other Beverages, J. F. Jackson. New England Water Works Assn.—Jl., vol. 43, no. 4, Dec. 1929, pp. 402-408 and (discussion) 408-409. Discussion of laws enforced in respect to bathing in water-supply reservoirs; brief reports on some Connecticut lawsuits.

RESIN, SYNTHETIC

Testing. Service Tests on Moulded Resinoid Products, K. Ripper and P. Schmidmeier. Plastics, vol. 6, no. 1, Jan. 1930, pp. 11-13, 2 figs. Simultaneous exposure to chemical fumes and electric current show advantages of resinoids over metals and ceramic products.

RETAINING WALLS

Design. General Formulae for Computation of Thrust and Bearing of Earths (Formules générales pour calculer la poussée et la butée des terres), L. Ravier. Génie Civil (Paris), vol. 95, no. 26, Dec. 28, 1929, pp. 647-647, 3 figs. Anonymous discussion of articles indexed from issue of Dec. 14, treating of application of retaining-wall formulae to construction of hollow type reinforced-concrete seawalls; numerical examples.

General Formulae for Computation of Thrust and Bearing of Earths (Formules générales pour calculer la poussée et la butée des terres), L. Ravier. Génie Civil (Paris), vol. 95, nos. 24, Dec. 14, 1929, pp. 596-597, 2 figs. Author presents transformation of Poncelet analysis from which formulae of Coulomb and Rankine follow as particular cases.

ROAD DESIGN

Curves. Superelevation of Road Curves (La technique des virages relevés sur les routes), R. Bégard. Génie Civil (Paris), vol. 96, no. 3, Jan. 18, 1930, pp. 59-60, 2 figs. Comparative discussion of French formula by Galatoire-Malégarie and State of Ohio or Voshell formula; graphical charts for computing superelevation required.

ROAD MACHINERY

Use of. Use of Mechanical Equipment in Highway Construction Work, T. W. Allen. Mfrs. Rec., vol. 97, no. 2, Jan. 9, 1930, pp. 58-61, 9 figs. Examples of modern road-building machinery and influence upon speed of machinery construction.

ROAD MATERIALS

Bituminous, Great Britain. Development of Tar Roads in Great Britain, W. E. Cone. Gas. Jl. (Lond.), vol. 189, no. 3476, Jan. 1, 1930, pp. 31-32. Road experience, particularly as to surface tarring, indicates that trend is favouring use of more viscous tar than hitherto; importance of relationship between tars of varying consistency and mineral aggregates of different physical characteristics; advantage of tar macadam in conservation of existing roads and production of granular surface that eliminates skidding. Abstract of paper read before German Road Tar Committee.

Concrete Aggregates. Progress and Present Status of Research on Mineral Aggregates for Asphaltic Type Roads, P. Hubbard. Rock Products, vol. 33, no. 1, Jan. 4, 1930, pp. 155-156. Summary of research to date on type and characteristics of aggregate required for this kind of construction; uniformity of aggregate is its prime requirement; evaluation of mineral aggregates; angularity and compaction; toughness, hardness and resistance to abrasion; graduation and stability; fine aggregate mixtures studied; sands from different sources affect stability.

Investigations in the Field of Rock Products Conducted by the Bureau of Public Roads During 1929, F. H. Jackson. Rock Products, vol. 33, no. 1, Jan. 4, 1930, pp. 144-145. During past year U.S. Bureau of Public Roads has carried on number of investigations of interest to both producer and consumer of mineral aggregates used in road construction; effect of kind and character of aggregate; use of maximum amounts of coarse aggregate; looking for lightweight concrete pavement; studies of fine aggregates; soundness of aggregate.

Emulsions. Emulsions for Asphalt Pavements ,L. Kirschbraun. Can. Engr., vol. 58, no. 5, Feb. 4, 1930, pp. 185-186. Definition and types of emulsions; emulsions as related to paving industry; mechanical technique of preparation; specific properties of emulsions for paving purposes. Paper presented before Assn. of Asphalt Paving Technologists. Indexed in Engineering Index, 1929, from Roads and Streets, Dec. 1929.

Steel. Road Building Providing Outlets for Steel, J. J. Palmer. Commerce Reports, no. 2, Jan. 13, 1930, pp. 92-93, 1 fig. Materials entering directly into road building; auxiliary equipment commonly employed in road building; new outlets for steel opened by new roads; market for hardware products.

ROAD SURFACE TREATMENT

Road Surface Treatment. The Surface Treatment of Roads, A. C. Tregoning. Instn. of Engrs. of Australia—Jl. (Sydney), vol. 1, no. 12, Dec. 1929, p. 440. Surface treatment of roads to enable them to withstand stresses caused by modern traffic is discussed; binders used in surface treatments include minerals, bitumens and tars, chemical preparations, etc.; mineral aggregates which are used with bituminous binders, include screenings, gravels, sands, etc.; various methods in use are described in detail with discussion on cost and traffic-carrying capacity; section of paper is devoted to plant used in various methods.

ROADS, ASPHALT

Cold Weather Construction. Rock Asphalt Construction in Cold Weather, S. F. Ferguson. Highway Engr. and Contractor, vol. 36, no. 1, Jan. 1930, pp. 68-70 and 2 figs. Report on direct steam heating to facilitate unloading and laying of rock asphalt at low temperatures; spacing of jets; steaming time; coal consumption; steaming equipment.

ROADS, CONCRETE

Construction. Curing Concrete Pavements and Working Periods, C. R. Waters. Good Roads, vol. 72, no. 8-9, Aug.-Sept. 1929, pp. 384 and 386. Curing concrete pavements with asphaltic emulsion; coloured pavement; working night shifts. Article previously indexed from Roads and Streets, July 1929.

Construction Plant and Methods for Concrete Roads. Am. Soc. Civil Engrs.—Proc., vol. 55, no. 8, Oct. 1929, pp. 2046-2048 and (discussion) 2048-2049. Abstract of committee report; number of set-ups; railroad facilities; plant layout; switch tracks and switching; storage piles and bins; cranes and unloading practice.

ROADS, LOW COST

Construction Studies. Low Cost Road Construction Studies, J. T. Pauls. Can. Engr. (Toronto), vol. 58, no. 7, Feb. 18, 1930, pp. 226-228. Progress in field studies on bituminous treatment of low-cost road construction; method of surface treatment; construction and maintenance costs; grades of bituminous material; typical soil grading. Paper presented before Eighth Annual Asphalt Paving Conference.

ROADS, LOW COST

Surface Treatment. Bituminous Surface Treatment of Sand-Clay and Topsoil Roads. Pub. Roads, vol. 10, no. 11, Jan. 1930, pp. 193-212, 19 figs. Report on co-operative study by Bureau of Public Roads and asphalt industry on surface treatment of sand-clay and topsoil roads with bituminous materials; projects selected for detailed study are described; steps in preparing sand-clay surface for treatment; examination of samples from subgrades and bases; analyses of bituminous materials; specifications used in bituminous surface treatment; construction and maintenance costs.

ROCK PRODUCTS RESEARCH

Bureau of Standards. Investigations at Bureau of Standards Dealing with Cement, Lime, Gypsum and Stone. Rock Products, vol. 33, no. 1, Jan. 4, 1930, pp. 137-141. Total of 60 samples of different composition have heen collected; cast stone; waterproofing agents for concrete; diatomaceous silicas as admixture in concrete; constitution of portland cement; durability of bond between mortar and hrick; strength of brick walls; strength of gypsum fibre concrete; soundness tests for lime; particle size distribution of hydrated lime; strength of commercial sand-lime brick; wear resistance of flooring materials; slate investigation.

ROLLING MILLS

Anti-Friction Bearings. A Review of the Proceedings of A.I. and S.E.E. in Connection with the Development of Anti-Friction Bearings in the Iron and Steel Industry, D. M. Petty. Iron and Steel Engr., vol. 7, no. 1, Jan. 1930, pp. 12-20. Review of data and information on what Association of Iron and Steel Electrical Engineers has compiled in connection with anti-friction bearings.

Blooming Mills. A New Three-High Blooming and Slab-Blooming Mill. Iron and Steel Industry (Lond.), vol. 3, no. 4, Jan. 1930, pp. 107-110, 8 figs. Description of three-high (blooming and) slab blooming mill suited for dealing with blooms weighing up to 2 tons each, which has been added to rolling plant of Societe Italiana Ernesto Breda, Milan; without changing rolls mill is capable of rolling blooms of 1 ft. 4 and 9–16 in. and 10 in. down to billets of 7 and ⅛ in. and 4 in. cross section or to any other rectangular section within these limits.

ROLLING MILLS

COOLING BEDS. Modern Cooling Beds (Neuere Kuehlbettbauarten), M. Curth. Stahl und Eisen (Duesseldorf), vol. 50, nos. 3 and 4, Jan. 16, 1930, pp. 65-70 and Jan. 23, pp. 99-104 and (discussion) 105, 34 figs. Requirements of efficient cooling bed and defects in existing types are set forth and certain improvements in design are discussed; recent types of cooling beds for different materials are described; suggestions for improvements in operation for purpose of achieving more accurate rolling.

DESIGN. Roll Pass Design, W. Trinks. Rolling Mill Jl., vol. 4, no. 2, Feb. 1930, pp. 49-53, 15 figs. Causes of formation of fins and overfills in rolling and methods by which they may be avoided are outlined; in general these effects can be minimized by rounding or chamfering corners of passes and use of convex box passes.

ELECTRIC CONTROL. Steel Mill Auxiliary Control Specification Guide Forms. Iron and Steel Engr., vol. 7, no. 1, Jan. 1930, pp. 1-8. Set of guide forms which have been compiled to enable purchasing agents, steel-mill engineers and their assistants to properly prepare requisitions for d.c. magnetic control apparatus; resistor applications; general guide forms given for specifying non-reversing d.c. magnetic controllers, reversing or reversing-plugging d.c. controllers, reversing dynamic braking d.c. magnetic controllers, and d.c. crane protective, switchboard and panels.

ELECTRIC DRIVE. Electrical Drives for Steel Plants, A. F. Kenyon. Iron and Steel Engr., vol. 7, no. 1, Jan. 1930, pp. 20-23, 3 figs. Description of new electric drive which has been installed during 1929; during year approximately 300,000 hp. in main roll drives of 300 hp. and larger, have been sold, making total capacity on main roll drives more than 2,500,000 hp.; truck type circuit breakers extensively applied with satisfactory results.

FILLING ROLL PASSES. Filling of Roll Passes (Das Fuellen von Kalibern), W. Tafel and G. Wagener. Stahl und Eisen (Duesseldorf), vol. 50, Jan. 30, pp. 126-128, 6 figs. Investigation of method developed by S. Ekelund for determination of ingot depth of irregular passes by means of practical tests; in most cases failure resulted; agreement with Tafel method of calculation is confirmed.

ROOFS

INSULATION. Roof Insulation, W. S. Wallace. Textile World, vol. 77, no. 1, Jan. 4, 1930, pp. 60-62 and 100, 7 figs. Conservative prediction is made that within few years practically all mill and other industrial buildings will have insulated roofs; discussion of insulating materials used in mill-roof construction.

ROTORS

BALANCING. Balancing Rotating and Reciprocating Masses (Ueber den Ausgleich umlaufendeer sowie hin- und hergehender Massen), W. Hohmann Maschinen-Konstruktur (Berlin), vol. 62, nos. 22, 23 and 24, Nov. 15, Dec. 1 and Dec. 15, 1929, pp. 515-519, 530-532 and 554-563, 51 figs. Theory and practice of balanced rotating masses, such as crankshaft of locomotives and revolving machines, and reciprocating parts, as in reciprocating machines, are treated; results from test machines are illustrated by examples. (To be continued.)

RUBBER

STRESS-STRAIN PROPERTIES. Thermodynamics of Stressed Vulcanized Rubber, R. H. Gerke. Indus. and Eng. Chem., vol. 22, no. 1, Jan. 1930, pp. 73-76 and (discussion) 76-77, 1 fig. Equilibrium stress-strain curves; effect of temperature on modulus; conventions and definitions; first and second laws of thermodynamics; very rapid stress-strain curves. Bibliography.

S

SAND, FOUNDRY

TESTING. Investigation of Endurance of Bond Strength of Various Clays in Moulding Sand. Univ. of Ill.—Bul., vol. 27, no. 18, Dec. 31. 1929, 25 pp. 6 figs. Report on tests to determine physical chemical properties of clays and to compare their bond strength when used in moulding sands under casting conditions; thermal conductivity of moulding sands and effect of heat on clays and moulding sands; effect of repeated heatings on permeability of moulding sands.

SCREW THREADS

COMPARISONS. Some Striking Comparisons between Different Screw Threads. Machy. (Lond.), vol. 35, no. 897, Dec. 19, 1929, pp. 388-389, 3 figs. Advantages and disadvantages of so-called self-locking nut and bolt utilizing Dardeled thread; fundamental of thread is cone, which naturally locks itself with increasing effectiveness into external cone, which forms nut, as pressure is increased question is whether advantage of having self-locking thread is not obtained; through disadvantage of greatly increased stresses in either nut or bolt; study of profiles of several threads and advantages and disadvantages tabulated with sufficient accuracy for general purposes.

STANDARDIZATION. Screw-Threads Division. Soc. Automotive Engrs. Jl.—Reports of Divisions to Standards Committee (Section 2), Jan. 1930, pp. 50-55, 10 figs. Proposed revision of American standard and S.A.E. standard for wrench head bolts and nuts and wrench openings; proposed American standard and S.A.E. standard for slotted-head screws; line cuts and dimensions given for flat, round, oval, and fillister-head machine screws, flat, button and fillister-head capscrews, round, flat, and oval-head wood screws, and brass and steel wood screws.

SEAPLANES

PASSENGER (CONSOLIDATED). The Consolidated Commodore Flying Boat, L. E. Neville. Aviation, vol. 28, no. 2, Jan. 11, 1930, pp. 49-55, 23 figs. Description of Consolidated Commodore Model 16, largest commercial flying boat to be built in United States, which is commercial adaption of Navy XPY-1; central hull monoplane flying boat; two Pratt and Whitney 575-hp. Hornet engines; forgings and open sections used in structure; maximum of athwart-ship bracing employed in structure; large proportion of weight of floor system carried by longitudinal members contributing to general strength of hull; section sizes standardized; plane operating on New York-Rio and Buenos Aires lines.

SEISMOGRAPHS

PRINCIPLE OF. Seismographs (Seismografer), H. Renqvist. Tekniska Forenings I Finland Forhandlingar (Finland), vol. 49, no. 12, Dec. 1929, pp. 217-221, 8 figs. Principle of seismographs is explained and application of principle in various apparatus is described.

SEWAGE DISPOSAL PLANTS

ALLIANCE, OHIO. Third Sewage Treatment Plant at Alliance Overcomes Nuisances, A. A. Burger. Am. City, vol. 42, no. 1, Jan. 1930, pp. 139-142, 4 figs. Design and construction of new plant for Ohio town having population of 36,000; construction plant layout; excavation methods; concreting plant; placing filtering material; total cost of work is about $800,000.

ELECTRIC EQUIPMENT. The Modern Sewage Disposal Plant, R. C. Allen. Elec. Jl., vol. 27, no. 2, Feb. 1930, pp. 82-86, 10 figs. Proper selection of pumps, electric motors, and control equipment makes possible clean, neat and efficient layout; features Newark, New Jersey, Jamestown, Va., Syracuse, N.Y. and Santa Cruz, Calif., plants are given; equipment is described.

SEWAGE DISPOSAL RESEARCH

NEW JERSEY. New Jersey Sewage Disposal Experiments, G. T. Hammond, W. R. Copeland. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 3, Mar. 1930, pp. 521-527. Progress report of Committee of Sanitary Engineering Division, on work of W. Rudolfs, etc., digestion of sewage sludge at high temperatures; enzymes; beneficial action of ripe sludge depends upon age; concentration of more than 15 per cent of solids prevents digestion; effect of organic acids upon number of bacteria and protozoa; drainage is more important than evaporation in dewatering sludge; tests with industrial wastes; chlorination; composition of materials for sprinkling filters.

SHEET METAL TESTING

NEW METHOD. New Testing Method for Sheet Metal (Ein Neues Pruefverfahren fuer Feinbleche), E. Siebel and A. Pomp. Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforschung (Duesseldorf), vol. 11, no. 18, 1929, pp. 287-291, 4 figs. Advantages and disadvantages of usual testing methods are discussed; deep-drawing widening test and stress conditions with this test; drawing force and circular stress; maximun load and strength; determination of best testing conditions; calculation of tensile strength; influence of thickness of plate.

SILICA SAND

UNITED STATES. Silica Sand in 1929. Rock Products, vol. 33, no. 1, Jan. 4, 1930, p. 117, 1 fig. Owing to major consolidations in glass-sand producing districts in Eastern states and Ohio and Illinois recently, there has been gradual strengthening of prices in silica industry, increase in price on glass sand were slight and in some locations there was no price movement during past year.

SLUICE GATES

ELECTRIC HEATING. Winter Operation of Sluice Gates. Elec. News (Toronto), vol. 39, no. 2, Jan. 15, 1930, pp. 48-50, 4 figs. Electric heating units built into gates and steel members at gains, successfully combat ice formation at critical periods; capacity of heaters generally recommended is 4 kw. per duct, and for this capacity are usually 10 ft. long.

SMOKE ABATEMENT

DUST COLLECTION. Some Problems of Dust Collection, J. W. Gibson. Iron and Coal Trades Rev. (Lond.), vol. 120, nos. 3229 and 3230, Jan. 17 and 24, 1930, pp. 83 and (discussion) 171; see also abstract in Colliery Guardian (Lond.), vol. 140, nos. 3603 and 3604, Jan. 17 and 24, 1930, pp. 234 and 324-325. Pulverized-coal firing has stimulated question of flue-dust emission from power station and factory chimney; main factors of problem of cleaning flue gases are enumerated and discussed. Abstract of paper read before Midland Inst. of Min. Engrs.

SOLVENTS

RECOVERY. Process and Apparatus for Recovery of Volatile Solvents (Verfahren und Apparate zur Gewinnung fluechtiger Stoffe), J. Bodewig. Chemische Fabrik (Berlin), no. 44, Oct. 30, 1929, pp. 471-473, 7 figs. Three possible courses are: condensation, absorption by solid reagents as activated carbon or silica gel, absorption by liquid reagents; in Cheminova process vapour-charged air is treated with absorbent in Feld gas washers; recoveries up to 95 per cent are possible under practical conditions and fire risks are negligible; method has also been applied to recovery of benzene, benzol, acetone, etc.

SPEED REDUCERS

PLANETARY. Planetary Reduction Gear. Engineering (Lond.), vol. 129, no. 338, Jan. 3,1930, p. 13. Gear known as Moss planetary speed transformer is recent production of Moss Gear Co., Birmingham, Eng., who have also taken opportunity afforded by construction of their new works of completely redesigning and increasing range of their worm and double-helical reduction gears; planetary reduction gear is made suitable for powers up to 40 b.hp. and ratios up to 100:1.

SPRINGS

LAMINATED. Experiments on Laminated Springs. Engineering (Lond.), vol. 129, no. 3338, Jan. 3, 1930, pp. 26-28, 17 figs. Review of recent reports of Department of Scientific and Industrial Research of experimental work at National Physical Laboratory; these deal respectively with their displacement while running; effect of nip on their mechanical properties; and, in continuation of latter work, further inquiry into their endurance.

STANDARDIZATION

UNITED STATES. The A.S.M.E. and Standardization under the A.S.A., W. S. Monroe. Mech. Eng., vol. 52, no. 3, Mar. 1930, pp. 209-210. Brief sketch of historical background for movement in United States; American Society of Mechanical Engineers is entitled to credit for having originated standardization activities in this country; any group of men in or out of member organizations of American Standards Association can originate standardization project by presenting it to standards committee of any one of organizations in A.S.A.; at present time A.S.M.E. is sponsor or joint sponsor for 26 sectional committees under procedure of American Standards Association.

STEAM CONDENSERS

SURFACE. Direction of Tube Axis, and Mean Axis of Flow into Tube Bank in Surface Condensers, T. Petty. Mech. World (Manchester), vol. 87, no. 2246, Jan. 17, 1930, pp. 53-54, 2 figs. Exhaust inlet branch of relatively large size situated centrally between tubeplates of two-pass condenser is sufficiently near theoretically correct position; principle may serve as guide to rational procedure in condensers of special type, as in single-pass naval condensers, or in low-vacuum condensers.

STEAM-ELECTRIC POWER PLANTS

DESIGN. Design of Modern Super Plants (Bau neuzeitlicher Gross-kraftwerke), A. Bannwarth. Elektrotechnische Zeit. (Berlin), vol. 51, no. 6, Feb. 6, 1930, pp. 209-212, 1 fig. Arrangement of building and space requirements are discussed from standpoint of modern steam and equipment practice.

PRESSURE CONTROL FOR. Steam Pressure Control for Stations Operating on a Two Pressure System, J. L. Kimball. Combustion, vol. 1, no. 8, Feb. 1930, pp. 30-33, 3 figs. Discussion of central generating stations operating under two-pressure systems; effective utilization of high-pressure steam gives rise to numerous questions affecting selection and arrangement of pressure-control valves, especially during period when it is necessary to operate with two pressures before station is completely changed over to high pressure cycle.

STEAM HEATING PLANTS

DISTRICT, NEW YORK CITY. Steam Service from Central Stations in New York City, W. J. Baldwin, Jr. Nat. District Heat. Assn.—Bul., vol. 15, no. 2, Jan. 15, 1930, pp. 84-97. Comprehensive discussion of present activities of New York Steam Corp., which is only public utility supplying steam under franchise in New York City; types of buildings supplied with steam; description of piping system; list of new large buildings which are purchasing steam; description of steam generating plants and their operation. Paper read before Am. Soc. Heat. and Vent. Engrs.

DISTRICT, TORONTO. C.P.R. Central Heating Plant, Toronto. Can. Engr. (Toronto), vol. 58, no. 5, Feb. 4, 1930, pp. 181-184, 8 figs. Description of steam plant serving Union Station, C.P.R. and C.N.R. Express Offices, and Royal York Hotel; details of eight horizontal water-tube Babcock boilers rated at 810 hp. each, automatic stokers and forced draft equipment, coal and ash-handling plant, Terry steam turbines driving Lea Courtney centrifugal pumps, Conchrane deaerating heater and water softener, etc.

STEAM PIPE BENDS

HIGH PRESSURE. Tests on High-Pressure Pipe Bends, W. Hovgaard. Jl. of Mathematics and Physics, vol. 8, no. 4, Dec. 1929, pp. 293-344, 27 figs. Series of tests, supplementing tests previously made on pipes designed for moderate steam pressures, shows that formulae established for pipes of moderate wall thickness hold good also for more thick-walled high-pressure pipe; longitudinal stresses in middle surface can be used as strength criterion; so long as maximum longitudinal stress at middle surface does not exceed 20,000 lbs. per sq. in. there will be no appreciable permanent set.

STEAM POWER PLANTS

FUEL ECONOMY. Boiler-Firing Economies (Aufgaben der Feuerungstechnik), Marcard. Waerme (Berlin), vol. 52, no. 48, Nov. 30, 1929, pp. 890-896, 9 figs. It is claimed that by improving efficiency of boiler furnaces and by use of low-grade fuels, it is possible to greatly reduce fuel costs; price of steam is gauge of steam-power-plant efficiency.

HIGH PRESSURE. 1,400-lb. German Station uses Steam Reheaters, C. H. S. Tupholme. Power Plant Eng., vol. 34, no. 3, Feb. 1, 1930, p. 187, 1 fig. Mannheim-Rheinau superimposes 1,420-lb. extension on original 1,285-lb. section; diagrammatic arrangement of high and low pressure sections of Mannheim-Rheinau station.

Developments in the Generation of High-Pressure Steam, I. E. Moultrop and M. D. Engle. Iron and Coal Trades Rev. (Lond.), vol. 120, no. 3233, Feb. 14, 1930, p. 285, 2 figs. Enumeration of high-pressure stations now under construction in United States; brief description of principal features. Abstract of paper read before Instn. of Engrs. and Shipbldrs. in Scotland.

High-Pressure Extensions to the Issy-Les-Moulineaux Power Station. Engineer (Lond.), vol. 149, no. 3866, Feb. 14, 1930, pp. 178-180, 4 figs. For supply of high-pressure steam six boilers were provided, each designed to evaporate normally 70 tons of water per hour; coal is prepared in separate pulverizing house, with capacity of 900 tons per day; boilers are of three-drum bent-tube type; metal employed is basic Siemens-Martin steel; all accessories of high-pressure pipe system are of forged steel, except bodies of valves, for which cast steel was employed.

The Generation of Superpressure Steam, S. Loeffler. Engineering (Lond.), vol. 129, no. 3339, Jan. 10, 1930, pp. 58-60, 10 figs. Considerations set forth are based mainly on experience with author's boiler, characteristic feature of which is that water is evaporated in non-fired vessel or container, by pumping through it supply of superheated and superpressure steam. Translated from Contribution in Festschrift Prof. Dr. A. Stodola zum 70. Geburtstag, 1929.

The Future of Higher Steam Pressure in Steam-Electric Generating Stations, I. E. Moultrop. Am. Inst. Elec. Engrs.—Paper for mtg., Dec. 2-4, 1929, 3 pp. Biggest problem before station designers today is to reduce cost of construction per unit of capacity; some engineers have suggested that cheaper and less economical stations should be built; high standards of efficiency that have been established and reduced cost of construction by intensive study and better design; better engineering in future is answer to problem.

INDUSTRIAL, GREAT BRITAIN. New Developments in British Industrial Steam Station Practice, D. Brownlie. Combustion, vol. 1, no. 8, Feb. 1930, pp. 39-43, 7 figs. Review of British practice in industrial power plants; illustrated description of superviser installations, also description of Atkinson rotary furnace; test results of rotary furnace installation operating standard Lancashire boiler with superheater, but not feed-water economizers.

PEAK-LOAD EQUALIZATION. Equalization of Power Fluctuations in Steam Power Plants (Der Ausgleich von Energieschwankungen in Dampfbetrieben), B. Gentzcke. Archiv. fuer Waermewirtschaft (Berlin), vol. 11, no. 1, Jan. 1930, pp. 16-22. It is shown that admission and emission of energy can be influenced in many cases even without steam accumulator to such extent that entire plant operates efficiently; examples are given of process steam plants, and steam-electric plants; comparison of different types of accumulators.

REFUSE BURNING. Utilization of Refuse and Coal Mixtures in Power and Gas Plants (Verbrunnung von Muell-Kohle-Mischungen durch Elektrizitaet- und Gaswerke), P. Wollenhaupt. Waerme (Berlin), vol. 53, no. 2, Jan. 11, 1930, pp. 17-20. Up to present time refuse incineration has been automatically effected in cellular ovens without coal addition; this operation is expensive and wasteful; with underfeed stoker, by adding coal to refuse, continuous operation is effected which obviates any necessity for pretreatment of refuse; it is recommended that municipal power and gas plants make use of such coal-refuse burning furnaces.

UNIVERSITY OF CHICAGO. Chicago University's New Steam Plant. Power, vol. 71, no. 5, Feb. 1930, pp. 164-168, 7 figs. Complete costs, operating data and guarantees for three 12,040-sq. ft. boilers, equipped with water walls, economizers, air preheaters, forced-draft chain grate stokers, and combustion control; lists of principal equipment in new boiler plants.

STEAM TRAPS

PROCESS HEATING. Trap Installation for Process Work, T. H. Rea. Heat, Piping and Air Conditioning, vol. 11, no. 2, Feb. 1930, pp. 108-112, 11 figs. Consideration of steam traps for process heating work; two kinds of process heating; draining cylinder driers; estimation of steam traps required to drain any apparatus. (Continuation of serial.)

STEAM TURBINES

GOVERNORS. Controlling Bled Steam Without Frequency Fluctuation, S. H. Hemenway. Power, vol. 71, no. 2, Jan. 14, 1930, pp. 59-61, 8 figs. Requirements of turbine bleeder pressure regulators have been increased from indifferent control to present-day need of holding bled steam pressure within close limits and at same time maintaining electrical frequency with change in bled steam demand; illustrated description of various types of steam turbine governors; performance curves of bleeder service.

SPECIFICATIONS. British Standard Specification for Steam Turbines. Brit. Eng. Standards Assn. (Lond.), no .132, Jan. 1930, 10 pp. Specifications for rating, economical rating, governing characteristics, speed adjustments; emergency cut-off speed; maximum speed; steam or heat consumption; limits of lubricating oil temperature; hydraulic test for parts exposed to boiler-pressure; lubricating oil; parallel running; vibration and noise; critical speed of rotating element; standard equipment.

STEEL

ALLOY. *See Alloy Steel.*

CHROMIUM-NICKEL. *See Chromium-Nickel Steel.*

HEAT TREATMENT. Structural Steel Heat Treated, P. F. Lee and H. A. Schade. Iron Age, vol. 125, no. 7, Feb. 13, 1930, pp. 510-514, 1 fig. Results of investigation undertaken to determine what physical properties could be obtained by heat treatment of hot rolled low-carbon steel, comparable to S.A.E. 1020 steel; preliminary tests on 45 steels; test pieces given various draws after water-quench; high-elastic-limit steel produced by quenching 0.20 carbon 0.60 manganese steel from 1,600 deg. fahr. and drawing at 1,100 deg.; welded joints respond to same treatment; tests on weldability of structural steel.

The Heat Treatment of Steel, H. Rickli. Engineering (Lond.), vol. 129, no. 3342, Jan. 31, 1930, pp. 141-142. Editorial comment on paper presented before World Power Conference in Tokyo, in which author drew attention to number of cases in which attempt to improve properties of alloy steels by heat treatment had been responsible for explosion of rotors of high-speed three-phase alternators; it seems certain that immediate cause of accidents was internal stresses set up by heat treatment; he suggests abandonment of process of heat treatment, and use for rotors of well-annealed alloy steels.

STAINLESS. Corrosion-Resisting Steels and Their Applications, J. H. G. Monypenny. Iron and Steel Industry (Lond.), vol. 3, no. 4, Jan. 1930, pp. 111-115, 4 figs.

TEMPERATURE EFFECT. Steel at Elevated Temperatures, A. Sauveur. Am. Soc. Steel Treating—Trans., vol. 17, no. 3, Mar. 1930, pp. 410-448, 38 figs. Some of physical properties at different temperatures of carbon steels, of austenitic and of non-austenitic steels have been investigated by twisting small grooved bars; factor of stiffness obtained by dividing breaking load in pounds by angle of twist in degrees bring out sharply blue-heat range in some steels; time-strain curves are obtained which throw considerable light on behaviour of steel of different compositions when subject to plastic deformation.

TENSILE TESTING. Tensile Properties of Rail and Other Steels at Elevated Temperatures, J. R. Freeman, Jr., and G. W. Quick. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 269, for mtg. Feb. 1930, 48 pp., 38 figs. Notes on special study of tensile properties, in approximate temperature range of 400 to 700 deg. cent.; ductility decreases with temperature increase, over a portion of range; elongation and reduction of area decrease at 500 to 650 deg.; data on rate of cooling and temperature distribution are also given. Bibliography.

STEEL CASTINGS

DEFECTS. Steel Castings and Their Design with Regard to Castings Properties and Machinability (Stahlformgusstuecke und ihre Konstruktion mit Ruecksicht auf die Giessbarkeit und die Bearbeitung). Zeit. fuer die Gesamte Giessereipraxis (Berlin), vol. 50, nos. 51 and 52, Dec. 22, 1929, pp. 431-433 and Dec. 29, 1929, pp. 441-443, 11 figs. Discussion of defects occurring frequently with steel castings, such as piping and cold cracks, and suggestions for their prevention.

SILICON STEEL. Properties of Silicon Steel in Form of Steel Castings (Ueber die Eigenschaften von siliziumlegiertem Stahl in Form von Stahlguss), E. H. Schulz and F. Bonsmann. Stahl und Eisen (Duesseldorf), vol. 50, no. 6, Feb. 6, 1930, pp. 161-168, 14 figs. Investigations of six silicon-steel mixtures in comparison with unalloyed steel castings; strength properties with and without annealing; influence of annealing temperature; tensile and notched-bar tests after different pretreatments at minus 80 to plus 500 deg. cent.; results of wear and corrosion tests.

STEEL MANUFACTURE

BILLET CHIPPING. To Clean Billet Surface by Machine, R. S. Haydock. Iron Age, vol. 125, no. 5, Jan. 30, 1930, pp. 366-368, 2 figs. Explanation of billet Shipping and methods and equipment used for operation; effect of work upon operator; description of various types of machines used; new equipment suggested. Abstract of paper presented before Am. Soc. Mech. Engrs., indexed in Engineering Index, 1929.

RESEARCH. Research Necessary for Plant Control of Manufacture and Subsequent Treatment of High-Quality Steel (Die Betriebsueberwachung bei der Herstellung und Weiterverarbeitung von Edelstahl und die dadurch bedingte Betriebsforschung), R. Hohage. Stahl und Eisen (Duesseldorf), vol. 50, no. 4, Jan. 23, 1930, pp. 93-97 and (discussion) 97-99, 5 figs. Notes on inspection of raw material; melting and slag handling; temperature measurement; pouring of steel and necessary tests; heat-conductivity determination proceding heat treatment; hardness testing; quenching; methods of determining toughness; defects and their prevention.

STEEL, STRIP

PROPERTIES. Deep Drawing Cold Rolled Steel Failures, P. Mabb. Machy. (Lond.), vol. 35, no. 899, Jan. 2, 1930, pp. 446-447, 1 fig. Properties of high-grade deep drawing quality strip used in press shops are discussed; troubles due to irregularity of grain structure and to softness of material; importance of correct structure which should be capable of withstanding shock and deformation; trouble cured by heat treatment; effect of material tolerance.

STEEL STRUCTURES

SPECIFICATIONS, CANADA. Standard Specification for Steel Structures for Buildings. Can. Eng. Standards Assn.—Specification (Ottawa) A16, Jan. 1930, 39 pp. Second edition containing revisions, principal of which is raising of allowable unit stress for axial tension from 16,000 to 18,000 lbs. per sq. in.

STEEL TESTING

RESEARCH. Testing of Hardened Steel (Provning av hardat stal), A. Lundgren. Statens Provningsanstalt (Stockholm), no. 45/46, 1929, pp. 1-9. Report of research to determine effect of velocity of quenching after tempering and effect of time of tempering on mechanical properties of hardened steel.

STREAM FLOW

ESTIMATING. A New Method of Estimating Stream-Flow Based Upon a New Evaporation Formula, J. A. Folse. Carnegie Inst. of Wash.—Pub., no. 400, 1929, 230 pp., 21 maps on supp. plates. Part I deals with investigation of laws of evaporation from observations on Great Lakes; how investigation was made and how final evaporation formula was derived; evaporation formula derived is used in establishing formulae of relationship between daily flow of perennial stream in moist climate and rainfall, snowfall, vapour pressure, air temperature, and wind velocity observed on its watershed.

STREAM GAUGING

CURRENT METERS. Ott Current Meter for Determination of Velocity and Direction of Water Currents (Moulinet Ott, pour la détermination de la vitesse et de la direction des courants d'eau). Génie Civil (Paris), vol. 96, no. 1, Jan. 4, 1930, pp. 20-21, 3 figs. Description of electric horizontal-axis current meter of propeller type, which can be used in depths up to 100 m. and determines velocity from 5 cm. per second to 3 m. per second with error of 1/1500; errors in direction not exceeding 2 degrees; details of mechanical and electrical parts.

CURRENT METERS, TESTING. Effect of Turbulence on the Registration of Current Meters, D. L. Yarnell and F. A. Nagler. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 2, Feb. 1930, pp. 381-382. Discussion by C. S. Bennett of paper indexed from issue of Dec. 1929.

UNITED STATES. Forty Years of Research Into Water Resources, F. H. Newell. Eng. News Rec., vol. 104, no. 4, Jan. 23, 1930, pp. 132-136, 9 figs. Historical review of problems and vicissitudes of building up present system of keeping continuous and accurate records of water resources of United States; details of gauging stations and measuring cars. Foreword by J. C. Hoyt.

STREAM POLLUTION

MISSISSIPPI RIVER. Pollution Studies of the Upper Mississippi River, F. L. Woodward. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 189-192, 5 figs. Article covers briefly activities of Minnesota State Board of Health and cooperating departments in studying pollution problem of Mississippi River from Minneapolis and St. Paul, Minn., to La Crosse, Wis., distance of 160 mi.; it was found that conditions of pollution are evident during winter time as far down stream as outlet of Lake Pepin, distance of 100 mi.; tentative classification from pollution standpoint, of river below Minneapolis is given.

STREET RAILROADS

TROLLEY WIRE BREAKS. Low Records Made in Trolley Wire Breaks. Elec. Ry. Jl., vol. 74, no. 1, Jan. 1930, pp. 48-49, 9 figs. Continued improvement over previous figures; survey shows average reduction of more than 60 per cent accomplished during past eight years; progress in overhead trolley wire maintenance during last eight years is clearly shown by general decrease in number of breaks.

STORAGE BATTERIES

DENMARK. Danish Market and Trade in Batteries, P. H. Pearson. Commerce Reports, no. 5, Feb. 3, 1930, pp. 315-316. Domestic production of storage batteries; much material for batteries imported; imports of storage batteries; American batteries used in automobite trade prices; domestic production of dry-cell batteries sufficient.

STONE QUARRIES AND QUARRYING

OHIO. Rockport Stone Produces Material Used as Top Dressing for Local Roads. Pit and Quarry, vol. 19, no. 8, Jan. 15, 1930, pp. 57-58, 4 figs. Description of Rockport Stone Co. operating small crushed-stone plant near Beaver Dam about 6 mi. northwest of Bluffton, Ohio; plant has capacity of 160 tons per day and has been in operation for about six years; single semi-Diesel 75-hp. engine operates entire plant including hoists, crushers, screen and elevators.

STRUCTURAL STEEL WELDING

STATUS OF. Structural Steel Welding, F. P. McKibben. Metals and Alloys, vol. 1, no. 7, Jan. 1930, p. 328. Present status of structural steel welding; welding and building codes; tests on welded joints; welded plate girder; qualification of welders; inspection of shop and field welding.

SURVEYING

NATIONAL. National Surveys, E. M. Jack. Pan.-Am. Geologist, vol. 52, no. 4, Nov. 1929, pp. 241-266. General discussion of duties and functions for which national survey ought to be responsible, and of certain characteristics which such survey should have; description of work of certain national surveys, both foreign and in British Empire; applications of knowledge derived from such work, for benefit of South Africa.

TOPOGRAPHIC, CANADA. Work of Topographical Surveys. Can. Engr. (Toronto), vol. 58, no. 3, Jan. 21, 1930, p. 157. Excerpts from report on surveys of Department of Interior, Canada; progress in topographical survey in Maritime and Western provinces of Canada, with special reference to mapping and photography in British Columbia.

T

TELEPHONE

CARRIER CURRENT. Experience With Carrier-Current Communication on a High Tension Interconnected Transmission System, P. Sporn and R. H. Wolford. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 2, Feb. 1930, pp. 129-133, 9 figs. Fundamentals of carried communication system over transmission network are outlined; installations on 132-kv. network having extent of 2,500 linear miles is described; experience with various types of equipment; receiving and transmitting systems; data as to cost, maintenance, reliability, traffic, and safety are cited.

TEMPERATURE MEASURING INSTRUMENTS

INDUSTRIAL. Temperature Instrument Developments in 1929, M. F. Béhar. Instruments, vol. 3, no. 1, Jan. 1930, pp. 3-13, 6 figs. Survey of what 1929 has brought forth in fields of indicating and recording thermometers and pyrometers; recorder, automatic thermometric and pyrometric controllers; special automatic controllers; industrial and electrical resistance thermometers; indicating pyrometers; pyrometric accessories.

TEXTILE MILLS

AIR CONDITIONING. Correct Regulation of Humidity, J. W. Cox, Jr. Black and White, vol. 2, no. 6, Jan. 1930, pp. 34-36, 3 figs. Purpose of article is to show how accurately regulated and controlled humidity conditions have increased production and lowered cost, as well as improved quality.

THREAD CUTTING MACHINE

SUPER-DUTY. Thread Milling Machine. Macny. (Lond.), vol. 35, no. 896, Dec. 12, 1929, pp. 365-366, 3 figs. Description of Super-Duty thread milling machine developed by Lees-Bradner Co., London, especially for wide range of thread milling and dealing with straight taper, internal or external threads and cut right or left hand; machine is also equipped for straight turning, facing and chamfering operations and is particularly adapted to milling of oil-well tools, tool joints, drill pipe and shafts.

TIN DEPOSITS

BORING, METHODS OF. Methods of Boring and Winnipeg Tin in Malaya, B. A. Hadley. Australasian Inst. of Min. and Met.—Proc. (Melbourne), no. 75, Sept. 30, 1929, pp. 121-130. Short account of methods of boring alluvial tin properties in Malaya; outline of methods of concentrating tin oxide by means of jigs.

TOLERANCES

CLEARANCE, FITS AND. Tolerances, Clearance and Fits in Machine Building (Toleranzen Spiele und Sitzarten im Maschinenbau), A. F. Lessochin. Werkstattstechnik (Berlin) vol. 24, no. 2, Jan. 15, 1930, pp. 44-48. Attempt is made to clear up fit and allowance problem along scientific lines; it is assumed that conditions in practical application follow law of probability which can be traced only by experiment; equations are developed; Czechoslovakian, German and ISA (international) standard proposals are analyzed.

TRACKLESS TROLLEYS

UNITED STATES. Interest Revived in Trackless Trolley Operations. Elec. Ry. Jl., vo. 74, no. 1, Jan. 1930, pp. 37-40. During past two years this type of service has enjoyed marked increase in popularity; more trackless trolleys were bought in 1929 than in any recent year; seven companies are now operating 65 such vehicles; synopsis of all operations since first installation in 1910 is presented.

TRACTOR PLANTS

CONVEYORS. Semi-Portable Conveyors in Tractor Production, C. B. Lord. Am. Mach., vol. 72, no. 5, Jan. 1930, pp. 215-216, 6 figs. Discussion of how San Leandro, Calif., tractor plant of Caterpillar Tractor Co., has facilitated production and reduced costs through system of portable and semi-portable, gravity, roller conveyors; short roller conveyors of gravity type keep materials steadily on move from one operation to another.

TRAFFIC SIGNS, SIGNALS AND MARKINGS

ELECTRIC. Correct Timing Signals Essential in Traffic Regulation, T. M. Matson. Elec. Ry. Jl., vol. 74, no. 2, Feb. 1930, pp. 82-84, 2 figs. Brief review of requirements which must be met for efficient traffic flow; factors influencing time ratio and length of cycle at single intersection are discussed; timing for signal systems covering number of intersections will be discussed in future article. (To be continued.)

TRAILERS

MOTOR TRUCK. 100-ton Industrial Trailer Truck. Ry. Gaz. (Lond.), vol. 51, no. 25, Dec. 20, 1929, p. 966, 1 fig. Description of vehicle, constructed by R. A. Dyson and Co., Ltd., for Pickfords Limited, is of extremely unorthodox and novel design and includes many special construction and operating features; trailer is of flat-top type, loading platform 22 ft. long by 8 ft. wide and height to top of platform not more than 42 in.; main frame superimposed upon two trucks, 60 tons capacity each; description of steering arrangement.

TRAINS

RAILROAD ACCIDENTS, DERAILMENT. Derailments on Open Track (Les déraillements en pleine voie). Génie Civil (Paris), vol. 95, no. 23, Dec. 7, 1929, pp. 561-566, 6 figs. Statistics of train derailments and analysis of their causes; discussion of rail defects, improper design or construction of tracks, faulty train operation, wrong methods of carloading and train make-up, defects in rolling stock and their elements as factors contributing to occurrence of derailments.

TRANSFORMER OIL

CONDUCTIVITY. The Conductivity of Insulating Oils, J. B. Whitehead and R. H. Marvin. Am. Inst. Elec. Engrs.—Advance Paper for mtg. Jan. 27-31, 1930, 9 pp., 12 figs. Experiments on charging current and other associated phenomena in high-grade transformer oil; charging currents remaining after elimination of initial transient were studies to within few hundredths second of application of continuous voltage; two samples of same oil obtained at different times differed radically; appendix gives theoretical discussion on influence of space charges; it is shown that at least qualitatively these account for observed phenomena. Bibliography.

TRUSSES, STEEL

WELDING. Structural Welding Scores Success on Large Western Project, A. W. Lewis. Am. Welding Soc.—Jl., vol. 8, no. 10, Dec. 1929, pp. 35-39, 6 figs. Description of world's heaviest welded truss just completed by Pacific Iron and Steel Co., Los Angeles, for Forest Lawn Memorial Park Mausoleum, Glendale, Calif.; is form part of all welded steel-frame mausoleum extending over top of existing building; one of trusses is 96 ft. long by 18 ft. high, having maximum chord stresses approximating 1,000,000 lbs.

TUBES

RIBBED. Investigation of Cooling Ribs (Undersokning av Kylflansar) M. Blomqvist. Teknisk Tidskrift (Stockholm), vol. 60, no. 3, Jan. 18, 1930, (Mekanik) pp. 5-13, 29 figs. Discussion of formulae for calculating effect of ribs; description of test made to check formulae and discussion of results obtained, and comparison with theoretical figures from different formulae; tests shows that square or rectangular ribs are more efficient than circular.

TUBES, NON-FERROUS

STRESSES. The Measurement of Initial Stresses in Hard-Drawn Tubes, J. Fox. Engineering (Lond.), vol. 129, no. 3340, Jan. 17, 1930, pp. 65-67, 16 figs. Outline of theory regarding initial stresses in cold-drawn tubes; measurement of circumferential stress; distribution of longitudinal stress; experiments to determine initial stress distribution and their maximum values; experiments on season cracking; hollow-sunk brass and arsenical-copper tubes season-crack provided sink is sufficiently large; hollow-sunk non-arsenical copper tubes do not season-crack.

TUNNELS, SUBAQUEOUS

STRAIT OF GIBRALTAR. Projects for Submarine Tunnel under the Strait of Gibraltar (Les projects de tunnel sous-marin sous le détroit de Gibraltar). Génie Civil (Paris), vol. 96, no. 1, Jan. 4, 1930, pp. 12-15, 9 figs. Features of railroad and vehicular tunnel projects suggested by Berlier, Ibanez de Ibero and P. Jénevois, G. Herrera.

TURBO-BLOWERS

LARGE. The Largest Turbo Blast Furnace Engines in the World. Iron and Steel Industry (Lond.), vol. 3, no. 3, Dec. 1929, pp. 81-82, 3 figs. Description of two turbo blast-furnace engines in German blast-furnace plant designed to supply air for blast furnace capable of producing 1,000 tons of pig iron per day; on normal service, each of these turbo-blowers takes in 2,620 cu. m. of air per min. and compresses it at 2½ atmospheres when working at 2,900 r.p.m.; blowers driven by high-pressure turbines.

TURBO GENERATORS

TESTING. Testing Equipment for Steam Turbines in Testing Station of Muelheim Works of Siemens and Schuckert (Die Pruefeinrichtungen fuer Dampfturbinen im Grossen Prueffeld des Muelheimer Werkes der S.S.W.), A. Bross. Siemens-Zeit. (Berlin), vol. 9, no. 12, Dec. 1929, pp. 872-873, 2 figs. Plant which had been taken over from Thyssen has been extended so that double-casing 30,000-kw. unit and triple casing 50,000-kw. unit including generators, and units of same capacity without generators can be tested simultaneously; cranes can be coupled in such way that pieces of 100 tons can be handled.

V

VANADIUM

POSSIBILITIES OF. Possibilities of Production of Radium and Vanadium from Carnotite, H. A. Doerner. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 185-189. Vanadium from carnotite and related ores; distribution and variation of production costs; production from low-grade ores; concentration methods; extraction of radium from concentrates; extraction with acids; preliminary roasting; chemical dissolution of silica; volatilization of silica; recovery of vanadium and uranium.

VEGETABLE OILS

POLYMERIZATION OF. The Polymerization of Drying Oils, J. O. Cutter. Chem. Age (Lond.), vol. 22, no. 551, Jan. 18, 1930, p. 46. Changes that occurred in linseed and tung oils upon heating; properties of oils in liquid state; review of knowledge available today concerning compositions of linseed oil and tung oil; two theories of polymerization which had been put forward to explain changes which were observed.

VIADUCTS, CONCRETE

SEATTLE, WASH. High Concrete Stresses Used in Design of Viaduct of Novel Design, W. F. Way. Eng. News-Rec., vol. 104, no. 8, Feb. 20, 1930, pp. 327-329, 4 figs. Design and construction of Woodway Park Viaduct, Seattle; eight 40-ft. spans carried on tall columns without sway bracing of any sort; slab spans of 40 ft. have maximum depth of 17½ in.; design planned for simple formwork and easy placement; stresses of 1,200 lbs. per sq. in. in bending and 360 lbs. per sq. in. in shear were limiting working values for concrete. See editorial comment on pp. 307-308.

VISCOSIMETERS

ACCURACY. Accurate Cochius Viscosimeter (Ein genaues Cochiusviscosimeter), H. J. Schulz. Chemische Fabrik (Berlin), vol. 47, Nov. 20, 1929, pp. 497. Extremely accurate results are obtained from using special glass tubes made by Rheinische Praezisions-Glasfabrik.

W

WASTE ELIMINATION

INDUSTRIAL. Many Industrial Wastes Uneliminated, H. V. Coes. Iron Age, vol. 125, no. 1, Jan. 2, 1930, pp. 67-68. Numerous leaks in production and distribution remain unstopped, awaiting attention of management; further elimination of waste can be best obtained by distribution research, merchandise research, industrial research, and management research.

WATER

CRITICAL POINT. Research on the Critical Point of Water, J. Havlicek. Engineering (Lond.), vol. 129, no. 3338, Jan. 3, 1930, pp. 1-3, 4 figs. Account of theoretical investigation, made in 1915, in which author studied change from ideal liquid to ideal vapour, both phases retaining their ideal properties at all temperatures and at all pressures; equations deduced showed that border curves of ideal substance would meet in cusp and not in horizontal tangent and also that there was critical temperature above which only gaseous phase could exist, no matter how high the pressure.

VAPOUR PRESSURE. Effect of an Inert Gas under Pressure upon Vapour Pressure of Water (Ueber den Einfluss eines indifferenten Gases unter Druck auf den Dampfdruck des Wassers.) J. J. van Laar. Zeit. fuer Physikalische Chemie (Leipzig), vol. 145, no. 3-4, Dec. 1929, pp. 207-219. Fact discovered experimentally by E. P. Bartlett, that steam pressure may be increased 4 times by introducing inert gas, such as nitrogen, under high pressure, say 100 atmos., is proved by mathematical discussion of author to follow directly and with quantitative precision from exact thermodynamic theories of energy.

Engineering Index

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A

AERONAUTICAL RESEARCH LABORATORIES

Canada. The Aeronautical Laboratories of the National Council of Canada, J. H. Parkin. Eng. Jl. (Montreal), vol. 13, no. 2, Feb. 1930, pp. 95-103, 10 figs. Scope and nature of work of laboratories; requirements for wind-tunnel testing; types of wind tunnels; open-jet closed-return form of wind tunnel adopted for Laboratory described in detail; test tank for hydro-dynamic laboratory for research on seaplanes; test of power-plant equipment.

AIRPLANE PROPELLERS

Blade Interference. On the Aerodynamical Interference of Propeller Blades, T. Moriya. Tokyo Imperial Univ.—Faculty of Eng.—Jl. (Tokyo), vol. 18, no. 7, Jan. 1930, pp. 195-212, 11 figs.

Testing. Experimental Study of Screw Propellers in Yaw (Experimentelle Untersuchungen an schraeg angeblasenen Schraubenpropellern), O. Flachsbart and G. Kroeber. Zeit fuer Glugtechnik und Motorluftschiffahrt (Munich), vol. 20, no. 23, Dec. 14, 1929, pp. 605-614, 30 figs. Study of forces on propeller models of different pitch in wind tunnel with inclined angle of attach of 0 to 90 deg.

AIRPLANES

Design. Miscellaneous Collected Airplane Structural Design Data Formulae, and Methods, J. E. Younger. Air Corps Information Cir., vol. 7, no. 644, Mar. 1, 1930, 9 pp., 16 figs. Data, formulae, and methods for torsion in various sections, properties of airfoil section, combined loading English riveting practice, torsion in braced framework, bent strut, weight and load factors, axial load allowed in corrugated sheet, torsion combined with bending, single spar wing, torsional rigidity of shell wing, angle of twist of any thin-walled tube, flange efficiency, flat and curved thin sheet, torsion strength, landing chassis, and thin webs of deep beams.

Some Economical Aspects of Airplane Design, S. Kleinhans. Am. Soc. Mech. Engrs.—Preprint, for mtg. Mar. 12, 1930, 10 pp.

Fuels. Behaviour of Fuels for Airplanes Under Low-Temperature Conditions (Das kaelteverhalten von Kraftstoffen zur Verwendung in Luftfahrzeugen), E. Rackwitz and A. v. Philippovich. Luftfahrtforschung (Munich), vol. 5, no. 4, Nov. 28, 1929, pp. 148-156, 14 figs. Behaviour of benzol-gasoline, benzol-tuoline, alcohol-gasoline, alcohol-benzol, and alcohol-gasoline-benzol as fuels under low-temperature conditions as encountered in aviation are experimentally investigated; results are given in tables, curves, and graphs. Communication of Germany Experimental Laboratory for Aviation (D.V.L.)

Landing Gear. Undercarriage Developments, G. H. Dowty. Roy. Aeronautical Soc.—Jl., vol. 34, no. 230 Feb. 1930, pp. 170-183, 15 figs.

Multi-Engined. Multi-Motored Airplanes, J. J. Pesqueira. Aviation Eng., vol. 3, no. 3, Mar. 1930, pp. 7-8, 3 figs.

Seaplanes. *See Seaplanes.*

Welden Joints in. Strength of Welded Joints in Tubular Members for Aircraft. Aviation Eng., vol. 3, no. 3, Mar. 1930, p. 8. Results of investigation made by Bureau of Standards of strength of welded aircraft joints; efficiencies of butt joints averaged about 88 per cent in tension and 85 per cent in compression; inserted gusset plates and U-straps were best methods of reinforcing T and lattice joints; in loading T-joints with supports as close together as possible, joint having U-strap was about 30 per cent stronger than unreinforced joint.

Wind Tunnel Testing. Full Scale Wind Tunnel Tests with a Series of Propellers of Different Diameters on a Single Fuselage, F. E. Weick. Nat. Advisory Committee for Aeronautics—Report, no. 339, 1930, 16 pp., 16 figs. Aerodynamic tests were made with four geometrically similar metal propellers of different diameters on Wright Whirlwind J-5 engine in open-cockpit fuselage; tests were made in 20-ft. propeller research tunnel of National Advisory Committee for Aeronautics; results show little difference in characteristics of various propellers, only one of any importance being increase of efficiency of order of 1 per cent for 10 per cent increase of diameter.

AIRPORTS

Floating. Armstrong Seadrome Project Progresses, E. Hanson. Airway Age, vol. 11, no. 3, Mar. 1930, pp. 353-357, 7 figs. Description of seadrome, Langley, to be put on New York to Bermuda route; main platform 1,100 by 180 ft., widened at centre to 340 ft. to take care of superstructures, is supported at height of 80 ft. above water mean level by 32 columns; drome can swing freely before wind travelling about buoy with radius of 500 ft.; test work accomplished.

Quebec. Building the St. Hubert Airport Near Montreal, Quebec. Am. City, vol. 42, no. 2, Feb. 1930, pp. 119-121, 4 figs. Description of government airport occupying area of 975 acres and having runways 150 ft. in width and from 1,800 to 2,000 ft. in length; emulsified asphalt replaces hot asphalt; use of cross tiling; applying emulsion; dirigible mooring mast.

AIRSHIP DESIGN

Rigid. Rigid Airships, E. W. Stedman. Eng. Jl. (Montreal), vol. 13, no. 2, Feb. 1930, pp. 104-122, 47 figs. History of development of airships from time of first hot-air balloon is traced; Zeppelin airships; airships in R.31 and R.33 classes; aerostatics; fuels; hull design; general arrangement of rigid airship; description of British airship R.101; reference to R.100 and Z.M.C. 2 metal-clad airship. Bibliography.

ALLOYS

Beryllium. *See Beryllium Alloys.*

Copper. *See Copper Alloys.*

Die-Casting. *See Die-Casting.*

Iron-Molybdenum. *See Iron-Molybdenum Alloys.*

ALUMINUM

Rolling Mills. Mill Rolls Large Aluminum Shapes. Iron Age, vol. 125, no. 13, Mar. 6, 1930, pp. 707-710, 3 figs. Aluminum Structural mill rolling channels up to 14 in., as well as other shapes and flats, squares and rounds, was put into service by Aluminum Co. of America at Massena, N.Y.; by alloying aluminum, heating, treating it, and aging it, material is produced that has physical properties comparable with those of mild steel.

Spinning. The Spinning of Aluminum, W. J. Leeder. Metal Industry (Lond.), vol. 36, no. 9, Feb. 1930, pp. 241-244, 8 figs. Adaptability of spinning process which offers advantages of utmost importance; advantages of aluminum; spinning methods outlined; lubrication of blanks; speed of rotation; blank sizes; temper of material; chucks; pressed wood and spinning; tools for spinning.

Structural Shapes. Rolling Aluminum Structural Shapes. Eng. News-Rec., vol. 104, no. 11, Mar. 13, 1930, pp. 452-453, 2 figs. See editorial comment on p. 429. New Massena mill of United States Aluminum Co. is turning out range of sections from zees to channels of strong alloy from 3,000 lb. ingot casting and rolling methods; structural mill is served by overhead crane built of aluminum alloys.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Fifty Years of. Fifty Years of the A.S.M.E., C. W. Rice. Mech. Eng., vol. 52, no. 4, Apr. 1930, pp. 261-276, 7 figs. Review of status of mechanical engineering in 1880, year of Society's birth; reasons for Society of Mechanical Engineers; period of expansion; administration of Society affairs; decentralization; activity of individual members; aims and organization; participation during World War; international relations; meetings and some important papers; publications; local and student branches; technical committees; standardization; research; power test codes; boiler code; opportunities of future.

ASBESTOS PLANTS

Electric Equipment. A New 4,000 Ton Asbestos Mill, J. R. Mole. Elec. News (Toronto), vol. 39, no. 3, Feb. 1, 1930, pp. 51-54, 7 figs. Asbestos Corporation's latest addition at Thetford Mines, P.Q., known as "Beaver," is completely and thoroughly electrified for hoisting, crushing, drying and milling; plant used over 6,600 hp.

ASH HANDLING

Hydraulic. Progress in Design of Hydraulic Ash-Disposal Plants (Fortschritte im Bau hydraulischer Entaschungsanlagen), A. Zoebelein. Waerme (Berlin), vol. 53, no. 6, Feb. 8, 1930, p. 86. Experiences of past winter have shown that flotation process (scavenging trough) caused difficulties in frezing weather, whereas well-designed hydraulic ash-disposal plants, due to slight water requirement, were unaffected by severest weather conditions; improvements in these plants have been effected by use of low and medium pressure.

AUTOMOBILE ENGINES

Diesel. *See Diesel Engines.*

Fuel Vaporizing in. Compression Aids Vaporization of Engine Fuel, P. M. Heldt. Automotive Industries, vol. 62, no. 11, Mar. 15, 1930, pp. 435-436. While under conditions outlined, typical of engine operation under full load, compression increases heat necessary to vaporize fuel in theoretically correctly proportionated mixture by amount equal to that required to raise temperature of air in mixture 41 deg. fahr., compression on results in generation of heat to amount which would raise temperature of air 382 deg. fahr.

AUTOMOBILES

Bodies, Manufacture. The Production of Automobile Body Stampings. Metal Stampings, vol. 3, no. 3, Mar. 1930, pp. 261-264, 4 figs. Quantity production methods employed in manufacture of automobile body and fender stampings feature synchronized conveyor lines and teletype instructions to line setters; principal operation include: forming, die trimming or rotary power shearing, wiring and edging, and seaming by means of special folding blade and roller machine.

Performance Testing. New Method to Determine Time, Power Consumption, and Cost of Operation of Automobiles (Ein neues Verfahren zur Ermittlung der Fahrzeiten, des Betriebstoffverbrauchs und der Fahrkosten der Kraftwagen), W. Mueller. Verkehrstechnik (Berlin), vol. 47, no. 8, Feb. 21, 1930, pp. 97-103, 4 figs. Based on study of resistance against motion and engine power of cars, graphical and analytical method is derived by which power consumption and operating costs may be determined; method is illustrated by example.

B

BALANCING MACHINES

Optical. A New Optical Dynamic and Static Balancing Machine, Y. Taji. Mar. Engr. and Motorship Bldr. (Lond.), vol. 53, no. 630, Mar. 1930, pp. 90-92, 7 figs. New machine was designed by S. Kuno, of Mitsubishi Research Laboratories; principal feature of this machine is that dynamical and statical balancing of turbine rotors, etc., can be carried out with high degree of accuracy in very short time by measuring amplitude and phase of oscillation of rotor, due to unbalance, and determining magnitude and position of balancing weight.

BEAMS, STEEL-CONCRETE

Strength of. Strength of Steel Beams Encased in Concrete, P. W. Leisner. Concrete, vol. 36, no. 2, Feb. 1930, pp. 29-30, 2 figs. High points of European investigations and practice; each material considered as taking part of load; tests by Danish State railways; Swedish tests; high working stresses adopted in bridge building by Swiss Federal Railways.

BELTS AND BELTING

Rubber, Friction of. The Coefficients of Friction Between Rubber and Various Materials, R. Ariano. India-Rubber Jl. (Lond.), vol. 59, no. 2, Jan. 11, 1930, pp. 6-8.

BERYLLIUM ALLOYS

Uses. Magnesium, Magnesium-Rich Alloys and Beryllium Alloys, T. H. Turner. Metal Industry (Lond.), vol. 36, no. 3, Jan. 17, 1930, pp. 85-89, 8 figs. Present uses of magnesium and beryllium alloys are discussed; ability to produce magnesium alloy casting at approximately same price as similar size aluminum alloy casting is surprising, machining magnesium alloy castings; magnesium sheet; resistance to corrosion; present-day applications; promising developments of beryllium has been direct production of beryllium alloys of copper and nickel to be used as temper alloys.

BOILERS

Automatic Control of. Economy of Automatic Boiler-Control Equipment (Wirtschaftlichkeit selbsttaetiger Kesselregelanglagen), P. Kaufman. Waerme (Berlin), vol. 53, no. 8, Feb. 22, 1930, pp. 117-120, 1 fig. Use of automatic boiler-control equipment not only reduces operating costs, but also initial costs of plant, increases operating safety and reliability, and ease in operation; economic limits of automatic control are discussed.

Feedwater Treatment. Water Softening Plant at the Peerless White Lime Co., R. W. Smith. Rock Products, vol. 33, no. 6, Mar. 15, 1930, pp. 63-65, 3 figs. Description of water-softening plant which has been functioning for some time at Peerless White Lime Co., Ste. Genevieve, Mo., has several interesting features; designed and constructed by company engineers, its operation is entirely automatic; efficient automatic operation giving steady supply of soft water for boilers and other uses; hardness reduced to minimum.

Heat-Storage. Electrode Steam Boilers at Carliol House. Elec. Times (Lond.), vol. 77, no. 1996, Jan. 23, 1930, pp. 163-164, 2 figs. Headquarters of Newcastle-on-Tyne Electric Supply Co. was first building in England to be equipped with electrical thermal storage heating plant; plant comprises two 1,000-kw. Oerlikon steam boilers (one as standby), operating on three-phase, 6,000 volts supply direct; two calorifiers in which heat in steam is transferred to water; and two thermal storage cylinders, having combined capacity of 28,500 gals.; total energy stored is 40 million.

High Pressure. The Design and Results of a 600 Lb. per Sq. In. Boiler Installation, W. Nithsdale. Engineering (Lond.), vol. 129, no. 3350, Mar. 28, 1929, pp. 406-408, and (discussion), 416-418, 6 figs. Endeavour is made to discuss some points in design of high-pressure boiler plant, with special application to land installation which has been in commercial operation for some time in Britain, steam-rasing parts only being dealt with. Paper read before Inst. Mech. Engrs., Mar. 21, 1930.

High-Pressure, Welding. Welding on High-Pressure Boilers, F. Hofmann. Am. Welding Soc.—Jl., vol. 9, no. 1, Jan. 1930, pp. 7-16, 13 figs. Report of results after two years' operation of high-pressure Loeffler boiler in power station of Karolina plant of Witkowitz Collieries, Czechoslovakia.

Locomotive. *See Locomotives.*

Plates, Stresses in. Failure and Life of Boilers and Vibration Resistance of Material (Schaeden und Lebensdauer der Dampfkessel in ihrer Abhaengigkeit von der Beanspruchung und Schwingungsfestigkeit der Werkstoffe), M. Ulrich. Veroeffentlichungen des Zentral-Verbandes der Preussischen Dampfkessel-Ueberwachungs-Vereine (Halle), no. 5, 1929, pp. 7-14, 8 figs.

Pulverized-Coal-Fired. Development of Pulverized-Coal Firing for Fire-Tube Boilers (Die Entwicklung der Kohlenstaubfeuerung fuer Flammrohrkessel), P. Krebs. Waerme (Berlin), vol. 53, no. 11, Mar. 15, 1930, pp. 169-175, 12 figs. Account of first tests with pulverized-coal-fired fire-tube boilers, and unsuccessful results with boiler without combustion chamber; improvements in design; success of turbulent firing in marine boilers, and application of experiences to stationary boilers.

Tubes, Ribbed. Gilled Tubes for Boiler Combustion Chambers. Engineering (Lond.), vol. 129, no 3350, Mar. 28, 1930, p. 421, 2 figs. Description of boiler combustion chamber fitted with gilled, or winged water-tube on system developed by J. Deschamps, Paris; gilled rings which are fitted over tubes are described by author as "ailettes," which may be translated as "little wings"; purpose of ailettes is to improve combustion and to allow to reduction in size of combustion chamber.

Water-Tube. Influence of Coefficient of Excess Air on Behaviour of Water-Tube Boilers (Einfluss der Luftueberschusszahl auf das Verhalten von Wasserrohrkesseln), F. Michael. Feuerungstechnik (Leipzig), vol. 18, no. 112, Jan. 15, 1930, pp. 5-9, 7 figs. Result of calculation of Babcock and Wilcox inclined-tube boiler with lignite stepped-grate firing; relation of heat output per square meter heating surface and flue-gas temperatures to excess air; and relation of exhaust-gas temperature, efficiency of superheating, and feedwater, and air preheating to excess air.

Wood-Waste-Fired, Efficiency of. High Efficiency Obtained from Wood Waste Fuel, K. P. Mykanen. Power Plant Eng., vol. 34, no. 6, Mar. 15, 1930, pp. 334-336, 4 figs. Tests made by Association of Power and Fuel Economy in boiler plant of Enso-Gutzeit Osakeyhtio, Finland, show efficiencies of 85 per cent when using wet wood waste; tabulated tests data and calculated results of seven 8-hr. boiler tests; efficiency curves drawn from three tests.

BORE HOLE SURVEYING

New Device. New Electric Well Surveying Device Simplifies Long Operation, W. F. Lowe. Nat. Petroleum News, vol. 22, no. 5, Jan. 29, 1930, pp. 57-58, 1 fig. Description of new instrument, called Driftmeter, claimed to have many advantages over older methods; principle of device is measurement of directional shifts by change in current intensity of electric circuit; tabular comparative readings of Driftmeter and acid bottle, in survey of two wells.

BRASS CASTINGS

Influence of Silicon. The Influence of Silicon in Foundry Red Brasses, H. M. St. John, G. K. Eggleston and T. Rynalski. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 300, for mtg. Feb. 1930, 18 pp., 21 figs. Incipient shrinkage; silicon in copper and copper alloys; factors influencing grain size; experimental procedure; experimental results; sources of silicon and its removal; discussion of results, with summary enumerating 13 conclusions drawn.

BRIDGE CONSTRUCTION

Cofferdams. Cofferdams Built on Shore. Constructor, vol. 12, no. 3, Mar. 1930, p. 61, 3 figs. In construction of Cherokee Bridge over Tennessee River, at Knoxville, two cofferdams, each 40 by 120 ft. by 25 ft. high outside dimensions, and containing 150 tons of timber and 4 tons of hardware, were built on bank of river, launched and floated to pier site supported on 150 empty sealed barrels of 50 gal. capacity.

BRIDGE DESIGN

Composite Trusses. Approximate Formulae for Design of Composite Trusses for Bridges (Naeherungsformeln zur Berechnung von Haenge- und Sprengwerken fuer Bruecken), O. Seyller. Schweizerische Bauzietung (Zurich), vol. 95, no. 1, Jan. 4, 1930, pp. 1-3, 2 figs. Mathematical analysis of stresses leading to derivation of approximate formulae; numerical examples.

BRIDGES, CONCRETE

Construction. Concrete Bridge Construction in Walla Walla County, E. R. Smith. Pub. Works, vol. 61, no. 2, Feb. 1930, pp. 59-62, 7 figs. County engineer of Walla Walla Co., Washington, describes construction of single- and multiple-span concrete highway bridges of moderate length; sample of construction sketches; detailed bid sheets; official dope sheets, etc.

Germany. Two New Highway Bridges over Naabarme in Schwandorf (Zwei neue Strassenbruecken ueber die Naabarme in Schwandorf), von Moro. Zentralblatt der Bauverwaltung (Berlin), vol. 49, no. 47, Nov. 20, 1929, pp. 762-764, 8 figs. Design and construction of concrete bridges, of maximum span 35 m.; details of spiral reinforcement of abutment of concrete arch bridge.

Ontario. New Bridge and Dam at Arnprior, Ont. Can. Engr. (Toronto), vol. 58, no. 12, Mar. 25, 1930, pp. 421-424, 6 figs. Description of combined water works dam and highway bridge, constructed at cost of $100,000 to replace old timber structure; entire structure built of reinforced concrete; bridge is 500 ft. long and 33 ft. wide; dam is 23 ft. high.

Steel Reinforcements. Welded Reinforcement for a Concrete Highway Bridge. Engineer (Lond.), vol. 149, no. 3868, Feb. 28, 1930, pp. 252, 1 fig. Brief description of multi-span reinforced concrete bridge in Victoria; light trusses, which were welded throughout, were constructed to span between piers; their form is such that they could be entirely embedded in concrete and act as partial reinforcement.

BRIDGES, CONCRETE ARCH

Germany. The Giebichenstein Bridge at Halle (Die Giebichensteinbruecke in Halle), A. Heilmann. Bauingenieur (Berlin), vol. 10, no. 45, Nov. 8, 1929, pp. 789-794, 10 figs. Construction of concrete arch bridge over Saale River, having maximum span of 60 m., to replace obsolete steel truss bridge; architectural treatment and ornamental sculpture for bridge.

Reinforced-Concrete Arch Bridge over Lahn River between Oberlahnstein and Niederlahnstein (Eisenbetonbogenbruecke ueber die Lahn zwischen Ober- und Niederlahnstein), A. Dischinger. Bautechnik (Berlin), vol. 7, no. 55, Dec. 20, 1929, pp. 861-863, 6 figs. Design and construction of hiway bridge having single span 78 m. long; details of reinforcement and erection falsework; total cost 192,000 marks.

Columbia-Wrightsville. Wooden Trestle Speeds Construction of Multiple-Arch Reinforced Concrete Highway Bridge, W. C. Fry, Jr. Contractors and Engrs. Monthly, vol. 20, no. 2, Feb. 1930, pp. 68-72, 8 figs. Design and construction of highway bridge between Columbia and Wrightsville, Pa.; having overall length of 7,374 ft. and comprising 28 arch spans, each 198 ft. on average; use of steel centreing; plant layout; timber trestle; tests.

BRIDGES, MOVABLE

Great Britain. Swing-Bridges over the Weaver Navigation, with Some Information about Other Movable Bridges, J. A. Saner. Instn. Civ. Engrs.—Selected Eng. Papers (Lond.), no. 79, 1929, 9 pp., 2 figs. Mechanical features are tabulated; statistical data on dimensions, etc. of more than 20 movable bridges in Great Britain.

BRIDGES, RAILROAD

England. Reinforced Concrete Railway Bridges, R. L. McIlmoyle. Concrete and Constr. Eng. (Lond.), vol. 25. no. 1, Jan. 1930, pp. 37-45, 10 figs. Report on practice of London, Midland and Scottish Railway; deck slab reinforcement; general arrangement of bridge over railway; lay-out of flat slab bridges; slab reinforcement and construction joints.

BRIDGES, STEEL

Welding vs. Riveting. Endurance Tests on Riveted and Welded Bridges, R. Bernhard. Metallurgist (Supp. to Engineer, Lond.), Feb. 1930, pp. 23-24. Author describes number of informative tests carried out to investigate behaviour of bridges under repeated loading; tests were intended also to show difference between riveted and welded bridges with particular reference to latest developments in welding practice. Translated abstract of article indexed in Engineering Index 1929, from V.D.I. Zeit., Nov. 23, 1929.

BRIDGES, SUSPENSION

Quebec. One of Canada's Great Highway Bridges, P. L. Pratley. Contract Rec. (Toronto), vol. 44, no. 9, Feb. 1930, pp. 220-226, 14 figs. Design and construction of suspension bridge over St. Maurice River at Grand'Mere, Que.; having span of 949 m., towers 128 ft. high and roadway 18 ft. wide; anchorage system; truss loading; rope strand system adopted; cable assembly.

BRONZE CASTINGS

Unsoundness in. Unsoundness in Bronze Castings, E. J. Daniels. Inst. of Metals—Advance Paper, no. 515, for mtg. Mar. 12, 13, 1930, 18 pp., 7 figs. Effect of some pure gases on soundness of bronze, and of casting in sand moulds of metal subjected to various melting treatments, is described, and tentative explanation of cause of unsoundness occurring in practice is suggested. Bibliography.

BUILDING MATERIALS

Sound Absorbing. Sound Insulation and Sound Absorption (Schallisolation und Schallabsorption), E. Meyer. V.D.I. Zeit. (Berlin), vol. 74, no. 9, Mar. 1, 1930, pp. 273-279, 19 figs. Report from Heinrich-Hertz-Institut, on electrical apparatus used by that Institute for testing efficiencies of sound-insulating and sound-absorbing materials.

BUILDING STONE

Weathering. The Weathering of Stone. Quarry and Surveyors' and Contractors' Jl. (Lond.), vol. 35, no. 395, Jan. 1930, pp. 18-22. Extracts from 1928 report of Building Research Board covering: efflorescences, their causes, effects and prevention; factors influencing distribution of moisture; evaporation; capillary properties; selective decay; biological agencies in stone decay; action of calcium sulphate; action of frost; remedial measures; cleaning of buildings.

BUILDINGS, STEEL

Welded. Design and Fabrication of Oxy-Acetylene Welded Buildings, H. M. Priest. Am. Welding Soc.—Jl., vol. 9, no. 2, Feb. 1930, pp. 33-43, 13 figs. Preparation of design for oxyacetylene-welded building outlined; importance of locating welds and arranging details so that work is accessible; steel construction of steel frame mill-type building of Union Carbide and Carbon Co. at Niagara Falls in which oxyacetylene welding was used in shop fabrication and in erection; essential consideration for affecting use of oxyacetylene process. Paper read before Int. Acetylene Assn. and Joint Meeting of Am. Welding Soc. and Am. Soc. Civil Engrs.

C

CANAL LOCKS

Floating Trough. Locks Without Consumption of Water Having Floating Pneumatically Operated Admission Basin (Schleuse ohne Wasserverbrauch mit schwimmenden luftbetriebenen Aufnahmebecken), H. Proetel. Bautechnik (Berlin), vol. 7, no. 54, Dec. 13, 1929, pp. 856-858, 5 figs. Principles of construction and operation of floating trough locks; construction and operation cost data.

CANALS

Movable Sections. The Raising of Barton Swing-Aqueduct, and the Renewal of Paths and Rollers, R. D. Brown. Instn. Civ. Engrs.—Selected Eng. Papers (Lond.), no. 67, 1929, 15 pp., 5 figs. Description of swinging section carrying old Bridgewater Canal over Manchester Ship-Canal at Barton, near Manchester; this section which is materially steel-wall tank 19 ft. wide about 7 ft. deep and about 230 ft. long, swings upon turning path, 27 ft. in mean diam. and 32 in. wide; report on repairs and improvements in construction; excerpts from specifications for metals used in paths, rollers, and axle pins; list of construction plant used.

CARS, STREET RAILROAD

Control. Speed, Comfort, and Safety With a New Multipoint Control, C. J. Axtell and R. H. Sjoberg. Gen. Elec. Rev., vol. 33, no. 3, Mar. 1930, pp. 158-163, 7 figs. Newly developed means furnishing at least partial solution of traffic difficulties encountered by street cars; chart showing fast, smooth acceleration secured through use of multi-point control; curves of schedule speed and energy consumption for various rates of acceleration and for various rates of breaking, are given.

CASE HARDENING

CARBURIZING. Mechanism of Carburization. Am. Soc. Steel Treating—Trans., vol. 17, no. 4, Apr. 1930, pp. 588-593, 2 figs. Purpose of carburizing; hardness; carbon content of case; effect of alloy elements; theory of carburizing process; formation of iron carbide; absorption of iron carbide by steel; general carburizing processes. Recommended Practice Committee Release.

CAST IRON

HIGH-TEST. High-Duty Cast Irons, A. E. McRae Smith. Foundry Trade Jl. (Lond.), vol. 42, nos. 701, 702, and 703, Jan. 23, 1930, pp. 59-60, Jan. 30, 1930, pp. 83-87, and (discussion), Feb. 6, 1930, pp. 99-100, 15 figs.

High Strength Cast Iron, E. J. Lowry. Am. Soc. Steel Treating—Trans., vol. 17, no. 4, Apr. 1930, pp. 538-557 and (discussion) 558-562, 26 pp. Author points out that perhaps greatest development in line has been made by European investigators; as a rule textbook information is not representative of cast iron produced today; addition of alloys is no means of producing high-strength cast iron from inferior irons; photo-micrographs are given of various alloy cast irons, also tables giving physical properties.

PROPERTIES. Grey Iron Possesses Valuable Engineering Properties. Foundry, vol. 58, no. 5, Mar. 1, 1930, pp. 107-110 and 142, 17 figs. While tensile strength values of grey cast iron generally are taken from separately cast test bars, considerable work is being done to correlate this with properties that may be expected in castings; close approximation made by casting bar with twice the diameter of average or most important section of casting, and it will have approximately same cooling conditions; various properties of iron, some erroneous impressions of which are corrected.

TESTING. Mass and Skin Effects in Cast Iron, Swift. Foundry Trade Jl. (Lond.), vol. 42, nos. 702 and 703, Jan. 30, 1930, pp. 79-80, Feb. 6, 1930, pp. 106 and 108, 6 figs. Jan. 30: Extent to which mechanical properties of cast iron are affected by transverse section of bar as cast, and by machining to various depths below skin; B.E.S.A. grey iron specifications; tests for tensile strength, crushing strength, Brinell and scleroscope hardness and resistance to abrasion. Feb. 6: Results of tensile and compressive tests carried out upon bars after their diameters had been reduced by turning; metallurgical aspects.

CASTING

CENTRIFUGAL. Centrifugal Castings and their Metallographic Analysis (Schleuderguss und seine metallkundliche untersucbung), M. v. Schwarz and A. Vaetb. Giesserei (Duesseldorf), vol. 17, nos. 8-11, Feb. 21, 1930, pp. 177-182, Feb. 28, pp. 204-208, Mar. 7, pp. 230-234, and Mar. 14, pp. 253-255, 41 figs. in all. Economy and advantages of centrifugal casting are set forth; main processes with horizontal axis; Bill and process with vertical axis; study of phosphorus-rich sand castings; investigation of unannealed centrifugal castings; structure, specific gravity, etc.; annealing tests of centrifugal castings; change in hardness, specific gravity, and bound carbon content.

CASTINGS

DESIGN. Factors Governing More Accurate Design of Castings (Die Bedingtheit Konstruktionsgenauer Formgebung), Riebensahm. Giesserei-Zeitung (Berlin), vol. 27, no. 5, Mar. 1, 1930, pp. 114-115. Author points out difficulties of coordinated working processes in foundry practice as compared with other metal-working practice; it is claimed that relations between casting, mould, and pattern greatly influence quality of castings.

MACROSTRUCTURE OF. Macrostructure of Cast Alloys: Effect of Turbulence due to Gases, R. Genders. Inst. of Metals—Advance Paper, no. 519, for mtg. Mar. 12-13, 1930, 6 pp., 7 figs.; see also Engineering (Lond.), vol. 129, no. 3348, Mar. 14, 1930, pp. 357-358, 7 figs. Communication forms additional section to previous paper in which work was described having object of making possible more general interpretation of macrostructure of cast metals; observations indicate that when ingot of small thickness is cast in mould prepared by application of coating or "dressing" of volatile material, macrostructure is considerably modified by turbulence resulting from evolution of gases between mould and liquid metal.

CEMENT KILNS

ROTARY. The Rotary Kiln in Cement Manufacture, W. Gilbert. Cement and Cement Mfr. (Lond.), vol. 3, no. 1, Jan. 1930, pp. 41-54, 7 figs. Series of articles treat of rotary kiln mainly from point of view of output and fuel economy and explain laws which govern rate of heat transmission from hot gases to raw materials in kiln, and from hot clinker to air passing through cooler. Article also printed in same issue in French, German and Spanish. (To be continued.)

CEMENT MANUFACTURE

RAW MIX. Raw Mix Control in Cement Manufacture, G. W. Jordan. Rock Products, vol. 33, no. 7, Mar. 29, 1930, pp. 55-56, 1 fig. Hydraulic modulus used in mix control; clinker appearance good evidence of quality; connection between silica-flux ratio and lime-silica index; lime-silica index of clinkers for different silica-flux values; essential factors in proportion.

CEMENT TESTING

OBJECT OF. The Testing of Cement, G. Haegermann. Cement and Cement Mfr. (Lond.), vol. 3, no. 1, Jan. 1930, pp. 69-72. Object of testing of cement is determination of principal qualities as constructional material; essential properties of cement are soundness, setting-time, and strength, fineness, volume, and specific gravity are of less importance; experience has shown that soundness and setting-time may be ascertained by testing specimens of neat cement, but strength should be determined by cement-sand mixtures. Article also printed in same issue in French, German, and Spanish.

COAL CARBONIZATION

LOW-TEMPERATURE. Low-Temperature Carbonization of Fuel, with Special Reference to Its Combination With the Production of Electricity (English Practice), E. H. Smythe and E. G. Weeks. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 398, Feb. 1930, pp. 219-228 and (discussion) 229-236.

Smokeless Fuels (Combustibles sans Fumée), P. Weiss. Chimie et Industrie (Paris), vol. 23, no. 1, Jan. 1930, pp. 2-13, 8 figs. Author describes Abder-Halden process for distilling pulverulent coals, K. S. G. retort, and briquetting process (tar-bonded avoids) as used at several mines in France, and discusses economic results obtained.

COAL MINES AND MINING

STREAM POLLUTION. Sealing Old Workings Prevents Acid Formation and Saves Pipes and Streams, R. D. Leitch and W. P. Yants. Coal Age, vol. 35, no. 2, Feb. 1930, pp. 78-80, 4 figs. Discussion of laboratory work that demonstrates fact that if iron pyrite can be kept out of contact with oxygen of air, sulphates of iron cannot be formed and, consequently, iron oxides and free sulphuric acid will be absent from mine drainage; samples were taken from all available sources, open and sealed, in eight mines in southwest section of Indiana.

COAL PREPARATION

STATUS OF. Present Status of Coal Preparation (Die gegenwaertigen Probleme der Kohlenaufbereitung), K. Glinz. Bergbau (Gelsenkirchen), vol. 42, no. 49, Dec. 5, 1929, pp. 689-693. Theoretical principles underlying preparation; preparation of coarse and fine coals; separation of fusain; dewatering; clay removal; drying; economic measures. From address before 2nd International Conference on Bituminous Coal in Pittsburgh.

COLUMNS

DESIGN. The Design of Column Bases in Single Storey Buildings, G. J. Voce. Structural Engr. (Lond.), vol. 8, no. 1, Jan. 1930, pp. 21-25, 5 figs. Design of steel base; anchor bolts; base angles; base plate; concrete foundations; numerical examples.

FOOTINGS. Design of Steel Slabs for Column Bases, K. G. Merriam. Eng. and Contracting, vol. 69, no. 3, Mar. 1930, pp. 131-134, 5 figs. Report on investigation performed at Worcester Polytechnic Institute in attempt to evolve design method based on experimental evidence obtained with full-sized specimens, and which would be free of uncertainty regarding fundamental assumptions; duplicating action of crumbling footing; deflectometer tests on square slabs; numerical example; experimental check on proposed design method. Agstract of paper presented before Am. Inst. of Steel Construction.

WOODEN, TESTING. Tests of Large Timber Columns and Presentation of the Forest Products Laboratory Column Formula, J. A. Newlin and J. M. Gabagan. U.S. Dept. of Agriculture—Tech. Bul., no. 167, Feb. 1930, 44 pp., 8 figs. Bulletin discusses tests on large structural timbers under following headings: introduction, methods of test, results and discussion, conclusions, and appendix.

COMPRESSORS

RECIPROCATING. Mean Theoretical Back Pressure and Its Relation to Actual Mean Back Pressure in Kilogram per Square Centimeter in Reciprocating Compressors, and Their Mechanical Efficiency (Der mittlere theoretische Gegendruck (pwo) und dessen Beziebungen zum tatsaechlichen mittleren Gegendruck in kg. qcm. bei Kolbenkompressoren, sowie dren mechanische Wirkungsgrade), H. R. Karg. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 23, no. 6, Mar. 14, 1930, pp. 109-114, 9 figs. Efficiency of compressors is discussed and new simple method for graphical determination of efficiency factor is proposed and illustrated by examples.

CONCRETE AGGREGATES

CHARACTERISTICS OF. Effect of Characteristics of Aggregates on the Quality of Concrete, S. Walker. Pit and Quarry, vol. 19, no. 12, Mar. 12, 1930, pp. 75-81. Discussion of aggregate characteristics which are of less importance than proportioning, mixing, placing and curing concrete; significant characteristics of aggregate; soudness and durability; sodium sulphate tests; freezing and thawing tests; miscellaneous deleterious substances; grading of coarse aggregates.

CONCRETE DESIGN

SIMPLIFIED. Reinforced Concrete Design Simplified, J. R. Griffith. Concrete, vol. 36, no. 2, Feb. 1930, pp. 43-46, 2 figs. Construction of charts for design of beams reinforced for compression; quantity comparisons of steel required in beams reinforced for compression.

CONTRACTION OF CONCRETE. Necessity, when Designing Reinforced-Concrete Structures, of Taking into Account the Contraction of Concrete on Setting (Sur la nécessité de tenir compte du retrait du béton à la prise dans le calcul des ouvrages en béton armé), De Sparre. Académie des Sciences—Comptes Rendus (Paris), vol. 189, no. 20, Nov. 12, 1929, pp. 791-793. Author emphasizes importance of allowing for forces set up by concrete on setting; contraction of concrete causes strain, and reinforcement will produce tensile stresses in concrete while bond with concrete is maintained.

CONCRETE MIXING

VARIATIONS IN. Effect of Fineness and Composition on Quantity of Water in Cement, H. Kuhl. Concrete, vol. 36, no. 2, Feb. 1930, pp. 111-116, 6 figs. Variations in concrete of mixes of "wet" consistency using cements of equal standard test strength accredited to fineness of cement; view that cement develops best properties as it is ground finer held in error. Paper read at Assn. of German Portland Cement Mfrs., translated from Zement.

DESIGN OF. The Design of Concrete Mixtures, A. E. Wynn. Concrete and Constr. Eng. (Lond.), vol. 25, no. 1, Jan. 1930, pp. 90-98, no. 2, Feb. 1930, pp. 149-158. Jan.: Details of economies effected by use of water-cement-ratio proportioning; results on recent contracts; advantages to contractor; variations in curves. Feb.: United States specifications; specification of New York Highway Department; methods of testing; ready-mixed concrete.

ADMIXTURES. The Effect of Clay as an Admixture in Concrete, A. N. Vanderlip and H. H. Scofield. Cornell Civ. Eng., vol. 38, no. 5, Feb. 1930, pp. 105-108 and 119, 5 figs. Preliminary report on tests; effects of clay, and of alternate freezing and thawing on strength and permeability of concrete; strength of resulting concrete is reduced by replacing 10 per cent of cement by approximately equal weight of clay. Bibliography.

CONCRETE SLABS

DESIGN. Simplified Method of Designing Slabs with Two Equal Concentrated Loads (Vereinfachte Berechnung von Platten mit Zwei Gleichen Einzellasten), R. Hauer. Bauingenieur (Berlin), vol. 10, no. 45, Nov. 8, 1929, pp. 796-798. Derivation of simplified, approximate formulae satisfying practical needs.

CONSTRUCTION INDUSTRY

GREAT BRITAIN. The Engineering Outlook—Constructional Engineering. Engineering (Lond.), vol. 79, no. 3347, Mar. 7, 1930, pp. 307-309. Both as regards buildings and erection of bridges and other steel structures, construction-engineering industry has had busy year; national unemployment insurance statistics for constructional engineering; apart from home demand, there is valuable export business; especially in Empire countries; statistics on unemployment in general engineering; national unemployment insurance statistics.

COPPER ALLOYS

HEAT CONDUCTIVITY. Thermal Conductivity of Copper Alloys, C. S. Smith. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 291, for mtg. Feb. 1930, 23 pp., 5 figs. Paper contains complete review of all previous work that has been done on copper alloys, and includes detailed description of apparatus and method of procedure used in present research, together with new results obtained on copper-zinc series, which is only one completed at present time; subsequent papers describing other alloys will contain experimental results and discussion only.

COPPER INDUSTRY

PRODUCTION AND CONSUMPTION. Copper Production and Consumption, P. E. Barbour. Eng. and Min. Jl., vol 129, no. 6, Mar. 24, 1930, pp. 303-304, 1 fig. Difference of opinion exists as to whether there is over-production or under-consumption; graph of United States and world production, 1880 to date, with comment on its regularity and post-war depression of 1921; Rhodesia, Congo, and Russia as factors in future production. Abstract of first of three articles in Annalist.

COPPER METALLOGRAPHY

DISCUSSION OF. Directed Stress in Copper Crystals, C. H. Mathewson and E. R. Van Horn. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 301, for mtg. Feb. 1930, 26 pp., 20 figs. Discussion of work of earlier investigators; preparation of single crystals; method of cutting sections on predetermined plants; location of an octahedral plant; location of dodecahedral plant; deformation of oriented sections; deformational bands in unequally strained parts of single crystal; deformation by rolling; deformation by impact. Bibliography.

COPPER REFINING

LEAD IMPURITY. Distribution of Lead Impurity in a Copper-Refining Furnace Bath, J. W. Scott and L. H. DeWald. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 290, for mtg. Feb. 1930, 5 pp., 2 figs. Lead occurs more or less uniformly distributed in bath; tendency to concentrate toward surface as oxidation progresses; initial reduction of lead content is easier when larger amounts of lead are present; oxygen content increases progressively during oxidation period and decreases with depth; lead must be in oxidized condition, to unite with carrier slag; agitation must be effected so that lead may come in contact with carrier slag.

COUPLINGS

FLEXIBLE. Flexible Couplings, W. Staniar. Indus. Eng., vol. 88, no. 2, Feb. 1930, pp. 100-102, 10 figs. Discussion of various types of special couplings which have been devised to avoid bending stresses in shafting and excessive pressures on bearings caused by misalignment; outstanding advantages of several types.

CRANES

FOUNDRY. Improvements in Electric Equipment of Foundry Cranes (Neuerungen bei elektrischen Ausruestungen von Giessereikranen), C. Schiebeler. Giesserei (Duesseldorf), vol. 17, no. 8, Feb. 21, 1930, pp. 186-189, 9 figs. Two new devices are described, namely, connection for precise regulation, and 3-phase double crane motor for rapid raising and lowering of light loads; both of these devices, developed by A.E.G. greatly increase efficiency of crane operation.

CRANKSHAFTS

FATIGUE IN STEEL OF. Fatigue Characteristics of Crankshaft Steel (Ermuedungseigenschaften von Kurbelwellenstahl), K. Matthaes. Maschinenbau (Berlin), vol. 9, no. 4, Feb. 20, 1930, pp. 117-122, 26 figs. Fractures which have actually occurred are investigated as to composition, structure, texture, etc., and with respect to strength characteristics, i.e., notching, bending, and resistance to torsional vibration; conclusions drawn are checked by model experiments.

CRUSHED STONE PLANTS

NEW YORK. A Straight-Line Designed Crushed Stone Plant. Rock Products, vol. 33, no. 7, Mar. 29, 1930, pp. 57-61, 13 figs. Details of Federal Crushed Stone Corp., Buffalo, N.Y., which has limestone crushing and screening operation combining simplicity and economy in first cost with capacity and low operating cost; safety feeding device; duplicate screening system.

D

DAMS, EARTH

CONSTRUCTION. Pishkun Reservoir Enlargement. U.S. Bur. of Reclamation—Specifications, no. 509, 6 pp., 7 figs. on supp. sheet. Statement of equipment and specifications for stripping and plowing foundation for dikes, blasting of construction; embankments of clay, sand, gravel and cobble.

DAMS, ROCK-FILL

LEAKS IN. Finding Leaks in Rock-Filled Dams, L. Rankin. Paper Industry, vol. 11, no. 12, Mar. 1930, pp. 2150-2151. Conservation of water increases output of low-head plants; locating leaks; plugging up leaks.

DIE CASTING

ALLOYS, ZINC BASE. A Note of Zinc-Base Die-Casting Alloys, R. Lancaster and J. G. Berry. Inst. of Metals—Advance Paper, no. 524, 2 pp., 4 figs. Effect of adding small quantities of magnesium to zinc-base alloy, hardened with copper and aluminum, has been examined; there is variation in physical properties, and distinct change in crystalline structure, with successive small additions of magnesium.

DATA ON. Die Casting, A. H. Mundey. Metal Industry (Lond.), vol. 36, no. 2, Jan 10, 1930, pp. 33-34. Results of investigations of large range of alloys for die casting as well as selection of mould materials; gravity die castings preferable when mechanical properties of finished castings are chief consideration and pressure castings are to be preferred when accuracy of dimension and elimination of machining are of first importance; magnesium alloys; aluminum alloys. Paper presented before Coordinated Soc., Birmingham.

DIESEL-ELECTRIC POWER PLANTS

GREAT BRITAIN. Oil Engine Power for Local Generating Stations. Gas and Oil Power, (Lond.), vol. 25, no. 294, Mar. 6, 1930, pp. 101, 1 fig. Arrangement of generating station employing heavy-oil engines to serve town of Bridport, Dorset, and immediate neighbourhood; total output of 362.5 kva.; six-cylinder engine with 12-in. bore and 17-in. stroke, running at 333 r.p.m., and three-cylinder unit with 10-in. bore and 15-in. stroke, which runs at 375 r.p.m.; lubricating and auxiliary equipment.

DIESEL ENGINES

AUTOMOTIVE. High-Speed Oil-Engines, E. C. Madgeburger. Soc. Automative Engrs.—Jl., vol. 26, no. 2, Feb. 1930, pp. 203-214 and (discussion) 214-220, 26 figs. Principal advantages sought in adopting Diesel cycle and developing oil engines to operate at high rotative speeds are discussed; descriptions of number of engines of different classes, slected according to contribution their designs have made to art; particular attention is given to provisions for metering fuel and for supercharging.

DOMES

DESIGN. Analytical Solution of Masonry Domes: Unbalanced Loads, D. C. Coyle. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 809-816, 3 figs. Discussion by A. Floris, and author's closure of discussion of paper published in issue of Aug. 1929; theory of stress distribution in beams with anti-symmetrical wind pressure; meridian and ring stresses; shearing stresses. Bibliography. See Engineering Index 1929, p. 579.

DRAINAGE PUMPING PLANTS

GERMANY. Flood Protection in the Moersbach District between Moers and Repelen (Die Vorflutbeschaffung im Moersbachgebiet zwischen Moers und Repelen), Schuetz and Dischinger. Bautechnik (Berlin), vol. 7, no. 48, Nov. 8, 1929, pp. 737-740, 13 figs. Report on work of left side Lower-Rhine Drainage District near Moers in Germany; details of pumping plant consisting of three vertical-axis centrifugal units having aggregate capacity of 5,800 cu. m. per second when operating against head of 3 m.

E

ELECTRIC CABLES

UNDERGROUND—TEMPERATURE. Earth Temperatures and Their Use in Rating Cables. Nat. Elec. Light Assn.—Pub., no. 021, Dec. 1929, 13 pp., 30 figs. Result of study on earth temperatures throughout United States; as earth temperature is based upon which operating temperatures of cables are determined, complete knowledge of their seasonal changes and variation with depth of duct line is essential; three chief methods of measuring earth temperatures as reported by various companies are described.

ELECTRIC CIRCUIT BREAKERS

COMPRESSED AIR. High Capacity Breakers Without Oil (Hochleistungschalter ohne Oel), J. Biermanns. Elektrotechnische Zeit. (Berlin), vol. 51, no. 9, Feb. 27, 1930, pp. 299-304, 9 figs. Results of further development work on compressed air breaker; 100-kv. breaker with 1,500,000 kva. heating capacity has been built successfully; history of development is reviewed, which has started with water breaker and it is shown why, regardless of favourable results obtained with breaker, A.E.G. has decided upon compressed-air breaker of Ruppel.

ELECTRIC CODES

CANADA. Canadian Electrical Code. Can. Eng. Standards Assn. (Ottawa), part I, 2nd edition, 210 pp., 25 cents. Essential requirements and minimum standards governing electrical installations for buildings, structures and premises, potentials of from 0-5,000 volts.

ELECTRIC CONDENSERS

DESIGN. Design of Condensers for Power-Factor Improvement (Die Ausfuehrungsformen von Kondensatoren zur Verbesserung des Leistungsfaktors), K. Schneider. Elektro Jl. (Charlottenburg), vol. 9, no. 22, Dec. 1929, pp. 227-229. Characteristic features of static phase-displacement condensers as manufactured by A.E.G., S. S. W. Meirowski, von Haetely and Sundyberg.

ELECTRIC CONDUCTORS

ALUMINUM. Aluminum Conductors and Corona. Elec. (Lond.), vol. 104, no. 2696, Jan. 31, 1930, pp. 137-138, 2 figs. Features of aluminum as material for electric conductors are outlined; steel-core aluminum conductors and copper hollow conductors for 220-kv. lines are discussed and compared.

BARE WIRES. Heating and Current-Carrying Capacity of Bare Conductors for Outdoor Service, O. R. Schurig and C. W. Frick. Gen. Elec. Rev., vol. 33, no. 3, Mar. 1930, pp. 141-157, 18 figs. Review of existing and new data on temperature rise of bare conductors under continous loads in both outdoor and indoor locations; formulae for calculation of currents to be carried by conductors limited to given temperature rise; theoretical considerations of heating; effects of conditions of exposure; comparison of calculations and tests and typical computations of current.

ELECTRIC FURNACES

See Furnaces.

ELECTRIC INSULATING MATERIALS

MOULDED. Moulded Insulating Compositions, A. R. Dunton and A. W. Muir. Elecn. (Lond.), vol. 104, no. 2698, Feb. 14, 1930, pp. 192-194, 7 figs. Review of moulded materials of any classification; arc-resisting, heat-resisting, hot service, moderate temperature and normal temperature service materials; concrete mounted reactance coils in cement moulding shop; improved quality and increasing variety; development of new processes.

ELECTRIC LINES

CONSTRUCTION EQUIPMENT. Handling Reel in Mountains Easily and Cheaply, J. E. Housley. Elec. World, vol. 95, no. 10, Mar. 8, 1930, p. 495. Delivery of cable reels, containing total of 90 mi. of 500,000-cir. mils steel-reinforced aluminum cable, to mountainous regions, was greatly simplified by use of two rebuilt farm wagons; inaccessible country through which reels had to be transported rendered some economical and satisfactory expedient advisable and rebuilt wagons did job; details of construction given.

POLES, CONCRETE. Transmission Line Poles. Concrete and Constr. Eng. (Lond.), vol. 25, no. 2, Feb. 1930, p. 147. Cost data on and description of spun concrete poles, with electrically welded reinforcement skeletons, used to carry 10,000-volt overhead ring-main in city of Waterford; poles of hollow tubular cross section were manufactured at Beton Schleuderwerke, Erlangen, Germany.

Concrete Supports for Rural and Trunk Lines. Elecn. (Lond.), vol. 104, no. 2696, Jan. 31, 1930, pp. 124-126, 7 figs. Correspondent reports on neat appearance; extensive use on continent; centrifugal process; methods of carriage in Italy and France.

TOWERS. Suggestion for Calculation of Tower Foundations (Vorschlag zur Berechnung von Mastfundamenten), T. Mueller. Elektro Jl. (Charlottenburg), vol. 9, no. 22, Dec. 1929, pp. 221-227, 8 figs. Supporting strength in relation to ground pressure is investigated; four equations are developed and compiled in curves; investigation lead to enlarging of concrete content for larger foundations whereas content in small foundations can be made less; experimental check on method is suggested.

ELECTRIC LINES, HIGH TENSION

LIGHTNING. Lightning Investigations on Transmission Lines, W. W. Lewis and C. M. Foust. Gen. Elec. Rev., vol. 33, no. 3, Mar. 1930, pp. 185-198, 20 figs. Surge voltage investigations of 1926 and 1927 are reviewed; data work in 1928 and 1929 are given; crest values of surge voltage due to lightning and switching; trip-outs caused by lightning, and flashed insulator strings; wave front and wave shape; attenuation; effect of overhead ground wires in reducing surge voltages; lightning stroke recorders; field intensity recorder and rate of change of field intensity record. Paper presented before Am. Inst. Elec. Engrs.

LOSSES. Transmission Losses of Long-Distance Electric Power Lines (Die Uebertragungsverluste von langen Fernleitungen), L. Leng. Elektrotechnische Zeit. (Berlin), vol. 51, no. 8, Feb. 20, 1930, pp. 278-283, 4 figs. Mathematical analysis and numerical examples.

ELECTRIC MANUFACTURING INDUSTRY

CANADA. Annual Review of the Canadian Electrical Industry for the Year 1929. Elec. News (Toronto), vol. 39, nos. 3, and 4, Feb. 1, 1930, pp. 34-37, Feb. 15, 1930, pp. 49-52, 6 figs. Progress and improvements in industry shown by installations: new movable blade turbines, welded steel generators and motors, large synchronous condensers, much new equipment, considerable construction and large increase in business by Canadian Electrical Manufacturers.

ELECTRIC MANUFACTURING PLANTS

TESTING LABORATORIES. High Voltage Research Laboratory. Engineering (Lond.), vol. 79, no. 3347, Mar. 7, 1930, pp. 312-315, 15 figs. Particulars of laboratory of Metropolitan-Vickers Electrical Co. of Manchester; first part is known as surge laboratory; later important addition, known as main laboratory; consists of building adjoining surge laboratory, these two are furnished, between them, with power-frequency equipment capable of giving voltage of 1,000,000; 1,000,000 volt transformer set is made up of two 500,000 volt, 500 kv.a., 50 cycle transformers.

ELECTRIC MEASUREMENTS

ALTERNATING CURRENT. Some Accessory Apparatus for Precise Measurements of Alternating Current, R. S. J. Spilsbury and A. H. M. Arnold. Instn. of Elec. Engrs.—Advance Paper (Lond.), Nov. 25. 1929, 9 pp., 4 figs. Description of apparatus for obtaining for purposes of measurement voltage proportional to, and in phase with, given alternating current; defects in water-cooled tube resistors in use at National Physical Laboratory; defects have led to construction of air-cooled resistors for moderate currents, and current transformers with nickel-iron cores for heavy currents; points in their design; tests showing satisfactory performance.

ELECTRIC MOTORS

PHASE CHANGING. Changing Motors from Two-Phase to Three-Phase, A. C. Roe. Indus. Eng., vol. 88, no. 3, Mar. 1930, pp. 149-151, 5 figs. General discussion pertaining to change-over of two-phase motor or generator to operate as three-phase machine; phase insulation; illustrated description of several windings.

ELECTRIC NETWORKS

SHORT CIRCUIT CALCULATION. Practical Method for Calculation of Permanent Short-Circuit Current in Networks with Single Supply (Praktische Methode zur Berechnung des Dauerkurzschlusstroms einfach gespeister Netze), F. Ollendorff. Elektrotechnische Zeit. (Berlin), vol. 51, no. 8, Feb. 20, 1930, pp. 269-274, 4 figs. Short-circuit over section resistances is discussed; numerical examples given. (Concluded.)

ELECTRIC POWER GENERATION

UNITED STATES. Recent Developments of Electric Power, E. W. Rice, Jr. Blast Furnace and Steel Plant, vol. 18, no. 3, Mar. 1930, pp. 478-480 and 483. Great savings in fuel and reductions in weight of equipment required both for generation and transmission of power have been accomplished; internal combustion engine; electricity in manufacture; use of water power, steam turbine electric units; Emmet mercury vapour process; transmission lines.

ELECTRIC POWER SUPPLY

RURAL, GREAT BRITAIN. The Bedford Rural Electrification Scheme. Engineer (Lond.), vol. 149, no. 3868, Feb. 28, 1930, pp. 237 Technical scheme for development of demonstrated area is based upon supply of electricity in bulk obtained from Bedford; it involves construction in main area of network of 56 mi. of three-phase, 11,000-volt overhead transmission lines.

ELECTRIC RAILROADS

GERMANY. Construction of the Jungfernheide-Siemensstadt-Gartenfeld Railway Branch (Der Bau der Zweigbahn Jungfernheide-Siemensstadt-Gartenfeld), A. Proelss. Bauingenieur (Berlin), vol. 11, no. 1, Jan. 3, 1930, pp. 1-15- 35 figs. Reasons for construction of this branch of rapid-transit system of Berlin; description of rigid frame trestle bents, several steel bridges, railway stations, signal system, etc.

ELECTRIC RECTIFIERS

REVIEW. Rectification of Large Alternating Current Capacities (Gleichrichtung grosser Wechselstromleistungen), E. Orlich. Elektrotechnische Zeit. (Berlin), vol. 51, no. 4, Jan. 23, 1930, pp. 122-126. Problem is discussed and historically reviewed; present means for direct and indirect transformation are enumerated; notes on present-day rectifier equipment; advantages, disadvantages, and range of application of system are outlined and future outlook is speculated upon.

JET WAVE. The Jet-Wave Rectifier—The Experimental and Theoretical Basis of its Design, J. Hartmann. Instn. Elec. Engrs.—Advance Paper (Lond.), April 17, 1929, 25 pp., 34 figs. Jet-wave rectifier, purely mechanical device which, in course of last 15 years has been developed into means for high-powered rectification, is discussed; it is shown how rectifier can be designed on basis of prototypes, and especially on result of investigations with regard to theoretical relations between their qualities; general properties of jet-wave rectifier, and anticipations with regard to its future development, are given.

ELECTRIC TRANSFORMERS

TESTING. Transformer Tests, A. A. Fredericks. Power, vol. 71, no. 10, Mar. 11, 1930, pp. 388-391, 10 figs. Simple tests that may be applied to transformers to determine polarity of leads, condition of oil and insulation, and tightness of tank, and to locate leaks in cooling coils; connections for correct polarity.

CURRENT. Omits Instrument Transformer without Impairing Service. Elec. World, vo . 95, no. 8, Feb. 22, 1930, pp. 399-400. Southern California Edison Co. has followed practice of using bushing-type current transformers for ammeters, indicating watt-meters and relays in its smaller substations on 66-kv. network; reliability and resulting economy over use of oil-filled or air-insulated current transformers has been proved and company felt justified in adopting same practice in its large and important 220/66-kv. substations.

CURRENT, TESTING. A New Null Method of Testing Instrument Transformers, and Its Application, G. F. Shotter. Instn. of Elec. Engrs.—Advance Paper (Lond.), Nov. 18, 1929, 15 pp., 19 figs. Common methods and author's new method are described; technical points are discussed and examples given illustrating simple derivation of ratio and phase-angle error of current and potential transformers; accuracy of method is dealt with, tests on hole-type current transformer; and number of standard transformers required is discussed; advantages and applications in connection with testing of power transformers.

TAP CHANGERS. Load Control under Abnormal Conditions, C. R. Fugill. Elec. World, vol. 95, no. 8, Feb. 22, 1930, pp. 386-391, 9 figs. Tap-changing transformer has proved useful in development of interconnections of Guanajuato and Chapala power systems, because it gives satisfactory voltage and phase-angle control without excessive cost; method of analysis and description of operation applicable to many interconnection situations involving use of tap changers.

ELECTRIC WELDING

See Welding.

ELECTROPLATING

PROTECTIVE VALUE. Protective Value of Some Electro-Deposited Coatings, L. Davies and L. Wright. Inst. of Metals—Advance Paper, no. 517, for mtg. Mar. 12 and 13, 1930, 12 pp., 5 figs. Investigations carried out during year 1929 on large number of specimens of steel, brass, phosphor-bronze, and copper; specimens were plated with cadmium, zinc, nickel, and chromium of thicknesses frequently specified or recommended; and their comparative behaviour to corrosion sprays of salt and sulphuric acid are dealt with. Bibliography.

ENGINES

VIBRATIONS. Practical Determination of Torsional Vibration in an Engine Installation Which May Be Simplified to a Two-Mass System, F. P. Porter. Applied Mechanics (A.S.M.E. Trans.), vol. 51, no. 30, Sept.-Dec. 1929, pp. 239-263, 27 figs. Practical solution is given for torsional vibration in shafting of reciprocating-engine installation which may be reduced mathematically to simple two-mass system; methods for computing damped vibrations in installations where damping forces follow various laws; particular attention is given to damping forces caused by marine propeller, elastic hysteresis, and friction damper; example of computations for engine installations that have been investigated.

EXCAVATING MACHINERY

BUCKET WHEEL. Time Studies of Steam- and Electric-Bucket Excavators in the Styrian Erz Mountains (Zeitaufhahmen an Dampf und Elektro-Loeffelbaggern am steirischen Erzberg), H. Mayr. Berg und Huettenmaennisches Jahrbuch (Vienna), vol. 78, no. 1, Feb. 15, 1930, pp. 12-20. Types and operation of excavators are discussed and time studies and performance formulae derived therefrom; electric excavators show 108 per cent better performance than steam excavators under similar conditions; costs and operating expenses are compared and conditions influencing first cost are discussed.

F

FLOORS

CONCRETE SLABS. Eight Floors Erected in Nine Days, E. Eberhard. Am. Architect, vol. 137, no. 2582, Apr. 1930, pp. 32-33, 4 figs. Report on system which consists of two types of slabs, one for floors and another for ceilings, used in conjunction with ordinary supporting members of steel construction set 2 ft. 6 in. o.c.

FLOW OF FLUIDS

BOUNDARY-LAYER THEORY. The Boundary Layer as a Means of Controlling the Flow of Liquids and Gases, O. Schrenk. Nat. Advisory Committee for Aeronautics—Tech. Memo., no. 555, Mar. 1930, 22 pp., 8 figs.

PIPES. The Hydraulic Mean Depth as a Basis for Form Comparison in the Flow of Fluids in Pipes, J. Caldwell. Roy. Tech. College—Jl. (Glasgow), vol. 2, part 2, Jan. 1930, pp. 203-220, 6 figs. Experiments of Stanton and Pannell, Schiller, Davies and White and others on smooth brass pipe, suggested that hydraulic mean depth is sufficient criterion for geometric form of pipe; experiments herein described show that this is true only in special cases; theory of resistance to streamline flow in pipe with eccentric ring section.

FLOW OF WATER

CHARTS. Water-Flow Chart, S. C. Mifflen. Eng. and Min. Jl., vol. 129, no. 5, Mar. 8, 1930, p. 240. Chart is applicable to flow of water through average cast-iron and wrought-iron piles in fair interior condition; for new pipe, chart will show too low discharge and too high friction loss; example of use is given in descriptive text.

FORGING

HYDRAULIC. Power Control in Hydraulic Forging, V. Tatarinoff. Heat Treating and Forging, vol. 16, no. 3, Mar. 1930, pp. 321-324, 11 figs. Discussion of important factors in obtaining greatest possible economy of production in hydraulically operated forging plant; reduction of water leakage in hydraulic machinery and piping; decrease of water pressure losses in pipe line; proper utilization of pumping plant in close accordance with actual water consumption by presses; stopping of pumps when no press is working.

FORGINGS

STEEL. Properties of Heavy Forged Pieces (Werkstoffeigenschaften schwerer Schmiedestuecke), M. Ulrich. Maschinenbau (Berlin), vol. 9, no. 4, Feb. 20, 1930, pp. 135-136, 13 figs. Analytic discussion of processes in structure which takes place in casting of ingot and which are of influence in judging characteristics of large forged-steel workpieces; various typical cases are illustrated.

FURNACES

ANNEALING, CONTINUOUS. Automatic Furnace Simplifies Annealing, W. M. Hepburn. Heat Treating and Forging, vol. 16, no. 3, Mar. 1930, pp. 374-375 and 382, 4 figs. Annealing equipment of Mullens Manufacturing Co., of Salem, Ohio, manufacturers of sheet-metal stampings, including full line of automobile parts, such as bodies, doors, panels, pillar panels, cowls, tonneau sides, and backs, etc., is described.

HEATING-TREATING, ELECTRIC. Electric Heat-Treatment of Metals, W. J. Millar and A. G. Robiette. Metallurgia (Manchester), vol. 1, nos. 1 and 2, Nov. 1929, pp. 32-33, and Dec. 1929, pp. 57-58, and 74, 4 figs. Nov.: Discussion of furnace design and operating practice. Dec.: Additional features of furnaces of recent design; examples of steels and their treatment, carburization and nitridation.

STEEL-MAKING, ELECTRIC. 30-Ton Electric Steel-Melting Furnace. Engineering (Lond.), vol. 79, no. 3348, Mar. 14, 1930, p. 360. Furnace constructed by Watson's Metallurgists, Ltd., Sheffield, is operated on Greaves-Etchells system; special feature is that heat is applied both above and below bath in order to obtain even temperature throughout mass of molten metal.

G

GEARS AND GEARING

HIGH-SPEED. High-Speed Gears, E. N. Twogood. Engrs.' Soc. of West. Penn.—Proc., vol. 45, no. 7, Oct. 1929, pp. 297-308 and (discussion), 308-323, 2 figs. Design and manufacture of gears which operate at greater than 4,000 pitchline velocity are discussed; history and origin of gears briefly reviewed; design of pinion; separate effects on tooth contact of both bending and torsion; effect combination of two has on tooth contact; methods of manufacture and inspection are outlined; accuracy of hob necessary; method of checking uniformity of spaces of helical or spur gear developed by F. L. Pearson.

GENEVA STOP. Geneva Stop Drives (Sternradgetriebe), K. Hoecken. V.D.I. Zeit. (Berlin), vol. 74, no. 9, Mar. 1, 1930, pp. 265-271, 18 figs. Theory is developed from angular speed of Geneva stop and acceleration is calculated; results are presented in graph and two nomograms are developed for practical use; method of calculation for design of elements; examples of some unknown forms of inside gear and rack drives and special case of drive with zero time of rest are given.

GEOPHYSICAL EXPLORATION

ELECTRIC. Depth of Investigation Attainable by Potential Methods of Electrical Exploration, C. Schlumberger and M. Schlumberger. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 315, for mtg. Feb. 1930, 16 pp., 2 figs. Object of paper is to clarify idea of depth attainable by electrical measurements; authors show how it is possible to regulate this depth and to obtain electrical drilling from surface observations; they consider also difficulties encountered in deep measurements and indicate how it is possible to reach greater depths than those of industrial interest. Bibliography.

MAGNETIC, COLORADO. Geophysical Investigation at Caribou, Colorado, C. A. Heiland, and J. A. Malkovsky. Colo. School of Mines Mag., vol. 20, no. 2, Feb. 1930, pp. 13-16 and 40, 4 figs. Geology of northern magnetic deposits, Caribou, Boulder County, Colo.; geodetic survey; relationship of topography, geology, and magnetic disturbance; earth-magnetic measurements; graphical representation; conclusions drawn from magnetic maps. Extracts from U.S. Bur. of Mines—Tech. Paper, no. 439, indexed in Engineering Index 1929, p. 884.

RADIO. Absorption of Electromagnetic Induction and Radiation by Rocks, A. S. Eve. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 316, for mtg. Feb. 1930, 11 pp., 1 fig. Paper gives brief summary of theory on radiation waves and describes experiments by United States Bureau of Mines and by Canadian Geological Survey at Mammoth Cave, Kentucky; Dr. D. A. Keys, Dr. F. W. Lee and author did experimental work, and Dr. L. V. King some of theoretical work.

GYPSUM DEPOSITS

CANADA. Hydration Factors in Gypsum Deposits of the Maritime Provinces, H. B. Bailey. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 308, for mtg. Feb. 1930, 11 pp., 1 fig. Notes on study of geological relation of gypsum to anhydrite, with particular reference to deposits of Nova Scotia and New Brunswick; paper is not concerned with general theories of original deposition and no opinion is expressed as to whether gypsum or anhydrite was first deposited from evaporating sea water; for purposes of study, block of formation is regarded as block of anhydrite which has become partly hydrated into gypsum.

H

HEAT INSULATING MATERIAL

SLAG WOOL. Heat Insulation by Means of Slag Wool (Waermeschutz mittels Schlackenwoole), C. Fabry. Waerme (Berlin), vol. 53, no. 7, Feb. 15, 1930, pp. 107-108, 1 fig. Properties of heat-insulating materials are discussed, and advantages of slag-wool insulation set forth; it is claimed that this material fulfills all requirements of good and durable insulating material.

HIGH BUILDINGS

DESIGN. Steel Framing Simplicity in 53-Storey Lincoln Building, A. N. Van Vleck. Eng. News-Rec., vol. 104, no. 10, Mar. 6, 1930, pp. 388-391, 7 figs. Design of steel framing of Lincoln Building, New York City, including tower 160 by 66 ft.; all setbacks are made on column lines and tower is of economically rentable size; special construction includes eccentrically loaded trusses over entrance hall and slab wing plates on column bases; wind design and standard wind connections; transferring column load into truss by direct bearing, thus eliminating large gusset plates. See editorial comment on p. 386.

WIND BRACING. Wind on Tall Buildings, E. E. Seelye. Eng. News-Rec., vol. 103, no. 12, Mar. 20, 1930, pp. 481-483, 7 figs. Outline of workable method of computing lateral stresses involving shear distribution, on basis of relative stiffness of wind bents and of column-to-beam connections; deformation of floor-bents and of column; deflection of wind bent under lateral load.

HIGHWAY SYSTEMS

ONTARIO. Highway Construction in York County, H. C. Rose. Can. Engr. (Toronto), vol. 58, no. 9, Mar. 4, 1930, pp. 82-83. Development of permanent pavement system under Toronto and York Roads Commission; types of pavement comprising 260 mi. in system and average construction costs. Paper presented before Annual Conference on Road Construction.

HYDRAULICS

PROGRESS IN. Fifty Years' Progress in Hydraulics, L. F. Moody and B. R. VanLeer. Mech. Eng., vol. 52, no. 4, Apr. 1930, pp. 366-367. Introduction to contributions, indexed separately, dealing with theoretical hydraulics, water measurement, water hammer, pumps, hydraulic turbines, hydro-electric developments, with brief remarks by authors on these subjects.

HYDRO-ELECTRIC POWER DEVELOPMENTS

UNITED STATES. New Capacity—202,000 Kva. in 1929, 471,490 Kva. in 1930. Elec. West, vol. 64, no. 2, Feb. 1, 1930, pp. 65-68, 2 figs. Western power companies develop 98,250 kva. in hydro plants during past year; current year's program calls for 218,190 kva. in water power plants; additions to hydro-electric generating plants in 1929-1930, and to generating capacity in 11 western states by districts, 1924-1930, are listed.

INDIA. The Punjab Hydro-electric Scheme, A. O'Brien. Engineer (Lond.), vol. 149, no. 3868, Feb. 28, 1930, pp. 234-235. In Himalayas in little State of Mandi, first water-power scheme of Punjab is advancing steadily; for construction purposes two complete hydro-electric plants had to be developed, distributing 1,200 kw. of power to various points of working; when tunnel is completed, water from Uhl will pass through it and by effect of its being dropped down pipe line for 2,000 ft., 36,000 kw. of electric energy will be developed at power house; should first instalment of Mandi project be successful, future will see immense extensions.

BRITISH COLUMBIA. Ruskin Development. Elec. News (Toronto), vol. 39, no. 3, Feb. 1, 1930, pp. 29-33, 8 figs. Development is under active construction on Stave River, B.C. to have 47,000-hp. unit running this year; ultimate capacity 188,000 hp.; boring of tunnels; construction features; equipment; transmission lines; program of expansion; notes on dam.

IRELAND. The Shannon Power Development in the Irish Free State, A. R. C. Markl. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 727-741, 7 figs. Outline of civil engineering part of construction; equipment and methods used in building head-race of power plant, detailed account of methods used in excavation and building embankments; operation of multiple-bucket excavators; bank-building machines.

SWITZERLAND. The Etzel Hydro-electric Project (Das projektierte Etzelwerk), H. Eggenberger. Schweizerische Bauzeitung (Zurich), vol. 94, no. 24, Dec. 14, 1929, pp. 299-304, 7 figs. Outline of project on Sihl River near Einsiedeln, Switzerland, involving construction of gravity dam 28 m. high to utilize run-off from watershed, 156 sq. km. in area; plant, which is to operate under maximum head of 483 m., will develop 110,000 hp. and is estimated to cost 62,000,000 francs.

RHINE RIVER. European Low-Head Hydro-Electric Developments, A. V. Karpov. Power, vol. 71, no. 13, Apr. 1, 1930, pp. 515-517, 5 figs. Description of Ryborg-Schworstadt and Kembs plants located on River Rhine; former is designed for four 35,000-hp. Kaplan turbines to operate under 35-ft. head and latter includes five 36,000-hp. propeller turbines for 54-ft. head; in Kembs project spillway is built into plant, but at Ryborg-Schworstadt spillway is in dam adjoining plant and is controlled by four gates, 39 ft. high by 80 ft. wide, Kaplan and propeller turbines; comparative data of both plants is given.

HYDRO-ELECTRIC POWER PLANTS

MASSACHUSETTS. Hydraulic and Mechanical Features of Bellows Falls Hydro-Electric Plant of the New England Power System, E. A. Dow. Boston Soc. of Civil Engrs.—Jl., vol. 17, no. 3, Mar. 1930, pp. 71-92 and (discussion) 92-97, 16 figs. Description of new plant developing 60,000 hp. at 60-ft. head, using three turbines with combined discharge of 10,000 second-feet; details of M.A.N. roller gates made up of steel cylinders 13½ ft. in diam. and 121 ft. long; power house location and substructure; draft-tube design; frequency control; generating units; water metering equipment.

TEMPORARY. Providing Construction Power with a Small Temporary Plant. Contract Rec. (Toronto), vol. 44, no. 12, Mar. 19, 1930, pp. 345-347, 7 figs. Description of temporary 2,500-hp. hydro-electric plant at Spruce Falls, on Swan River, Saskatchewan, which was constructed by Churchill River Power Co. to supply construction power for its main development 12 mi. away, at Island Falls on Churchill River; power house is equipped with two vertical waterwheel driven generators rated 1,000 kva., 400 r.p.m., 600-volt, 3-phase, 60-cycle.

ICE CONTROL. Ice as Affecting Power Plants, F. C. Shenehon, J. R. Freeman, D. W. Mead, L. C. Sabin and W. T. Walker. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 743-759. Review of research on ice problems of hydro-electric plants with special reference to work on surface, middle and bottom ice formations. Bibliography.

HYDROLOGY

VALLEYS. Water Supply from Rainfall on Valley Floors, A. L. Sonderegger. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 787-800, 4 figs. Discussion by C. H. Lee, of paper published in issue of May 1929; report on observations made by writer at 24 wells in valleys of San Diego County, Calif., before and after first heavy storm of season; determination of rainfall penetration from soil moisture tests; comparison with mountain run-off; rainfall-run-off curves; development of formula for converting observed rise of water-table into equivalent depth of water. See Engineering Index 1929, p. 970.

I

INDUSTRIAL MANAGEMENT

GERMANY. Ten Years of Work of Germany Industrial Management Society (Zehn Jahre beitsgemeinschaft Deutscher Betriebsingenieure) F. Ludwig. V.D.I. Zeit. (Berlin), vol. 74, no. 10, Mar. 8, 1930, p. 313. Review of work of German societies in shop management, labour relations, accident prevention, industrial organization, etc.

INDUSTRIAL PLANTS

STEEL FRAME. A New AEG Manufacturing Plant (Eine neue Fabrikationshalle der AEG), E. Heideck. Bauingenieur (Berlin), vol. 10, no. 49/50, Dec. 6, 1929, pp. 900-905, 5 figs. Structural features of steel-frame building, housing transformer assembling plant at Oberschoenewide near Berlin, measuring 93.5 m. in length, 33 m. in width and 21.5 m. in height; details of rectangular frames 31.2 m. in span.

INTERNAL COMBUSTION ENGINES

HISTORY. Oil- and Gas-Engine Development, L. H. Morrison. Mech. Eng., vol. 52, no. 4, Apr. 1930, pp. 347-352, 8 figs. Birth of internal-combustion engine in United States was practically coincident with founding of American Society of Mechanical Engineers; that internal-combustion engine found wide field of application soon after 1880 is traceable to two factors: (1) engine was modified to permit it to burn gasoline; (2) broadening of Pennsylvania oil-field limits, and necessity of finding economical pumping power; gasoline and gas-engine development; natural-gas and blast-furnace gas engines; early ventures in oil engines; story of Diesel; low-compression oil engines.

IRON-MOLYBDENUM ALLOYS

DIFFUSION IN. Case-Hardening of Metals by Diffusion (Die Oberflaechenveredlung der Metalle durch Diffusion), G. Grube and F. Lieberwirth. Zeit. fuer anorganische und allgemeine Chemie (Leipzig) (Special number), vol. 188, Mar. 8, 1930, pp. 274-289, 10 figs. Fourth report from laboratories of Stuttgart Institute of Technology dealing with diffusion of molybdenum in solid iron; production of homogeneous iron-molybdenum alloys by diffusion; acid corrosion of sintered iron and molybdenum alloys.

IRRIGATION

CALIFORNIA. Progress and Results on One of Best Irrigation Projects. Eng. News-Rec., vol. 104, no. 12, Mar. 20, 1930, p. 487. Excerpts from report on management of 21,000-acre Orland Reclamation Project in California.

IRRIGATION STRUCTURES

SPECIFICATIONS. Earthwork, Tunnels, and Structures—North Branch Canal Division No. 3. U.S. Bur. of Reclamation—Specifications, no. 508, 1930, 28 pp., 17 figs. on supp. sheets. Statement of equipment; specifications for earthwork, concrete siphons etc.; testing siphons; bridge approaches; tunnels; concrete mixing.

J

JIGS AND FIXTURES

WELDED. Application of Arc Welding in Construction of Jigs and Fixtures (Anwendung der Lichtbogenschweissung im Vorrichtungsbau), O. Kienzle. Maschinenbau (Berlin), vol. 9, no. 1, Jan. 2, 1930, pp. 17-19, 13 figs. Advantages of welded equipment over cast-iron models are light weight, more rigidity, less machining, possibility of using scrap material, and lower cost of manufacture.

Arc-Welded Jigs, Fixtures and Machine Tools, J. R. Weaver. Am. Welding Soc.—Jl., vol. 9, no. 2, Feb. 1930, pp. 7-18, 13 figs. Advantages of arc-welded construction for jigs, fixtures, and special machine tools are discussed; methods employed by Westinghouse Electric Manufacturing Co. are described; great saving in time with welded construction; method of preparing sketches by tool designers; outline of how jigs are actually manufactured.

L

LEAD FATIGUE

ATMOSPHERIC ACTION. Atmospheric Action in Relation to Fatigue in Lead, B. P. Haigh. Inst. of Metals—Advance Paper, no. 521, for mtg., Mar. 12-13, 1930, 11 pp., 9 figs. Account of number of fatigue tests carried out under abnormal conditions, specially devised to study action of air in relation of fatigue in lead, it being believed that this action is representative of chemical and mechanical action; fatigue fracture of lead is intercrystalline only round margin; and in general, interior surface of fatigue fracture differs in character from marg n al zone.

LEVEES

CONSTRUCTION, KENTUCKY. Industrial Railways Build Levees in the Reelfot District. Pub. Works, vol. 61, no. 2, Feb. 1930, pp. 66-67, 4 figs. Practice of Levee District located 50 mi. south of Cairo, Ill.; narrow-gauge cars used to haul material from hills near one end of contract nearly mile long, and drag-line for placing it on levee; layout of borrow pit trackage; method of building enlargement.

CONSTRUCTION. Tower-Excavator Performance and Costs on Three Types of Levee, M. W. Gilland. Eng. News Rec., vol. 104, no. 13, Mar. 27, 1930, pp. 510-516, 10 figs. See editorial comment on p. 509. Report on Mississippi River levee-construction practice; tower-excavator set-up for levee enlargement; tower dimensions and equipment for tower excavator; performance and costs on new levee, set-over levee and levee enlargement; possibilities of improvement to meet conditions imposed by new superflood levee section; cost summary of four tower excavator operations in Vicksburg district; camp operations and equipment upkeep.

LEVELLING

MANUAL OF. Manual of First-Order Levelling, H. G. Avers. U.S. Coast and Geodetic Survey—Special Publication, no. 140, 1929, 90 pp., 18 figs. partly on supp. plates. General instructions in revised form; methods employed by U.S. Coast and Geodetic Survey in executing first-order levelling and in making office computations; organization and management of party and procedure in field; errors of levelling.

LIGHTNING ARRESTERS

THYRITE. New Lightning Arresters. Engineer (Lond.), vol. 149, no. 3868, Feb. 28, 1930, pp. 239. For use in lightning arresters new material, called Thyrite which has property of increasing or decreasing its resistance as voltage is decreased or increased, has been developed by General Electric Company of America; advantages claimed for new arresters are small size, low installation cost, small weight, and predictability of results to be expected for any given condition.

LOCOMOTIVES

DIESEL. Hydraulic Couplings for Internal Combustion Locomotives. Engineer (Lond.), vol. 149, no. 3870, Mar. 14, 1930, p. 298, 3 figs. Details of this useful power-transmitting device, specially designed for locomotives driven by internal-combustion engines and similar drives; coupling is transmission gear of pump-turbine type, which consists essentially of impeller driven by engine and runner attached to driven shaft.

New 2-6-2 Diesel Locomotive for Chile. Ry. Gaz. (Lond.), vol. 52, no. 10, Mar. 7, 1930, pp. 343-344, 3 figs. Constructed for service on 2 ft. 6 in. gauge and for duties hitherto performed by steam locomotives; engine which develops 300 hp. and 1,000 r.p.m., is mounted directly over centre coupled wheels; six-cylinder McLaren-Benz four-stroke cycle, solid injection, cold starting engine with overhead valve gear, having cylinders 205 mm. bore by 270 mm. stroke; driving wheels 2 ft. 9 in. total wheel base 20 ft.; fuel consumption 0.45 lb. per B.hp. per hr.; four-speed transmission; cooling systems; starting arrangements.

The 1,200-Hp. Diesel Compressed-Air Locomotive of the German Governmental Railroad (Die 1,200 PS-Diesel-Druckluftlokomotive der Deutschen Reichsbahn), Witte and R. P. Wagner. V.D.I. Zeit. (Berlin), vol. 74, no. 10, Mar. 8, 1930, pp. 289-296, 31 figs. Detailed description of 4-6-4 1,000-hp. and 1,200-hp., 80-km. per hr. locomotive; pressure of operating air is 6.5 atm. of 330 deg. cent.; tractive effort is 12,000 kg.; driving wheel diameter 1,600 mm.; service weight 124,600 kg.; plan drawing of engine is given.

STEAM-TURBINE. 2,000-hp. Krupp Turbine Locomotive. Engineering (Lond.), vol. 129, no. 3346, Feb. 28, 1930, p. 280, 4 figs. partly on supp. plates. Principal dimensions are given; length including tender 76 ft. 9 in.; weight in running order, 111 tons; boiler is designed to supply steam at pressure of 15 atmos.; main turbines and transmission gearing are of Zoelly type, manufactured by Escher, Wyss and Co.; condenser, of surface type, has cooling surface of 220 sq. m.

VALVE GEARS. Valve Control of Renaud System Tested on Single-Expansion Superheated Mikado Locomotive of the French State Railroad (Distribution par soupapes systême Renaud en essai sur une locomotive Mikado à simple expansion et à surchauffe des Chemins de Fer de l'Etat), M. Nasse. Revue Générale des Chemins de Fer (Paris), vol. 48, no. 6, Dec. 1929, pp. 459-473, 20 figs. System is detailed, test results and diagrams are given.

LUBRICANTS

CUTTING. Characteristics and Selection of Cutting Fluids. Machy. (Lond.), vol. 35, no. 908, Mar. 6, 1930, pp. 729-735, 2 figs. Functions of cutting fluids are described; types of fluid employed for cutting; properties of specific oils and emulsions; aqueous solutions; objections to use of emulsions.

LUMBER

DRYING. Artificial Drying of Wood (Zur kuenstlichen Trocknung des Holzes), F. Moll. V.D.I. (Berlin), vol. 74, no. 11, Mar. 15, 1930, pp. 343-344, 1 fig. Physical principles of current methods of lumber drying and seasoning; construction and operating practice of lumber kilns.

LUMBER MILLS

DESIGN. Standardized Design of Lumber Yard on Wheels, T. D. Perry. Wood-Worker, vol. 48, no. 12, Feb. 1930, pp. 48-50, 8 figs. Article describes installation of factory lumber yard on wheels, where problem presented was that of providing trackage for about 300 kiln cars, equivalent to about 1,000,000 ft. of lumber.

M

MACHINE TOOLS

HYDRALIC DRIVE. Hele-Shaw Beacham Patent Variable Speed Hydraulic Transmission. Machy. (Lond.), vol 35, no. 905, Feb. 13, 1930, pp. 649-651, 9 figs. Description of new pump of entirely different design from original Hele-Shaw pump; most noticeable changes are to be found in inward operation of pistons instead of outward, and in employment of stationary crank; system consists of pump and hydraulic motor or pump and ram; pump employed in transmission constructed with variable and reversible stroke; hydraulic motor or ram has fixed capacity corresponding to definite speed of rotation or movement.

DESIGN. Calculation of Frames of Presses, Punches, Automatics, Shears, etc. (Die Berechung der Rahmenkoerper von Pressen, Stanzen Automaten, Scheren, etc.), O. Rieger. Maschinen Konstrukteur (Munich), vol. 63, no. 4, Feb. 25, 1930, pp. 83-83, 4 figs. Mathematical design analysis.

MACHINERY

NOISE ELIMINATION IN. Prevention and Elimination of Machine Noises (Maschinengeraeusche, ihre Verhinderung und Beseitigung), K. Wachwitz Tonindustrie-Zeitung (Berlin), vol. 53, no. 97, Dec. 5, 1929, pp. 1707-1708. Measures employed to prevent or dampen noises and vibrations in machinery used in clayworking, cement, and lime industries are discussed, and sound-insulating materials described.

MATERIALS HANDLING

INDUSTRIAL PLANTS. Auxiliary Devices Insure Safe Delivery of Goods in Materials Handling Systems, J. C. Siegesmund. Indus. Eng., vol. 88, no. 2, Feb. 1930, pp. 87-89, 6 figs. Continued description of application and use of auxiliary devices that are employed in Eli Lilly and Co., Indianapolis, Ind., in conjunction with other elements of materials-handling systems that enable delivery of finished fragile products to stock room and shipping platform with comparative safety; flow charts of conveyor systems are given.

EQUIPMENT. Correct Engineering Principles in Selecting Handling Equipment Result in Real Economies, H. V. Coes. Matls. Handling and Distribution, vol. 3, no. 4, Jan. 1930, pp. 27-31, 11 figs. Article aims to point out some of fundamental principles of materials handling and their effect upon production plant operation and design and economic production; table listing 50 typical installations of material-handling equipment; fundamental principles of new and existing plant operation.

MERCURY-VAPOUR PROCESS

Test Data. Results of Mercury Vapour Cycle at Hartford, W. L. R. Emmet. Power Plant Eng., vol. 34, no. 7, Apr. 1, 1930, p. 378, 2 figs. Figures indicate 8,900 B.t.u. per net kw-hr. is possible; cross-section of plant and details of boiler drum; data on performance of 10,000-kw. mercury installation.

METALS

Cold Working. On the Distribution of Hardness Produced by Cold Working, W. P. Sykes and A. C. Ellsworth. Am. Soc. Steel Treating—Trans., vol. 17, no. 4, Apr. 1930, pp. 509-518 and (discussion) 518-526, 17 figs. Preliminary study of progress of hardening throughout section produced by cold working; three materials, differing considerably in hardness, are reduced by cold swaging; hardness measurements are taken at various depths below surface of round section after each of series of reductions; effects of starting diameter and original hardness upon distribution of final hardness are reported.

Cold Working of Metals, J. W. Berry. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 34, no. 230, Feb. 1930, pp. 210-211. Cold working of metals from first stages is explained, including cold raising, spinning and pushing in and pulling out process, hot spinning process, stamping, and drop stamping by double-acting press; size and shape of blanks. Abstract.

Conductivity. Constant Relation Between Thermal and Electric Conductivities of Metals (Rapport constant des conductibilités thermique et électrique des métaux), A. Grebel. Chaleur et Industrie (Paris), vol. 10, no. 116, Dec. 1929, pp. 569-571, 2 figs. Comparative study based on curves and tables of Bureau des Longitudes, and Landbolt-Bernstein tables.

Deformation. Problem of Plasticity—Deformation at Low Temperature (Zur frage der Plastizitaet. Verformung bei tiefen Temperaturen), M. Polanyi and E. Schmid. Mitteilungen der deutschen Materialpruefungsanstalten (Berlin), no. 10, 1930, pp. 101-104, 5 figs. Study of different forms of plasticity; elastic limit of zinc and cadmium crystals at low temperatures; deformation at minimum temperatures.

METALS TESTING

Creep. Creep Stress Determination, W. Rohn. Metallurgist (Supp. to Engineer, Lond.), Feb. 1930, pp. 22-23, 2 figs. Author propounds novel method of making creep tests; he bases his ideas on fact that creep limit varies rapidly with temperature so that it would be more satisfactory to determine limiting creep temperature for given stress than creep stress for given temperature; method should prove of very great value, especially where approximate guide to creep properties of material is required. Abstract translated from German.

Stresses. Stresses Due to Forging and Heat Treatment (Schmiedespannungen, Verguetungsspannungen und Waermespannungen), G. Sachs. Mitteilungen der deutschen Materialpruefungstalten (Berlin), no. 10, 1930, pp. 43-48, 22 figs. Methods of testing to determine effect of treatment on metals, such as forging, hardening, annealing, quenching, etc.; results of tests to determine stresses in round bars of steel at 0.55 deg. cent.; comparison of effect of different treatments.

Temper. The Pile Temper Testing Machine, R. G. Johnston. Metal Industry (Lond.), vol. 36, no. 11, Mar. 14, 1930, pp. 293-296, 4 figs. Explanation of construction and operation of machine for testing temper of metals and alloys; analysis of results obtained.

Wear. Theory of Wear (Ueber die Abnutzungstheorie), H. Friedrich. Maschinenbau (Berlin), vol. 9, no. 4, Feb. 20, 1930, pp. 129-131, 4 figs. Comparisons is made between abrasion by friction and by machinery, i.e., grinding, filing, sawing, etc., in order to find explanation for theory of wear; experiments on abrasion-testing machine; comparison of calculated and measured values.

MINES AND MINING

Cementing. Preparation and Resistance of Cement and Gypsum Plasters in Wet Copper Mines, T. E. Smith. Eng. and Min. Jl., vol. 129, no. 5, Mar. 8, 1930, pp. 248-249. Description of experiments conducted at mines in Butte district of Montana, water in most of which contains mixture of free sulphuric acid and soluble sulphates; portland cement will not set in water containing copper, but remains friable and porous; certain gypsum products were found to give satisfactory results.

British Columbia. British Columbia in 1929. Min. Jl. (Lond.), vol. 168, no. 4927, Jan. 25, 1930, p. 23. Brief general review, with production estimate by J. D. Galloway; extension of milling capacity; activity in exploration and development.

MOTOR TRUCKS

Six-Wheel. Recent Improvements in Mechanical Transport Vehicles, N. G. Duckett. Eng. Jl. (Montreal), vol. 13, no. 2, Feb. 1930, pp. 90-95, 7 figs. Development of multi-wheeled cross-country commercial type of motor trucks; action by British War Office to supersede solid-tire type vehicle and introduce 1½-ton subsidy-type motor truck; their specifications; truck; War Department patented suspension; overall non-skid chains; use of skis with six-wheelers; comparison between War Department rear suspension and other forms in general use throughout America; improved form of front-axle springing; performance formula.

N

NICKEL ALLOYS

Castings. Nickel Casting Alloys, J. McNeil. Metal Industry (Lond.), vol. 36, no. 10, March 7, 1930, pp. 275-278. Physical properties of nickel brasses and nickel silvers are considered; founding; uses; nickel high-tensile brasses; nickel bronzes; high nickel-copper alloys; founding; nickel-chromium and nickel-chromium-alloys. (To be concluded.) Paper presented before Co-ordinating Committee at Birmingham.

NOZZLES, STEAM

Research, Great Britain. Sixth Report of the Steam Nozzles Research Committee. Engineering (Lond.), vol. 129, nos. 3346 and 3348, Feb. 28, 1930, pp. 296-298 and (discussion) pp. 291-292, and Mar. 14, pp. 361-362, 20 figs. Account of following series of tests which form continuation of work since presentation of fifth report; test of straight rectangular convergent nozzle of 3 in. by ¼ in. opening; effect of entrance conditions in straight nozzles; impulse nozzles with increased radius of curvature; effect of entrance conditions in curved nozzles; impulse nozzle under increases steam temperature; test of 2-in. Parsons nozzle.

O

OCCUPATIONAL DISEASES

Lead-Poisoning. Industrial Diseases and Compensation, M. R. Mayers. Safety Eng., vol. 59, no. 2, Feb. 1930, pp. 88, 90 and 92. Findings of lead-poisoning investigation; difficulties arising regarding lead-poisoning cases are lack of standardization of terminology and diagnosis, and difficulty in establishing etiologic relationship between disability and exposure to lead. (Concluded.) Paper read before Int. Assn. of Indus. Accident Boards and Commissions.

OFFICE BUILDINGS

Heightening. Adding Storeys to a Steel-Frame Chicago Bank Building, M. Rosner. Eng. News-Rec., vol. 104, no. 13, Mar. 27, 1930, pp. 516-518, 6 figs. Report on alterations and additions to Northern Trust Company's four-storey building, occupying area 72 by 190 ft.; additions include two new storeys over entire area, with large penthouse extending two storeys above roof; tall unbraced columns strengthened; girders and cantilevers in framing; condition of steel and foundations.

OIL FIELDS

Alberta. The Oil Fields of Alberta, E. H. C. Craig. Oil Weekly, vol. 56, no. 11, Feb. 28, 1930, pp. 70 and 72. Brief general account of Turner Valley and Wainwright fields; Turner Vzlley has 40 producing wells; 33 yield crude gasoline and 19 produce crude oil of various grades; wells in Wainwright field produce heavy oil in small quantities; geological note and theory as to source of oil. Abstract of paper read before Instn. of Petroleum Technologists.

OIL WELL PRODUCTION

Flooding. Valuation of Flood Oil Properties, E. A. Stephenson and I. G. Grettum. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 323, for mtg. Feb. 1930, 20 pp., 13 figs. Discussion of flooding method of oil well production, as practiced in Bradford field of Pennsylvania; geological structure of fields; flooding practice; factors considered in valuation methods; flooding methods; recovery of oil per acre; daily or yearly production rate per well; operating cost, usually expressed as unit cost per barrel; expected price per barrel; discount factor for converting expected income into present net worth.

ORE CRUSHING AND GRINDING

Ball Milling. A Laboratory Investigation of Ball Milling, Z. M. Gow, A. B. Campbell and W. H. Coghill. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 326, for mtg. Feb. 1930, 26 pp., 22 figs. Paper deals with both diameter and speed and proposes to show laws which apply to some laboratory ball mills, ranging in diameter from 18 to 42 in., run at various speeds; correlation of power, speed, and grinding rate of respective mills is shown by curves of markedly significant similarity; mechanics and theory of ball milling; mathematical derivation of new equation of ball path; grinding tests; data and discussion. Bibliography.

ORE TREATMENT

Flotation. Chemical Reactions in Flotation, A. T. Taggart, T. C. Taylor and A. F. Knoll. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 312, for mtg. Feb. 1930, 33 pp., 5 figs. Paper by Taggart and Gaudin was published in Am. Inst. Min. Engrs. Trans. vol. 68, 1922; present paper offers different definition of adsorption and sets up generalization that simple chemical reaction underlies functioning of flotation reagents which control mineral collection, when these reagents are soluble in and act from solution in water of pulp; frothing and collecting agents; tests are described and discussed. Bibliography.

Classification. Classifier Efficiency, an Experimental Study, A. W. Fahrenwald. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 275, for mtg. Feb. 1930, 14 pp., 3 figs. Relation of classifier efficiency to grinding efficiency; critical consideration of size analysis as basis of measuring classifier efficiency; experimental method developed; experimental data; enumeration of conclusions drawn from results of experiments.

P

PAVEMENTS

Asphalt. Recent Developments in Asphalt Paving, F. P. Smith. Pub. Works, vol. 61, no. 3, Mar. 1930, pp. 87-90, 5 figs. Review of recent improved practice as to cold-laid asphalt, foundations, thickness, plant and methods of manufacture, construction and maintenance.

Bituminous Macadam. Reconstruction of Highways in Massachusetts, F. E. Cassidy. Pub. Works, vol. 61, no. 2, Feb. 1930, pp. 63-65, 3 figs. Report on reconstruction of 4½-mi. section of Mohawk Trail en route from Boston to North Adams, which called for standard bituminous asphalt-macadam of penetration type, 24 ft. wide; stone in wearing course coarser than that in base course, giving rough wearing surface; adapting foundation to wider pavement and modified alignment; handling traffic.

Concrete, Testing. A Study of Tests of Cylinders and Cores Taken from Concrete Roads in Texas during 1928, J. A. Focht. Univ. of Texas Bul., no. 2922, June 8, 1929, 18 pp., 21 figs. Report on tests of 8,000 concrete cylinders, and 1,000 cores taken from concrete roads; methods of sampling and laboratory procedure; data are presented in graphic forms.

Rubber. Use of Rubber Pavements (L'emploi du caoutchouc dans les revêtements de chaussées), J. Thomas. Génie Civil (Paris), vol. 96, no. 2482, Mar. 8, 1930, pp. 236-239, 10 figs. Features of rubber pavements experimented with in Metropolitan cities of France, United States and Great Britain with special reference to Gaisman type of rubber pavement tried out in Paris.

PIERS, STEEL

Costa Rica. The New Steel Pier in the Port of Puntarenas (Die neue Eiserne Mole in Hafen von Puntarenas), H. Schott. Bauingenieur (Berlin), vol. 10, no. 49/50, Dec. 6, 1929, pp. 881-887, 11 figs. Design and construction of L-shaped pier about 500 m. total length, built at railroad terminal of Puntarenas, Costa Rica; details of steel bents of supporting testles, screw-base tubular piles, etc.

POWER GENERATION

Polar Seas. Extracting Heat and Power from Ice Water. Power, vol. 71, no. 10, Mar. 11, 1930, pp. 400-402, 6 figs. Novel scheme for utilizing heat in Arctic lakes and rivers is proposed by Barjot of Montreal, Canada, in which ice water is used as "fuel" to vaporize hydrocarbon, and vapour after passing through turbine is condensed by blocks of frozen brine; typical river-flow curves showing deficit of available water power in winter months; diagrammatic sketch of proposed plant for generation of power from heat in ice water.

POWER PLANTS

Interconnection. Load Division in Interconnections, E. C. M. Stahl. Elec. World, vol. 95, no. 9, Mar. 1, 1930, pp. 434-438, 8 figs. Problem of obtaining most economical division of load among interconnected generating stations becomes more involved as number of stations in system increases; in practice boilers and turbines are grouped in separate stations; each station will have limiting ranges of operation which depend on total system variation in load, degree of reliability of feeders, importance of local load and size of interconnecting lines, as well as station's economy characteristics; Brooklyn Edison Co. practice is quoted.

PRESSURE VESSELS

Welding. The Strength and Design of Fusion Welds for Unfired Pressure Vessels, L. W. Schuster. (Engineering (Lond.), vol. 79, nos. 3348, 3349 and 3350, Mar. 14, 1930, pp. 362-364, Mar. 21, pp. 394-396, and (discussion) 353-354 and 386-387, and Mar. 28, pp. 427-428, 12 figs. Investigation into fusion welding undertaken by author's company with view to determine true worth of legitimate claims arising from more recent development of fusion welding, and to place application, as applied to pressure vessels, on sage and rational basis; findings do not in any way apply to welding of structures other than pressure vessels. Paper read before Instn. Engrs.

PULVERIZED COAL

Combustion of. Thermodynamics of Powdered Coal Combustion, P. Rosin. Power Plant Eng., vol. 34, no. 6, Mar. 15, 1930, pp. 326-329, 2 figs. Investigations of thermal considerations show dust firing to be velocity problem; table giving burning time and rate of heat liberation; combustion period rarely exceeds 4 sec.; meaning of combustion time; empirical law holds only for limited range; heat absorbing capacity of boiler; curves showing heat transfer in 1,000 sq. m. (10,760 sq. ft.) boiler. Paper presented before Int. Conference on Bituminous Coals.

PUMPING STATIONS

Oshawa, Ont. Waterworks Pumping Station Equipment, W. C. Smith. Contract Rec. (Toronto), vol. 43, no. 11, Mar. 12, 1930, pp. 293-296 and 327, 2 figs. History and description of waterworks of Oshawa, Ont., serving population of 30,000; total costs and operating costs of several varieties of plant installation including filter pump.

PUMPS

Gas. Two-Stroke Cycle Gas Displacement Pump. Engineering (Lond.), vol. 129, no. 3350, Mar. 28, 1930, pp. 404-406, 3 figs. Details of pump constructed by Hodges Brothers, Basin Ironworks, Exeter, to designs of S. P. Christie, who claims that it is simple and reliable and can be operated for long periods with but few, and relatively inexpensive, renewals; consists of vertical combustion chamber connected to horizontal play pipe terminating, at one end, in old boiler, which acts as air vessel; part of water delivered into air vessel from play pipe is discharged through horizontal pipe lying by side of play pipe and connected by bend to vertical pipe.

R

RAILROAD TRACKS

Spring Supports. Measurements of Vertical Movements of Rails (Messung senkrechter Schienenbewegungen), A. Wettl. Organ fuer die Fortschritte des Eisenbahnwesens (Berlin), vol. 84, no. 21, Nov. 1, 1929, pp. 457-459, 2 figs. Description of electric apparatus especially designed for use in Wirth experimental study of spring-supported railroad tracks.

RAILROADS

Canada. Connections with the Hudson Bay Railway. Engineering (Lond.), vol. 79, no. 3348, Mar. 14, 1930, p. 355. Since decision of Canadian Government to press forward construction of Hudson Bay railway and shipping route through Hudson Strait to Port Churchill, Manitoba, number of plans have been crystallizing, aim of which is to bring existing lines of transportation into closer connection with new railway.

RAIN AND RAINFALL

Intensity. Frequency and Intensity of Excessive Rainfalls at Boston, Massachusetts, C. W. Sherman. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 717-726, 2 figs. Study of records of rain gauge at Chestnut Hill Reservoir covering term of 50 years, and durations of heavy rain up to 72 hours; curves of intensity corresponding to any period of time for various frequencies are derived and discussed; application of general formula to other localities.

REFRIGERATION

Plant Design. The Design of Modern Refrigerating Plant, B. C. Oldham. Ice and Cold Storage (Lond.), vol. 33, no. 383, Feb. 1930, pp. 30-33, 3 figs. Results of theoretical research work, which was performed by author, concerning refrigerating capacity and power requirements tables giving thermodynamic properties of super-heated ammonia and carbon dioxide gas; indicator diagrams on modern machines; description of electric indicator adapted to totally enclosed refrigerating machines; dry and wet compression. Abstract of paper presented before Brit. Assn. of Refrigeration.

RESERVOIRS

Concrete. Concrete Reservoirs and Tanks, W. S. Gray. Concrete and Constr. Eng. (Lond.), vols. 24 and 25, nos. 12 and 2, Dec. 1929, pp. 725-732, Feb. 1930, p. 135, 14 figs. Dec.: Principles of design of L-shaped concrete retaining walls: reinforcement of wall slab; design of long projection of base. Feb.: Joints in wall; details of horizontal reinforcement at corners; construction of floor; types of joints in reservoir and tank floors. (To be continued.)

RETAINING WALLS

Design. Marine Structures in Reinforced Concrete, R. N. Stroyer. Concrete and Constr. Eng. (Lond.), vol. 24, no. 12, Dec. 1929, pp. 709-719, 8 figs. Derivation and discussion of author's formula for reduction in bending moments on flexible walls in reinforced-concrete; tables and charts.

RIVETS

Testing. Permissible Stresses on Rivets in Tension, C. R. Young and W. B. Dunbar. Univ. of Toronto, School of Eng. Research—Bul., no. 8, 1928, section no. 16, pp. 389-418, 15 figs. Report on University of Toronto tests on rivets (1) in pure tension, (2) subjected to combination of tension and flexure, and (3) subjected to combination of tension, shear and flexure; extension of rivets; permissible stresses for tension with flexure.

ROAD CONSTRUCTION

Cold Weather. Winter Paving with Asphaltic Concrete on Macadam Base, W. H. Flood. Eng. News Rec., vol. 104, no. 11, pp. 446-448, 3 figs. See editorial comment on pp. 429-430. Report on construction, under extreme exposure to cold of asphalt pavement section of Leif Eriksen drive along lake front in Chicago; 67,000 sq. yds. of 2 in. asphalt surfacing was laid in eight days; six rollers following on heels of extra-size spreading and raking crews got asphalt down hot; mixture and mixing procedure; progress, working force. Abstract of paper read before Ill. Soc. of Engrs.

ROAD FOUNDATIONS

Treatment of. Treatment of Subgrades with Bituminous Materials, C. A. Hogentogler and H. Aaron. Roads and Streets, vol. 70, no. 2, Feb. 1930, pp. 77-82, 5 figs. Theory of subgrade stabilization; its practical application and function of bituminous treatments with respect to stage construction; influence of internal friction and cohesion on stability; what admixtures may do; expansion depends upon both capillary properties and degree of cohesion possessed by soil; frost heave apt to be important in permeable silts. Paper presented before Asphalt Paving Conference.

ROADS

Specifications. Tunnels and Roads, Owyhee Project, Oregon-Idaho. U.S. Bur. of Reclamation—Specifications, no. 505, 1930, 37 pp., 9 figs. on supp. sheets. Statement of equipment and electric power requirements; specifications for earthwork; tunnels; concrete mixing.

Low Cost. Some Conservation in Low-Cost Roads, W. Huber. Can. Engr. (Toronto), vol. 58, no. 9, Mar. 4, 1930, pp. 91-92. Factors affecting durability of road and need for conservation by surface treatment; new retread type of road and method of construction. Paper presented before Annual Conference on Road Construction.

ROADS, EARTH

Sand-Clay. Surface Treated Sand-Clay Roads in Georgia and Florida, B. P. McWhorter. Roads and Streets, vol. 70, no. 2, Feb. 1930, pp. 73-76, 4 figs. Report on methods of constructing sand-clay base for surface treating and materials and methods used in treatment; prime coat; application of seal coat; blading crushed slag; spreading crushed stone cover. Paper presented before Asphalt Paving Conference.

ROADS, GRAVEL

Canada. Conservation of Road Gravel Supplies, M. R. Parish. Can Engr. (Toronto), vol. 58, no. 9, Mar. 4, 1930, p. 96. Sources of supply and need for conservation; economical application about 600 yds. per mi.; maintenance of gravel roads; educating motorist. Paper presented before Annual Conference on Road Construction.

ROLLING MILLS

Rolling Process. The Rolling of Metals, J. S. Casewell. Engineer (Lond.), vol. 149, nos. 3868, Feb. 28, 1930, pp. 232-234, Mar. 7, pp. 260-262, Mar. 14, pp. 288-289, Mar. 21, pp. 316-318, Mar. 28, pp. 342-344, in all 52 figs.

Tests to Determine Vertical Stresses in the Rolling Process (Versuche zur Emittlung der Vertikalspannungen beim Walzvorgang), E. Siebel. Stahl und Eisen (Duesseldorf), vol. 50, no. 8, Feb. 20, 1930, pp. 233-234, 3 figs. Account of experiment carried out by K. Hubert; conversion of pressure-time curves into pressure-path curves; it is claimed that pressure distribution, as established by Hubert, does not correspond to actual conditions and practically all of his conclusions are incorrect inasmuch as they are based on false evaluations.

S

SEAPLANES

Catapults. Co-operation between Ship and Aircraft (Zusammenarbeiten von Schiff und Flugzeug), Kiwull. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 20, no. 22, Nov. 28, 1929, pp. 581-582, 3 figs. Brief notes on landing and take-off of seaplanes from ships at sea, and description of necessary catapult arrangement. Abstract of paper read before Wissenschaftliche Gesellschaft fuer Luftfahrt.

SEWAGE PUMPS

Automatic. Automatic Sewage Lifting Plant. Engineer (Lond.), vol. 149, no. 3867, Feb. 21, 1930, p. 224, 1 fig. For automatically removing sewage, which cannot flow away by gravity, self-starting and stopping plant has been introduced by Daniel Adamson and Co., named Eject-o-Pump; apparatus is operated by air pressure-control switch, which is entirely automatic; plants are made with capacities of from 25 to 1,000 gals. per min.

Failure. Gas Pressure Bursts Sludge Pump, C. E. Keefer. Pub. Works, vol. 61, no. 2, Feb. 1930, pp. 56-57, 1 fig. At Back River Works, Baltimore, casing of 8-in. pump, which was filled with sludge, burst due to gas generated by sludge; laboratory tests indicate that sludge kept in sealed containers will produce pressures as high as 1,400 lbs. per sq. in.

SHEET-METAL TESTING

Drawing Qualities. The Practical Testing of Sheet and Strip for Drawing Operations, L. N. Brown. Metal Stampings, vol. 3, no. 3, Mar. 1930, pp. 239-242 and 270, 4 figs. Discussion of scientific methods for specification of drawing qualities and thickness of strip and sheet; types of testing machines and testing methods; use of load and cup depth to indicate comparable drawing qualities.

SHEET-METAL WORKING

Press Squeezing. The Squeezing Group of Press Operations, E. V. Crane. Metal Stampings, vol. 3 no. 3, Mar. 1930, pp. 221-226 and 248, 4 figs. Discussion of volume changes, flow in metals and pressures involved in squeezing operations.

SNOW REMOVAL

Equipment. International Competition in Snow Removal Equipment (Le concours international d'appareils chasse-neige), J. Thomas. Génie Civil (Paris), vol. 96, no. 2484, Mar. 22, 1930, pp. 277-282, 9 figs. Report on competition held by Touring Club of France, during February 1930; performance of snow plows of various types manufactured by French, Norwegian, and other firms, including rotary plows; use of steam shovels for snow removal.

STEAM

Condensation. Temperature Distribution and Turbulence in Condensation of Superheated Steam in Pipes (Temperaturverteilung und Turbulenz beim Kondensieren von Heissdampf in einem Rohr), M. Jakob, S. Erk, and H. Eck. V.D.I. Zeit. (Berlin), vol. 74, no. 7, Feb. 15, 1930, p. 208. Results of recent experiments, discussed in Technische Mechanik und Thermodynamik, vol. 1, 1930, p. 46, by which it was shown that temperature drop in axis of test pipe decreased when wall cooling was increased have been verified; importance of results of heat-transfer measurements as contribution to turbulence problem, is pointed out.

Superheaten. Steam Properties (Propriété de la vapeur d'eau), R. Martin. Chaleur et Industrie (Paris), vol. 10, no. 116, Dec. 1929, pp. 605-614, 3 figs. Communication of Central Bureau of Rational Heating, France, on specific heat and steaming-up heat in superheated steam for pressures from 1 to 120 kg. at saturation temperature of 550 deg. cent.; curves and tables are given.

STEAM CONDENSERS

Tubes. Modern Aspects of Condenser-Tube Problem (Die neuere Entwicklung der Kondensatorrohrfrage), S. Hirsch. Schiffbau (Berlin), vol. 30, no. 24, Dec. 18, 1929, pp. 596-597, including discussion. Improved methods adopted in Germany for manufacture of brass tubes, particularly hot press method, allowed German manufacturers more rapidly to start upon successful manufacture of nickel tubes when economic conditions had adjusted themselves; nevertheless metallurgical differences between brass and nickel alloy have required considerable research; it is felt the problem of condenser-tube corrosion is now largely solved. Abstract of paper read before Schiffbautechnische Gesellschaft.

STEAM-ELECTRIC POWER PLANTS

New York City. Hell Gate Station Design, W. E. Caldwell. Elec. World, vol. 95, no. 9, Mar. 1, 1930, pp. 444-446, 1 fig. Problems encountered in adding generating capacity to power station are discussed; original design was for comparatively low steam pressure and comparatively small generating units; latest additions involved very large and economical generating units; principles involved in Hell Gate additions are applicable to large and small stations. (To be continued.)

Pittsburgh, Pa. The James H. Reed Station Will Help Duquesne Light Co. serve Pittsburgh District. Power Plant Eng., vol. 34, no. 7, Apr. 1, 1930, pp. 366-373, 14 figs. Description of first unit of station which will have ultimate capacity of 240,000 kw.; 60,000 kw. turbo-generator, and three 31-795-sq. ft., 400 lb. boilers have been installed; flow diagram is given of station; plan of station showing ultimate capacity of four 60,000 kw. units; coal handling and storage; auxiliary wiring scheme is decided advance in power-station design; station auxiliary power supply; building design.

STEAM POWER PLANTS

Economic Pressure. Most Economic Steam Pressure (Der wirtschaftlichste Dampfdruck), P. Gilli. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 2, Feb. 1930, pp. 39-45, 14 figs. Discussion as to whether 22, 37 or 100 atmos. is most economic, and whether high pressure should be employed only with back pressure; increase in fuel economy with increase in pressure with regard to live steam temperature, intermediate superheating, machinery efficiency, and size of plant.

Heating and Power. Power from Process and Space Heating Steam, L. A. Harding, Power Plant Eng., vol. 34, no. 7, Apr. 1, 1930, pp. 386-388, 4 figs. Heating water for process work by means of condensing bleeder turbine offers advantages in many plants; multi-stage turbine operation; chart shows operation for all conditions; two-stage water heaters.

High-Pressure, Germany. Development and Prospects of High-Pressure Steam Installations in Germany (Entwicklung und Aussichten der Hochdruckdampfanlagen in Deutschland), X. Mayer. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 502, Feb. 2, 1930, pp. 90-92, 1 fig. Review of high-pressure steam development in Germany since 1922; heating surface and heating surface loads for boilers from 30 to 120 atmos. pressure, are tabulated; heat-economy developments in Germany, United States, and British power plants since 1913, shown in curves.

Industrial, Paper, and Pulp Mills. Crocker, Burbank Station—An Outstanding Example of Balanced Design, P. W. Swain. Power, vol. 71, no. 12, Mar. 25, 1930, pp. 460-464, 10 figs. Three paper mills in Fitchburg, Mass., pool supply of steam and by-product power in single ultra-modern plant; pressure drop from 400 lbs. to 35 lbs. in efficient units, with outlet for all excess by-product power generated, insures effective utilization of fuel energy; illustrated description of equipment and operation; list of principal equipment.

STEAM TURBINES

Back-Pressure. Governing the Operation of Back-Pressure Turbines, R. G. Standerwick. Power, vol. 71, no. 11, Mar. 18, 1930, pp. 431-433, 4 figs. Exhaust or bled steam used for process work is generally required at constant pressure; regulation of this pressure is made automatic by turbine controls; diagram illustrating back-pressure and centrifugal governor.

STEEL

Manufacture, Duplex Process. Practice in Making Duplex Steel, J. E. Carlin. Iron Age, vol. 125, no. 13, Mar. 27, 1930, pp. 925-927. Duplex steel practice is carried out usually in tilting Talbot furnace of 100 to 300 tons capacity; certain refinements have been developed recently and process is now capable of producing steel of any carbon content of quality which rivals that of regular basic open-hearth process; characteristics of slag; proportioning charge.

Metallography. A Heuristic Theory of the Structure of Steel, L. Cammen. Am. Soc. Steel Treating—Trans., vol. 17, no. 4, Apr. 1930, pp. 563-569. According to new theory steel consists, not of aggregation of crystals with amorphous cement in between, but of matrix of extremely fine crystalline matter (so fine that even most powerful microscope does not disclose its structure), in which are embedded now visible crystals of same presumable composition as matrix: theory is said to explain why, at room temperature, steel breaks through crystals and not through cement.

TEMPERATURE EFFECT. Creep of Steel Under Simple and Compound Stresses, R. W. Bailey. Engineering (Lond.), vol. 129, nos. 3345 and 3347, Feb. 21, 1930, pp. 265-266, and Mar. 7, pp. 327-329, 15 figs. Two series of tests are recorded; one was made upon steel tubes strained separately at same temperature by tension and torsion producing equal maximum shear stress; other was made upon lead pipes under internal pressure with superimposed axial loading. Paper read before World Power Conference, Tokio.

TESTING. Endurance Properties of Steel in Steam, T. A. Fuller. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 294, for mtg. Feb. 1930, 13 pp., 15 figs. Description of preliminary experiments; investigation outlined to determine combined effects of steam and temperature; work reported deals chiefly with nickel steel, with one series of tests including nitrided steel; endurance limit of nickel steel is lower in steam than in air at room temperature; endurance limit of 65,000 lbs. per sq. in. was obtained with specimens of nitrided steel.

TOOL. *See Tool Steel.*

STONE QUARRIES AND QUARRYING

QUEBEC. Stone Quarries in Quebec, R. H. Pitcher. Quarry and Surveyors' and Contractors' Jl. (Lond.), vol. 35, no. 396, Feb. 1930, pp. 55-58. Brief account of 29 stone-quarrying operations in Quebec.

STREET LIGHTING

CENTRAL STATIONS. Promotion of Street and Highway Lighting by Central Stations, W. T. Blackwell and H. W. Hardy. Illum. Eng. Soc.—Trans., vol. 25, no. 2, Feb. 1930, pp. 123-141, 1 fig. Policy of one large utility is stated and manner in which plans for financing, installing and operating such systems are prepared and placed in practice is explained; two quite different plans are presented and advantages of each compared; rapid increase in growth of street lighting in communities served by this utility proves success of its policies.

STRUCTURAL STEEL WELDING

CODES. Structural Welding Code Data Applying to the United States. Am. Welding Soc.—Jl., vol. 9, no. 1, Jan. 1930, pp. 65-72. Report of Committee on Building Codes of Society covering cities adopting American Welding Society Code for Fusion Welding and Gas Cutting in Building Construction, and uniform building Code of Pacific Coast Building Officials Conference, cities and towns not having provisions for welding in their Building Codes, and cities revising such codes.

STRUCTURAL STEEL WELDING

ADVANTAGES OF. Strengthening Bridges and Structures by Welding, A. G. Leake. Am. Welding Soc.—Jl., vol. 9, no. 2, Feb. 1930, pp. 18-25, 7 figs. Advantages of welding over riveting for steel structures; replacing stiffener angle which has corroded or web of girder which has deteriorated with balance of girder in perfect condition by arc welding in railway and highway bridges. Paper presented at joint meeting of Am. Welding Soc. and Am. Soc. Civil Engrs.

SUBWAY CONSTRUCTION

LONDON. London Subway Reconstruction. Tramway and Ry. World, (Lond.), vol. 67, no. 8, Feb. 13, 1930, pp. 69-72, 10 figs. Illustrated description of subway reconstruction in which minimum height of 16 ft. 6 in. is to be obtained so as to admit double-deck cars; estimated cost of reconstruction $1,630,000.

SUPERHEATERS

HIGH-TEMPERATURE. Superheater for High Steam Temperatures (Ueberhitzer fuer hohe Dampftemperaturen), F. Muenzinger. Waerme und Kaelte Technik (Muehlhause), vol. 32, nos. 3 and 4, Feb. 15, 1930, pp. 6-10 and Feb. 28, pp. 1-4, 16 figs. It is shown by new method that superheater pipes of SM-steel, even with steam that is clean and free from air, is exposed to strong internal corrosion as soon as steam temperature greatly exceeds 500 deg.; Conclusions are summarized.

SWIMMING POOLS, INDOOR

HAMILTON, ONT. Municipal Swimming Pool at Hamilton, E. H. Darling. Can. Engr. (Toronto), vol. 58, no. 10, Mar. 11, 1930, pp. 311-315, 10 figs. Report on 100,000 gal. exhibition pool constructed for British Empire Games; length 75 ft., width 45 ft., and depth ranging from 3 ft. to 10 ft. 6 in.; pool is equipped with purification plant, heating system, laundry, sanitary conveniences, showers, etc.; underwater illumination; details of gutter; hot air heating system.

T

TESTING MACHINES

FATIGUE. Fatigue Testing Machines (Maschinen fuer Dauerversuche), W. Deutsch. Zeit. fyer Metallkunde (Berlin), vol. 22, no. 2, Feb. 1930, pp. 56-61, 21 figs. Description of various machines for prolonged testing of materials; tension-compression, bending-vibration, and torsional-vibration machines; special machines.

TOOL STEEL

QUENCHING. On the Cause of Quenching Deformation in Tool Steel, D. Hattori. Tohoku Imperial Univ.—Sci. Reports, vol. 18, no. 5, Dec. 1929, pp. 665-698, 34 figs. Results of expriments on deformation produced by quenching prisms and cylinders of various lengths or sections, made of carbon steel, special tool steel, or high-speed steel; cause of this deformation is discussed, comparing it with that of Armco iron; warping is also caused by quenching; deformation and warping are produced by difference of structural change and of thermal expansion at different portions of specimens. (In English.)

Some Notes on the Behaviour of Carbon Tool Steel on Quenching, G. V. Luerssen. Am. Soc. for Steel Treating—Trans., vol. 17, no. 2, Feb. 1930, pp. 161-192 and (discussion), 192-198, 2 figs. Paper is plea for uniform carbon tool steel; emphasizes necessity of uniformity through series of illustrations showing characteristic conditions of quenching, range, and hardness penetration which may exist; convenient type of Metcalf test to determine degree to uniformity; relationship of quenching range and hardness penetration to occurence of soft spots, change of size in hardening and susceptibility to cracking; influence of these characteristics upon actual tool performance.

TRACTORS

CATERPILLAR. Design of Caterpillar Tracks (Die Bauarten der Raupenbandfahrwerke), Friedrich. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 23, no. 6, Mar. 4, 1930, pp. 114-118, 13 figs. Use, application, and advantages of caterpillar drives are discussed; design and construction of parts; discussion of wheel sizes and distribution of strains and stresses in parts.

GEARS, HEAT TREATMENT OF. Case-Hardening Practice for Tractor Gears, J. F. Harper. Am. Mach., vol. 72, no. 11, Mar. 13, 1930, pp. 449-452, 5 figs. Methods employed by Allis-Chalmers Manufacturing Co., for heat-treating gears for Model U tractor units; tractor gears and spline shafts are carburized, hardened, and drawn in electrically-heated units, semi-automatic in operation and with smooth flow of work between units; furnaces operated 24 hrs. a day, 7 days a week; operations outlined.

TUBES

BRASS. Internal Stress and Season Cracking in Brass Tubes, D. K. Crampton. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 297, for mtg. Feb. 1930, 18 pp., 11 figs. Résumé of literature descriptive of investigations; correlation between mercurous nitrate tests and actual season cracking on long-time atmospheric exposure; quantitative effect of type and degree of drawing operations on intensity of internal stress and on tendency to season crack in brass tubes; possibility of drawing high-brass tubes so as to prevent occurrence of harmful stresses. Bibliography.

NON-FERROUS, EXTRUSION OF. The Extrusion Process in the Metal Industry, E. Pfann. Metal Industry (Lond.), vol. 36, no. 3, Jan. 17, 1930, pp. 97-99, 4 figs. Technique of extrusion process and machinery now in use are dealt with; modern conditions and requirements; speed control; extrusion processes being applied to production of articles which were previously rolled and several advantages over rolled process.

TUNNELS

CONSTRUCTION, INDIA. A Practical Note on Tunnelling in Shale and Limestone, R. O. C. Thomson. Government of India—Tech. Paper (Calcutta), no. 274, 1929, 23 pp., 14 figs. General discussion of principles of tunnel construction with special reference to Indian conditions.

TUNNELS, RAILROAD

ENGLISH CHANNEL. The Channel Tunnel. Engineering (Lond.), vol. 129, no. 3349, Mar. 21, 1930, pp. 381-382; see also editorial comment in Engineer (Lond.), vol. 149, no. 3871, Mar. 21, 1930, p. 327. Editorial comment on latest report; economics of tunnel project turn largely upon passenger traffic; engineering features have settled down to approximate form which may be accepted, if further geological examination reveals no unfavourable features; serious feature of project is that traffic would ten to concentrate at tunnel; it would become uneconomical to maintain boats, which would pass out of existence; and great sums expended on harbour facilities and vessels would be lost.

MOFFAT. Completion of Moffat Tunnel of Colorado, C. A. Betts. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 4, part 1, Apr. 1930, pp. 679-716, 12 figs. History and description of methods of construction of railroad tunnel 6.2 mi. long; details of survey methods used over range that rises to 12,000 ft. above sea level and 28,000 ft. above tunnel; plans and equipment of construction camps; tunneling in soft ground for 2½ mi.; use of "Lewis Travelling Cantilever Girder"; ventilation tests for correlation of data on air-friction factors for tunnels of mining size and on factors for standard railroad tunnels; itemized cost data.

TUNNELS, VEHICULAR

HUDSON RIVER. Plan Second Highway Tunnel Under Hudson River. Eng. News Rec., vol. 104, no. 11, Mar. 13, 1930, pp. 454-456, 5 figs. General information and cost estimate for proposed vehicular tunnel near 38th St., New York City, which would be prolongation of cross-town tunnel from Borough of Queens; second Hudson River vehicular tunnel is estimated to cost from $77,000,000 to $95,000,000; expected cross river traffic.

V

VIADUCTS

CONCRETE ARCH. Designing the Hyperion Viaduct at Los Angeles, M. Butler and A. L. Enger. Eng. News-Rec., vol. 104, no. 12, Mar. 20, 1930, pp. 476-478, 7 figs. $1,600,000 continuous concrete arch structure, with spans up to 135 ft. in width, solves difficult traffic problem; stress calculations checked by Beggs machine; two design methods compared.

W

WATER DISTRIBUTION SYSTEMS

PIPE FOR. Choosing Types of Pipe for Iowa Distribution Systems, H. F. Blomquist. Water Works Eng., vol. 83, no. 3, Jan. 29, 1930, p. 176. Comparative discussion of materials for distribution-system pipe of water works. Paper presented before Water Works Conference. Indexed in Engineering Index, 1929, from Can. Engrs., Nov. 26, 1929.

WATER DISTRICTS

PORTLAND, MAINE. History of the Organization of the Portland Water District, D. E. Moulton. New England Water Works Assn.—Jl., vol. 43, no. 4, Dec. 1929, pp. 359-363. Political and financial history of Portland Water District, Portland, Maine, since 1866.

WATER FILTERS

RAPID SAND. The Rapid Sand Filter Bed, J. R. Baylis. Water Works and Sewerage, vol. 77, no. 1, Jan. 1930, pp. 7-10, 2 figs. Chemical treatment and rapid sand filtration; sand beds for rapid sand plants; voids; flocculated matter; filtration by straining and lodgment of particles; loss of head for ¾ in. filter near end of run.

WATER FILTRATION

PRETREATMENT. Preliminary Purification Processes of Polluted Water, L. L. Jenne. Am. Soc. Mun. Improvements—Proc., vol. 35, 1929-1930, pp. 293-312, 3 figs. Comparison of monthly results obtained over period of three years at four Philadelphia filter plants; improvement in turbidity and bacterial content effected by long-time sedimentation as compared with short sedimentation and filtration in either slow or rapid-sand filters. Article indexed in Engineering Index, 1929, from Pub. Works, Dec. 1929.

WATER FILTRATION PLANTS

OTTAWA. Ottawa's Water Purification Problems, W. Gore. Contract Rec. (Toronto), vol. 44, no. 12, Mar. 19, 1930, pp. 343-345, 5 figs. Features of filtration plant and trial filters established for investigation of satisfactory methods of purification for highly coloured Ottawa River water. Paper read before Am. Water Works Assn.

NIAGARA FALLS. Some Unusual Features in the Design of the New Water Filtration Plant at Niagara Falls, F. A. Dallyn. Am. Water Works Assn.—Jl., vol. 22, no. 3, Mar. 1930, pp. 362-365. Proposed filtration plant described is designed primarily for ease in operation; construction will be aided by use of crane to handle control parts and pipes; provision is made for testing different units while in use without interrupting service. Indexed in Engineering Index, 1929, from Contract Rec., Aug. 21, 1929.

WATER METERS

SPECIFICATIONS. Meters, Water (Cold and Hot), Positive Displacement Type for Shipboard Use. U. S. Navy Dept. Specifications, no. 45M2, Dec. 2, 1929, 5 pp. General specifications covering types and classes, material and workmanship, general and detail requirements, method of inspection, tests, packing and marking. Bibliography.

WATER PIPE LINES

CROSS CONNECTIONS. Safeguarding and Eliminating Cross Connections in New York State, C. A. Holmquist and E. Devendorf. Am. Water Works Assn.—Jl., vol. 22, no. 1, Jan. 1930, pp. 103-109. Summary of resolutions adopted by various water-works organization; use of chlorinators as remedial measure.

WATER HAMMER. Oscillations of Pressure in Pipe-Lines during Closure, E. Parry. Instn. Civ. Engrs.—Selected Eng. Papers (Lond.), no. 74, 1929, 18 pp., 7 figs. Theoretical mathematical study by analytic and graphical methods; character and extent of variations produced by combination of elastic and inertia forces; neglect of elastic forces is seldom justified in dealing with comparatively rapid closures; compressibility of water and elasticity of pipe casing; closure by rhythmic steps; closure by uniformly increasing or uniformly decreasing retardations; closure by harmonic retardation; comparison of five different modes of closure.

WATER POWER

CANADA. Water Power Resources of Canada, N. Marr. Eng. Jl. (Montreal), vol. 13, no. 2, Feb. 1930, pp. 75-89, 10 figs. Survey of available and developed water power; outline of development 1900 to 1930; capital invested in water power; coal equivalent of developed water power; total turbine installation by provinces; 7 of transmission systems in provinces of Canada; water power in mineral industries and in pulp and paper industry; water powers available for future development.

WATER SOFTENING

ZEOLITE PROCESS. Trends in Municipal Zeolite Water Softening, W. J. Hughes and H. B. Crane. Am. Water Works Assn.—Jl., vol. 22, no. 1, Jan. 1930, pp. 68-81, 5 figs. Discussion of tendencies; utilization of greater operating economy made possible by more recent zeolites of increased power; use of plant construction which in filter practice has proven its suitability; cost data; estimated cost of three types of softening plant for 10 m.g.d. of 51 p.p.m. effluent; effect of by-passing zeolite softening plant; example of modern installation for Mangum, Okla.

Engineering Studies of Municipal Zeolite Water Softening, H. N. Jenks. Am. Water Works Assn.—Jl., vol. 22, no. 3, Mar. 1930, pp. 342-351 and (discussion) 351-356, 4 figs. Results of preliminary studies made on practical-scale softening apparatus in sanitary engineering laboratory of Iowa State College; restrictions in use of zeolite; program of investigation relating to engineering aspects of municipal zeolite water softening; water-softening capacity studies; regeneration and wash-water studies; underdrain distribution system.

WATER TOWERS

FAILURES. Ice Formed on Outside of Tank Causes Its Collapse, A. H. Fretter. Water Works Eng., vol. 83, no. 5, Feb. 26, 1930, p. 298, 2 figs. Description of failure of 40,000-gal. tank at Medina, Ohio; unequal stresses set up by mass of ice on one side of tank blamed for accident; tree sheared by roof of water tank.

WATER TREATMENT

AERATION. Some Uses of Aeration in Water Purification, M. Pirnie. New England Water Works Assn.—Jl., vol. 43, no. 44, Dec. 1929, pp. 395-398. Report on operation experiences and experimental tests; West Palm Beach, Fla.; Providence, R.I.; Watertown, N.Y., and Danville, Va.

BARIUM ALUMINATE. Barium Aluminate and Its Use in Water Purification (L'aluminate de baryum et son emploi dans l'épuration des eaux), R. Stumper. Chimie et Industrie (Paris), vol. 22, no. 6, Dec. 1929, pp. 1067-1083, 25 figs. Use of barium compounds and of aluminum salts is familiar in water treatment; combination of two reagents as barium aluminate, which would also precipitate calcium and magnesium, therefore, appears attractive; in general precipitation is more complete than with single salts, barium carbonate first formed reacting again with calcium sulphate.

COAGULANTS. Ferric Alumina, A. R. Moberg and E. M. Partridge. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 163-164. Modern development in field of coagulation; development of new coagulant; nature and properties and results accomplished with ferric alumina.

DECOLORIZATION. Colour Reduction in Storage Reservoirs, C. M. Saville. New England Water Works Assn.—Jl., vol. 43, no. 4, Dec. 1929, pp. 416-442 and (discussion) p. 443, 4 figs. Additional data to previous publication on subject by same author; curves showing relation between colour, rainfall and depletion at Nepaug Reservoir, 1917-1928, and at reservoirs no. 2 and no. 6, 1915-1929; abstracts from reports of F. P. Stearns in connection with water-supply problems of Hartford, Conn.; average and maximum colours of surface water at Wachusett and Sudbury, dams.

TASTE REMOVAL. The Prevention of Chloro-Phenol Tastes in New York State, C. R. Cox. Am. Water Works Assn.—Jl., vol. 21, no. 12, Dec. 1929, pp. 1693-1704. Assistant Engineer of State Department of Health reviews method of removal or destruction of phenolic compounds introduced into streams or lakes with wastes from by-product coke ovens; practice of water works of Buffalo, Rensselaer and Waterloo; superchlorination; ammonia treatment; potassium-permanganate treatment.

WATER WAY TRANSPORTATION

MOTORSHIP. Motorshipping Its Own Map Maker, A. C. Hardy. Motorship, vol. 15, no. 1, Jan. 1930, pp. 21-23, 3 figs. Discussion of how motorship has usurped many trade routes and why it has altered shape of others.

WATER WELLS

POLLUTION. Pollution of Abandoned Well Causes Fond du Lac Typhoid Epidemic. Eng. News-Rec., vol. 104, no. 10, Mar. 6, 1930, pp. 410-411, 2 figs. River relocation allowed sewage and tannery waste to enter old well and pass underground to city wells.

WATERWAYS

ST. LAWRENCE RIVER. Report on the St. Lawrence Waterway Project, H. Holgate and J. A. Jamieson, Southam Press, Montreal, Ltd., 46 pp., 1929. Full text of report to Montreal Board of Trade on economic advantages of proposed St. Lawrence Deep Waterway both from navigation and power viewpoint; international aspects of problem; authors conclude that proposed St. Lawrence Deep Waterway, Lake Ontario to Montreal is unnecessary unceconomic project.

WATER WORKS

CEDAR RAPIDS, IA. The New Water Works of Cedar Rapids, Ia., H. T. Rudgal. Water Works and Sewerage, vol. 77, no. 1, Jan. 1930, pp. 1-4, 7 figs. Construction features of combined pumping station and 12 m.g.d. water softening and filtration plant; layout of construction plant; architectural treatment of building.

CORROSION. Some Water Works Corrosion Problems, I. D. Van Giesen. Am. Water Works Assn.—Jl., vol. 22, no. 1, Jan. 1930, pp. 36-48, 11 figs. Outline of processes of electrolytic, graphic and mutual corrosion, with special reference to corrosion of open tanks and water pipes; features of preventive methods, Indexed in Engineering Index, 1929, from Water Works Eng., Dec. 4, 1929.

WINDSOR, ONT. Windsor and District Water Supply, J. C. Keith. Can. Engr. (Toronto), vol. 58, no. 10, Mar. 1930, pp. 325-327. Excerpts from report on adequate water supply for Windsor, Ont.; problem of filtration; plant extension recommended at cost of $554,000; metering is reducing consumption.

HAMILTON, ONT. Water Supply for City of Hamilton, A. E. Berry. Can. Engr. (Toronto), vol. 58, no. 10, Mar. 11, 1930, pp. 317-318. Report recommends installation of mechanical filtration plant; and program for sewage disposal to decrease contamination in bay.

CANADA. Water Works Statistics. Can. Engr. (Toronto), vol. 58, no. 11, Mar. 18, 1930, pp. 139-170. Supply, pumps, purification, distribution, services, mains, meter rates, names of officials and other reference data on 100 Canadian water works arranged in alphabetical order.

ONTARIO. Water Supply System at North Bay, Ont., W. B. Redfern. Can. Engr. (Toronto), vol. 58, no. 11, Mar. 18, 1930, pp. 116-118 and 130A-130C, 7 figs. Description of new water works for city having population of 16,500; water pumped from Trout Lake to new reservoir; new pump house and concrete reservoir constructed; water mains laid and new pumping plant installed; floor plan of pump house. Paper presented before Am. Water Works Assn.

WEIGHTS AND MEASURES

CONVERSION. The Conversion of Combined Metric Units into British Units. Engineering (Lond.), vol. 129, no. 3338, Jan. 3, 1930, p. 20. Reference is made to article by E. Klapper published in Oct. 18, 1929, issue of this journal, covering table of factors for converting quantities expressed in combined metric units into corresponding quantities expressed in British or American units; as table contained number of errors, it is reprinted in full with certain additions; every care has been taken in checking this table as it now appears, and it is believed to be entirely reliable.

WEIRS, STONEY GATE

SPAIN. Open-Weir Dam in Ebro River (Una presa de compuertas en el Ebro), J. L. Grasset. Ingenieria y Construccion (Madrid), vol. 7, no. 84, Dec. 1929, pp. 621-627, 17 figs. Description of hydro-electric development of Sociedad Salto del Cortijo; 8 km. bend in Ebro river gives fall of 12 m.; derivation tunnel 1,100 m. long from dam to power house; details are given of construction of dam 13.5 m. high, with 7 Stoney gates; supporting piers 3 m. wide, spaced at 18 m. centre to centre; metallic caissons used in placing of concrete foundations.

WELDING

BEST PRACTICES. Best Practices for Welding the Different Metals, O. Trentham. Soc. Automotive Engrs., vol. 27, no. 2, Feb. 1930, p. 257. Preheating gray-iron castings before welding; welding of cast iron also employed for reclaiming defective castings in foundry by filling in cold shuts and blowholes; bronze-welding practice; welding non-ferrous metals described. Abstract.

PROGRESS IN. Extend Applications of Both Welding and Riveting. Iron Trade Rev., vol. 86, no. 1, Jan. 2, 1930, pp. 26-27 and 121, 3 figs. Progress in welding and riveting during 1929 is discussed by various executives.

ELECTRIC WELDING MACHINES. Results of Research in Theory of Arc Welding Machines, A. F. Davis. Am. Welding Soc.—Jl., vol. 9, no. 1, 1930, pp. 62-64, 2 figs. Methods of reducing opening circuit voltage of arc-welding machine to varying voltage demanded by arc; experiments have shown possibility of inseting in arc circuit a device which will produce effects similar to those produced in machine by transformer action of double winding on pole pieces, except that effect will be in opposite direction thus nullifying original transformer action.

GERMANY. Welding. Metallurgist (Supp. to Engineer, Lond.), Feb. 1930, pp. 18-19. Review of group of papers on technology of welding occupying whole of V.D.I. Zeit. for Dec. 7, 1929; contents throw interesting light on position attained by welding in Germany; authors do not entirely agree in their views, while all of them still adopt tone of propagandist, who has to convince those who are at lest still skeptical; it is quite clear that immense development in welding has taken place and that rapid progress is being made.

PRESSURE VESSELS. *See Pressure Vessels.*

WELDS

HEAT TREATMENT. A Contribution to the Study of Influence of Welding Conditions and Subsequent Heat Treatment on the Structure of the Weld, K. Kuetter and V. N. Krivobok. Am. Welding Soc.—Jl., vol. 8, no. 10, Dec. 1929, pp. 40-62, 19 figs. Report presented to Fundamental Research Committee of American Bureau of Welding is given; in study of resistance welds of low-carbon wire, recrystallization experiments show that gas absorption is much less than in electric arc process and probably less than in oxyacetylene welding. Study of metallurgical literature of welding processes given.

TESTING. Examining Arc Welds for Quality, G. C. Ward. Iron Age, vol. 125, Jan. 30, 1930, pp. 369-370, 1 fig. Various methods of inspecting finished welds are discussed; kerosene penetration indicates soundness only; quality of tone cannot distinguish good from fair welds, nor can visual inspection; correct procedure control is indispensable; inspection during welding is necessary.

Testing Welds with Stethoscope. Oxy-Acetylene Tips, vol. 8, no. 6, Jan. 1930, pp. 127-128, 1 fig. Description of new non-destructive method of testing welds which provides effective means for checking quality of welded products; application of stethoscope is development of familiar method of testing soundness of metal part by ring when struck with hammer or sledge.

WIND TUNNELS

FRANCE. The Electrodynamic Balance of the Small Wind Tunnel of the French Service of Aeronautical Research, P. Rebuffet. Nat. Advisory Committee for Aeronautics—Tech. Memo. no. 556, Mar. 1930, 10 pp., 13 figs. Principle of Villey's electrodynamometers is explained; principal difficulties met in installation of these electrodynamometers in small wind tunnel of French service of Aeronautical Research are described covering mechanical, electrical, and thermal, problems; precision of 0.002 to 0.003 of maximum force measured can be obtained. Read before Société de Navigation Aérienne, June 5, 1929.

WIRE ROPE

TESTING. Breaking Strength of Wire Rope Subjected to Bending (Ueber Bruchbiegezahlen von Drahtseilen), L. Klein. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 23, no. 1, Jan. 3, 1930, pp. 1-6, 15 figs. Discussion of tests made by English Wire Rope Committee to determine breaking strength of wire rope subjected to bending; causes for breaks are investigated and proven to be mainly from rearrangement of strands in radial direction on entering groove in sheave.

Tensile and Bending Tests of Wire Rope (Pruefung von Seildraehten durch Zug und Biegeversuche), G. Sachs and H. Sieglerschmidt. Mitteilungen der deutschen Materialpruefungsanstalten (Berlin), no. 10, 1930, pp. 68-78, 30 figs. Composition is given of materials used in tests which include electrolytic copper, bronze, aluminum, electron, electrolytic iron, and steels of different composition; influence of tensile stress, and of strength of wire.

WOOD DISTILLATION

ENGLISH HARDWOOD. Oils from English Hardwood Tar, M. Schofield. Indus. and Eng. Chem., vol. 22, no. 1, Jan. 1930, pp. 63-64. Total yield of oils from tar; phenolic constituents of oils; fractional distillation of tar; colour and odour of fractions. Bibliography. Indexed in Engineering Index, 1929, from Indus. Chemist, Apr. 1929.

WOOD PRESERVATION

CREOSOTING. Comparative Efficiencies of the Components of Creosote Oil as Preservatives for Timber, F. H. Rhodes and F. T. Gardner. Indus. and Eng. Chem., vol. 22, no. 2, Feb. 1930, pp. 167-171, 5 figs. New method for determination of fungicidal powers of preservatives for timber is described; fungicidal powers of various fractions from dead oil, tar acids, and tar bases from creosote oil, and of some of pure components of creosote oil were measured; vapour pressures of various fractions and mixtures of fractions of creosote oil were measured; percentages of certain hydrocarbons in fractions from coal-tar croesote oil were determined. Bibliography.

GREAT BRITAIN. British Wood Preserving Association. Elecn. (Lond.), vol. 104, no. 2696, Jan. 31, 1930, p. 139. Co-operation for study of problems; encouragement of use of home-grown timber; need of fundamental research; improved methods required.

X

X-RAY ANALYSIS

MATERIALS TESTING. X-Ray Densograms in Materials Testing (Roentgendensogramme in der Werkstoffpruefung), M. v. Schwarz. Giesserei (Duesseldorf), vol. 17, no. 2, Jan. 10, 1930, pp. 37-39, 8 figs. Notes on use of densograms for evaluation of X-ray photographs in materials analysis; operation of densograph; examples are given showing application of densograms.

VEIN ENGINEERING. X-Rays in Engineering, V. E. Pullin. Engineer (Lond.), vol. 149, no. 3867, Feb. 1930, pp. 204-207, 12 figs. Author's purpose is to explain possibilities of radiography, defining its limits from engineering point of view and to describe roughly apparatus and its use and methods of engineering radiologist.

Z

ZINC ORE ROASTING

EQUIPMENT CORROSION. The Corrosion of Rabbles in Zinc Concentrate Roasting Furnaces, N. Greenwood, and A. J. Roennfeldt. Australasian Inst. of Min. and Met.—Proc., (Melbourne), no. 75, pp. 99-120, 18 figs. partly on supp. plates. Description of experimental work on Barrier roasting furnaces at Port Pirie, South Australia; it was found that, as structural material for rabbles, alloys high in chromium, but containing no nickel, are superior to chrome-nickel, as corrosion is much less under operating conditions at that plant; tabular analysis of alloy and data on corrosion tests. Full text of paper indexed in Engineering Index 1929, from abstract in Eng. and Min. Jl., Nov. 30, 1929.

ZINC ORE TREATMENT

ELECTROLYTIC. Development of Zinc Electrolysis (Die Entwicklung der Zinkelektrolyse), G. Eger. Zeit. des Oberschlesischen Berg- u. Huettenmaennischen Vereins zu Katowice (Katowice), vol. 68, no. 11, Nov. 1929, pp. 580-587, 1 fig. Historical review and description of experiments, present practice; chloride and zinc-sulphate electrolysis; latest development of zinc-sulphate electrolysis; description of Tainton's process.

ZINC ROLLING MILLS

PRESSURE AND POWER. Rolling Pressure and Power Requirements of a Zinc Rolling Mill (Ueber Walzdruck und Energiebedarf an einem Zinkwalzwerk), G. B. Lobkowitz. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 1, Jan. 1930, pp. 8-13, 9 figs. Results of measurements are given; it is claimed that treatment of zinc is of special interest, as its properties and preparation are to great extent unsolved problems.

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

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A

AERIAL SURVEYING

Application to Engineering Problems. Aerial Surveying as Applied to Engineering Problems, A. M. Narraway. Eng. Jl. (Montreal), vol. 13, no. 3, Mar. 1930, pp. 171-178, 10 figs. Short description of use of stereoscope; practical applications of aerial surveys; mapping; water-power engineering; transmission line location; forestry; railway and road location; geodetic surveying; other applications of aerial engineering.

AIRPLANE ENGINES

Design. Influence of Power-Plant Weight on Performance (Der Einflus des Triebwerksgewichts auf die Flugleistungen), M. Schrenk. Luftfahrtforschung (Munich), vol. 6, no. 4, Feb. 14, 1930, pp. 92-95 and (discussion) 95-96, 4 figs. In preceding article by Kamm (same issue, p. 87) development of engine is urged which is more reliable in operation, but, on the other hand necessarily heavier than most of those now used; present author, as airplane manufacturer, reports effect of such an engine on airplane performance, and suggests means and ways of overcoming disadvantages of heavy power plant.

Small Airplane Engines, N. N. Tilley. Soc. Automobile Engrs.—Jl., vol. 26, no. 3, Mar. 1930, pp. 346-351 and (discussion) 351 and 371, 12 figs. Stating that requirements of airplane power plant are light weight, low fuel and oil consumption, reliability and durability, smooth and flexible operation and compactness, author discusses briefly how these are obtained; greater proportionate weight of accessories, foundry limitations and other considerations than loads and stresses tend to make small airplane engine heavier in proportion to horse power than larger power plants, manufacturing cost being more important than maximum performance in power and weight.

Research. Thermodynamic Aspects of Aeronautical Research (Thermodynamische Aufgaben der Luftfahrtforschung), K. Loehner. Luftfahrtforschung (Munich), vol. 6, no. 4, Feb. 14, 1930, pp. 111-120, 8 figs. Thermodynamics of aircraft engines embraces phenomena occurring in gases due to special influences affecting these engines, such as heat transfer, and auxiliary equipment, such as blowers and exhaust-gas turbines; further development of aircraft Diesel is deemed desirable; results of thermotechnical measurements. Bibliography and table giving saturated-vapour temperatures of fuel mixtures and initial temperature for dry and moisture-containing air.

Vibrations. Vibrations in Airplane Power Plants (Die Schwingungen in Luftfahrzeug Triebwerkanlagen), K. Luerenkaum. Luftfahrtforschung (Munich), vol. 6, no. 4, Feb. 14, 1930, pp. 97-102 and (discussion) 109-110, 9 figs. Oscillations and dynamic stresses which are source of hazard to airplane power plant are studied, but without aid of numerical data, and with special reference to torsional vibrations, which are probably main cause of failures; means of reducing hazard of torsional vibrations are studied.

AIRPLANES

Autogiro. *See Autogiros.*

Design. Theoretical and Experimental Study of Class of Profiles with Constant Centre of Pressure (Etude théorique et expérimentale d'une class de profils à centre de poussée constant), M. Risack. Service Technique de l'Aéronautique—Bul., (Brussels), no. 9, Mar. 1930, pp. 3-22, 10 figs. Résumé of mathematical wing theory; requirements for transforming of circle into customary wing profile; curves and data on wing profiles; some polar curves of bulletin no. 7 have been revised because use of standard wing in tunnel tests has reduced errors due to suspension of air foil.

AIRPORTS

Canada. Airports Have Many Problems in Canada's Far North. Airports, vol. 4, no. 2, Feb. 1930, pp. 28-30, 4 figs. Development of civil and commercial flying has helped development of whole country; distance from manufacturing centres demands elaborate repair shops at airports; describes hangars of Ontario Government Service at Sault Ste. Marie; buildings are constructed over steel girders and uprights with concrete floors and ceilings; describes airport at Pointe-aux-Trembles, constructed of reinforced concrete.

Montreal, Que. Building an Airport at St. Hubert, Que. Canadian Engr. (Toronto), vol. 58, no. 15, Apr. 15, 1930, pp. 489-491, 5 figs. Report on construction of modern airport near Montreal, to serve all types of aircraft, including mooring tower for large British dirigible; 3 runways built of bituminous macadam using Colas emulsified asphalt, are 150 ft. in width and from 1,800 to 2,000 ft. in length; reconditioning macadam road.

AIRSHIPS

Mooring Masts. The St. Hubert Airship Mooring Tower. Engineer (Lond.), vol. 149, no. 3872, Mar. 28, 1930, pp. 358-359, 2 figs. Canadian tower is self-contained structure, anchored to concrete footings; at base there is two-storey building, cruciform in shape, to house mooring winches, heating plant, etc.; it is octagonal structure 171 ft. high, surmounted by projecting telescopic mooring arm to which nose of airship is attached; total height of tower to top of mooring arm is 205 ft.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Bearing Metals. *See Bearing Metals.*
Brass. *See Brass.*
Chromium-Nickel. *See Chromium-Nickel Alloys.*
Copper. *See Copper Alloys.*
Die-Casting. *See Brass.*
Phosphor Bronze. *See Bearing Metals.*

Properties. Thermal Properties of Different Groups of Alloys (Die thermischen Eigenschaften verschiedener Legierungsgruppen), A. Schulze. Giesserei-Zeitung (Berlin), vol. 27, no. 7, Apr. 1, 1930, pp. 177-184, 23 figs. Thermal expansion (dilatometry) and its relation to constitution of alloys is discussed and method of investigation described; relations between heat conductivity and constitution; notes on magnetic properties of alloys and X-ray analysis by which fine structure of alloys is rendered visible.

ALUMINUM ALLOYS

Heat Treatment. Aluminum Alloys Capable of Heat Treatment (Verguetbare Aluminiumlegierungen), W. Fraenkel. Zeit. fuer Metallkunde (Berlin), vol. 2, no. 3, Mar. 1930, pp. 84-89, 15 figs. An example of simple alloy, aluminum with slight copper content, and its heat treatment are discussed; phenomena observed with treatment at ordinary, elevated, and fluctuating temperature; theory of treatment is discussed; main types of important aluminum alloys and their transformation to other and to more complicated systems are described.

ARCHES, CONCRETE

Testing. Laboratory Tests of Reinforced Concrete Arch Ribs, W. M. Wilson. Univ. of Ill.—Eng. Experiment Station—Bul., vol. 7, no. 26, Feb. 25, 1930, 102 pp., 55 figs. Report on investigation with object of comparing measured stresses with stresses computed by elastic theory, both when stresses are produced by loads and when they are produced by abutment movements; specimens used were reinforced concrete, hingeless arch ribs, having span of 17 ft. 6 in. and rise of 4ft. 1/16 in.; measured and theoretical values found to agree closely.

ASPHALT

Mastic. The Principles of the Manufacture of Mastic Asphalt, A. W. Attwooll. Chem. and Industry (Lond.), vol. 49, no. 15, Apr. 11, 1930, pp. 181t-187t. Great distinction between rock and mastic asphalt is that, while in former incorporation of bitumen and mineral base has been effected by nature, in latter it takes place mostly by human agency and as is not unusual, is not nearly so thorough; author illustrates building up of mastic-asphalt specifications and shows that it is admirable material for roofing and floors of factories and buildings and for lining of tanks, ducts, and channels in many chemical engineering problems.

AUTOGIROS

Theory of. Autogiro. Flight (Lond.), vol. 22, no. 14, Apr. 4, 1930, p. 391, 3 figs. Theory of autogiros; many engines may be used; Armstrong-Siddeley "Genet" or "Cirrus III" is advocated for privately owned machines; fuselage of normal construction; autogiro tests on 3,000 mile flight without accidents.

AUTOMOBILE ENGINES

Combustion Chambers. Combustion Chamber Research, H. S. Glyde. Automobile Engr. (Lond.), vol. 20, no. 264, Feb. 1930, pp. 62-65, 13 figs. Results of experiments carried out on series of side valve turbulent heads of constant head throat area but having head clearances varying in steps of 1/16 in. from 0.022 in. to 0.272 in.; in order to investigate possibility of igniting very thin layer of combustible mixture and to obtain information with regard to detonation in small head clearances in Ricardo turbulent head.

Ignition. Coil Ignition, F. W. Lanchester. Instn. Automobile Engrs.—Proc. (Lond.), vol. 23, 1928-29, pp. 214-44 and (discussion) 245-253, 19 figs. Origin of ignition coil; theory of Ruhmikorf coil; number of turns necessary in secondary windings; design of primary condenser; discussion of question of coupling; improved method of operating induction coil; various systems of automatic advance.

AUTOMOBILES

Front-Wheel Drive. Front-Wheel Drives, P. M. Heldt. Soc. Automotive Engrs.—Jl., vol. 26, no. 3, Mar. 1930, pp. 352-360 and (discussion) 360, 8 figs. Engineering consideration leading to former almost universal practice of steering with rear wheels are reviewed, and desire for bodies lower than can be made reason for present interest in front drives.

Riding Qualities. Riding Qualities of Automobiles Determined by Rate of Vibration, J. W. Watson. Automotive Industries, vol. 62, no. 12, Mar. 22, 1930, pp. 470-472. Attainment of higher degree of comfort in cars is possible with reversal of present practice in designing suspension systems; what makes car comfortable otherwise is not that springs are weak or stiff, nor that weight supported by them is light or heavy, but rate at which rider's movement is accelerated or retarded.

AVIATION

Canada. The Northland is Proving to be the Realm of the Airplane, E. L. Chicanot. U.S. Air Services, vol. 15, no. 3, Mar. 1930, pp. 45-48, 3 figs. Review of progress; airplanes adding vast economic realm of northern extremities to Canada; vast amelioration of previous primitive life; base established at waterways; transport of fish by air; Tike transportation of furs.

B

BEAMS

Continuous. Study of Continuous Girders with Special Reference to Plasticity (Der durchlaufende Traeger unter Beruecksichtigung der Plastizitaet), J. H. Schaim. Stahlbau (Supp. to Bautechnik) (Berlin), vol. 3, no. 2, Jan. 24, 1930, pp. 13-15, 4 figs. Report on results of tests made at State Materials Testing Bureau of Berlin-Dahlem; bending, deflection and elongation of two and three span continuous beams.

BEARING METALS

PHOSPHOR-BRONZE. Modern Bearing Metals with Special Regard to Phosphor Bronze (Neure Lagermetalle, unter besonderer Beruecksichtigung von Phosphorbronze), D. Schulz. Automobiltechnische Zeit. (Berlin), vol. 33, no. 9, Mar. 31, 1930, pp. 224-225. Results of tests of Caro bronze bearing metal with 8 to 9 per cent tin content, claimed to be especially well adapted for automobile engines.

BOILERS

FURNACES, COMBUSTION IN. Admission of Combustion Air (Die Technik der Zufuehrung von Verbrennungsluft), R. Fehling. Archiv. fuer Waermewirtschaft (Berlin), vol. 11, no. 4. Apr. 1930, pp. 119-123, 5 figs. Thermal and aerodynamic conditions of combustion-air admission are discussed; nature of turbulence, its influence on combustion, and relation between air admission and heat transfer in furnace.

FURNACES, RADIATION IN. Measurement of Flame Radiation in Boiler Furnaces (Messungen der Flammenstrahlung in Dampfkesselfeurungen), P. Koessler. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 6 and 7, Mar. 31, 1930, pp. 75-78, and Apr. 15, pp. 95-98, 4 figs. Mar. 31: Fundamentals for calculation of radiation of gases and soot suspensions are briefly set forth, and it is shown that radiation of soot suspensions in flame greatly exceeds that of gases; description of testing equipment. Apr. 15: Tests of traveling-grate stokers.

HIGH-PRESSURE. Foreign Developments in the Use of High Pressure Steam, J. B. Crane. Combustion, vol. 1, no. 10, Apr. 1930, pp. 39-41, 8 figs. Review of development of high-pressure boilers, which has been somewhat different in Europe than in United States. Supplement of paper "Progress in the Use of High Pressure Steam" by authors, presented before Am. Soc. Mech. Engrs., Mar. 25.

PULVERIZED COAL-FIRED. General Operation Experiences with the First Wood Steam Generator, E. W. Smyth. Mech. World, (Manchester), vol. 87, no. 2252, Feb. 28, 1930, pp. 193-195 and (discussion) no. 2254, Mar. 14, 1930, pp. 242-244, 5 figs. Table of results of tests conducted during 1927; slag troubles; tube failures; arrangement of superheater, economizers and soot blowers. Abstract of paper presented before Instn. Mech. Engrs.

TUBES, STRESSES IN. The Thickness of Boiler Tubes, J. G. Docherty. Engineering (Lond.), vol. 129, no. 3354, Apr. 25, 1930, pp. 527-529, 9 figs. Author presents simple method of deducing "equivalent" or "resultant" stress in tubes of any given thickness under given conditions of heat flow and pressure, and gives minimum equivalent stress under these conditions.

BRASS

FOUNDRY PRACTICE. Casting Boiler Accessories in the Penberthy Plant, J. Breakey. Can. Foundryman (Toronto), vol. 21, no. 4. Apr. 1930, pp. 13-15, 4 figs. Methods and equipment employed by Penberthy Injector Co., Windsor, Ont., in making brass parts for steam power plants; all castings are moulded by means of two Tabor jolt-squeeze machines, patterns all being in form of match plates; core making.

SILICON, EFFECT ON. Effects of Silicon on the Properties of Brass, H. W. Gould and K. W Ray. Metals and Alloys, vol. 1, no. 10, Apr. 1930, pp. 455-457, 3 figs. Structure of brass containing silicon has been studied for two copper-zinc ratio series; silicon forms homogeneous alpha solutions with 85-15 brass if present to extent of not more than 2.8 per cent; it does not form homogeneous alpha solutions with 60-40 brass; silicon lowers freezing point of 85-15 and 60-40 brasses when present in amounts up to 10 and 7 per cent respectively; many of silicon brasses are subject to heat treatment.

BRIDGE PIERS

CONSTRUCTION. Deep Caisson Cylinders, in Clusters, Form Stilts to Support Piers of Bridge Approach. Construction Methods, vol. 12, no. 4, Apr. 1930, pp. 34-37, 13 figs. Construction of eight concrete piers for west approach of new passenger bridge of Pennsylvania Railroad across Hackensack River, near Marion, N.J.; special type of substructure employs 4-ft. corrugated shell sunk 80 ft. through core of mud and filled with concrete.

BRIDGES CONCRETE

DESIGN. Computation of Stresses in Bridge Slabs due to Wheel Loads, H. M. Westergaard. Pub. Roads, vol 11, no. 1, Mar. 1930, pp. 1-23, 21 figs. Theoretical mathematical analysis of homogeneous elastic slabs; deirvation of fundamental formulae; solution for slab loaded by concentrated force, expressed by infinite series; Nadai's solution in finite form proved; derivation of formulae for bridge floors; greatest bending moments computed for case of wheel load at centre, two wheel loads on line in direction of span; slab cantilevered from single fixed edge investigated.

BRIDGES, CONCRETE ARCH

CONSTRUCTION. Ingenious Construction on Mill Street Bridge, Watertown, N.Y., E. H. Harder. Eng. News-Rec., vol. 104, no 15, Apr. 10, 1930, pp. 603-605, 6 figs. Structural-steel ribs of 140-ft. concrete arch hung from old bridge during erection and later made hingeless to carry forms and concrete; details of steel rib and of erection and bracing schemes.

FRANCE. The 600-Ft. Concrete Arch Bridge at Brest, France, E. Freyssinet. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 83-97 and (discussion) 98-99, 10 figs. Report by designer and builder on construction of bridge, located at Plougastel, over River Elorn, which comprises three arches of reinforced concrete of 612-ft. span; arch centreing suspended from haunches; experiments of concrete contraction.

BRIDGES, PLATE GIRDER

COSTS. Unit Prices from Current Construction Bids. Eng. News-Rec., vol. 104, no. 17, Apr. 24, 1930, pp. 709-710, 2 figs. Comparison of bids on Newark Bridge of nine through girder spans, concrete viaducts and approach fills; cost of boardwalk at Jones Beach State Park, N.Y., 40 ft. wide by 3,500 ft. long; sanitary sewers at Dallas, Tex., awarded for $39,768.

BRIDGES, RAILROAD

REINFORCING. Making Old Bridges Stronger, G. A. Haggander. Ry. Age, vol. 88, no. 13, Mar. 29, 1930, pp. 756-760, 9 figs. Practical methods of reinforcing existing structures to extend their life and enable them to carry heavier loadings; strengthening floor systems. Abstract of paper present before West. Soc. Engrs.

BRIDGES, STEEL ARCH

GREAT BRITAIN. Tyne Bridge, Newcastle, D. Anderson. Instn. of Civil Engrs.—Minutes of Proc. (Lond.), vol. 22, no. 4771, 1930, pp. 3-24. Design and construction of combined bridge having two-hinge steel arch of 531-ft. span and rise of 170 ft., roadway 38 ft. wide and two sidewalks 9 ft. each; details of concrete towers; cost 693,808 pounds sterling.

SYDNEY, AUSTRALIA. The Sydney Harbour Bridge. Engineering (Lond.), vol. 129, nos. 3353 and 3354, Apr. 18, 1930, pp. 495-498, and Apr. 25, pp. 533-534, 44 figs. Apr. 18: Erection of bridge approaches was begun in July, 1923; work on bridge proper started in Jan. 1924; it is two-hinged arch with five steel spans at each end, total length of structure being 3,770 ft.; method adopted for constructing main span. Apr. 25: Actual work of erection is being effected by 122-ton creeper cranes; method of carrying out erection will be continued simultaneously from each bank; bridge being built by Dorman, Long and Co.

BRIDGES, STEEL TRUSS

WELDING. The First Arc-Welded Bridge in Europe, S. Bryla. Eng. News-Rec., vol. 104, no. 16, Apr. 17, 1930, pp. 644-645, 6 figs. Description of steel highway bridge erected for Polish government in Lowicz, Poland, 88½ ft. in span; all members built up of plates, channels and angles, using flux-covered electrodes with 180-amp. and 30-volt current; jigs used in fabricating members.

BRIDGES, SUSPENSION

PHILADELPHIA-CAMDEN. Suspension Bridges With Special Reference to the Philadelphia-Camden Bridge, U.S.A., R. Modjeski. Assn. of Chinese and Am. Engrs.—Jl. (Peiping), vol. 10, no. 4, Dec. 1929, pp. 6-21. Evolution of suspension-bridge construction; comparison of suspension bridges constructed between 1882 and 1932; principles of design of suspension bridges; foundations, towers, cable bents, cables, stiffening trusses, erection methods, tests of materials. Paper presented before World Eng. Congress in Tokyo. (In English.)

BRIDGES, WROUGHT IRON

TESTS. Strainmeter Tests of a Railway Bridge, H. R. Garth. Instn. Civil Engrs.—Selected Eng. Papers (Lond.), no. 68, 1929, 15 pp., 36 figs. on supp. plates. Report on Tests of double-track bridge of two square spans 71 ft. 6 in. between bearing-plates, having girders of wrought iron; object of tests was to find distribution of load to all parts of superstructure of each span; test-load used was an engine of "Atlantic" type; value of method of testing.

BUILDINGS

HIGH, ENGINEERING PROBLEMS OF. Engineering Problems of the Modern Skyscraper, D. P. Albert. Universal Engr., vol. 51, no. 2, Feb. 1930, pp. 17-20, 6 figs. Brief history of skyscraper development; description of design features of Chrysler Building; water pumping and elevator equipment.

BUILDINGS, STEEL

ELECTRIC WELDING. Arc-Welded Buildings Permitted in 71 Towns, F. P. McKibben. Elec. World, vol. 95, no. 14, Apr. 5, 1930, pp. 692-694, 2 figs. In last decade it has been shown that welding probably will become real factor in erection of steel-building structures; Austin Co. is now prepared to offer welding as alternative to riveting in any type of building steel erection; for welding buildings where ⅜-in. fillets are used 175 to 200 amp. with arc voltage of 18 to 20 gives satisfactory results for hand welding with 3/16-in. welding wire.

C

CANAL LOCKS

COSTS. Unit Prices From Current Construction Bids. Eng. News-Rec., vol. 104, no. 14, Apr. 3, 1930, pp. 595-596, 2 figs. Unit prices quoted in contracts for reconstructing Twin City Lock at Minneapolis, ten road projects in New Mexico (with actual prices on three jobs); grading and drainage for Mount Vernon highway.

CARS, REFRIGERATOR

MAINTENANCE AND REPAIR. Modern Refrigerator Repair Shop. Ry. Mech. Engr., vol. 104, no. 2, Feb. 1930, pp. 57-61 and 68, 10 figs. Pacific Fruit Express Co. plant at Roseville, Calif. is fully equipped and organized for efficient operation; annual production is 100,000 repaired cars; all work is organized on progressive system; shop machine tools are all electrically operated with direct motor drive.

CAST IRON

PROPERTIES. Gray Iron Possesses Valuable Engineering Properties. Foundry, vol. 58, nos. 7 and 8, Apr. 1, and May 1, 1930, pp. 111-115 and 209-212, 21 figs. Apr. 1: Effect of silicon and carbon in gray iron; tests and casting of test bars; curves showing relation of cooling time to ratio of volume to surface area; tensile strengths of various types of cast iron determined on standard test bars; tensile and transverse strength tests of cast iron in relation to ratio of volume to surface area; stress-strain diagrams for different types of cast iron; tables with data on classification of cast irons on Si plus C content; volume to surface-area relationships; routine tensile tests; various high-strength irons poured in regular practice. May 1: Effects of repeated stressing on cast iron are described; physical properties given and changes in structure discussed; reference made to J. T. MacKenzie's article in proceedings A.S.T.M. 1929.

TESTING. The Effect of Melting Conditions on the Microstructure and Mechanical Strengths of Gray Cast Irons Containing Various Amounts of Carbon and Silicon, A. L. Norbury and E. Morgan. Iron and Steel Inst.—Advance Paper (Lond.), May 1930, 20 pp., 21 figs. Part 1 contains results of experiments on effects of melting conditions, such as superheating, additions of steel, silicides, graphite, gases, and iron oxide; part 2 gives results of tensile, transverse, repeated impact, Brinell drill-hardness, and specific gravity tests on cast irons having total carbon contents between 1.5 and 4.0 per cent, and silicon contents between 0.5 and 10 per cent.

CERAMIC PRODUCTS

CANADA. Canadian Ceramic Products—Raw Materials and Finished Wares, G. M. Hutt. The Ceramic Age, vol. 15, no. 1, Jan. 1930, pp. 42-45. General discussion of deposits of ceramic materials in Canada; heavy clay products; clay products by provinces in 1928; geological survey of following: fire clays, pottery clays, bentonite, feldspar, magnesite, silica, gypsum and limestone, fuels, miscellaneous minerals and chemicals.

CHROMIUM-NICKEL ALLOYS

PROPERTIES. Nickel-Chromium Alloys, J. H. Russell. Metal Industry (Lond.), vol. 36, nos. 14 and 16, Apr. 4, 1930, pp. 377-379, and Apr. 18, pp. 429-431, and (discussion) 431-432. Outstanding features in these alloys as nickel content increases is that they become more resistant to heat; alloys become less liable to oxidation, and maintain good mechanical properties at quite high temperatures; brittle range; heat-resisting nickel-chromium alloys; wire drawing of nickel-chromium rods; production of nickel-chromium tape; castings; industrial-furnace parts. Paper read before Coordinated Societies, Mar. 10.

Some Alloys for Use at High Temperatures, W. Rosenhain and C. H. M. Jenkins. Iron and Steel Inst.—Advance Paper (Lond.), May 1930, 80 pp., 24 figs. Investigations carried out at National Physical Laboratory relates to preparation and mechanical properties of alloys of nickel containing 20 to 40 per cent chromium but certain sections include alloys containing 0 to 60 per cent chromium; development of complex alloys of especially high strength must be regarded as still in preliminary stage although considerable advance has been made.

CHROMIUM STEEL

CHROMIUM-COPPER. Chromium-Copper Structural Steels, J. A. Jones. Iron and Steel Instn. Advance Paper (Lond.), May 1930, 9 pp. Investigation of steels containing 0.3 per cent. carbon, 0.5 to 1 per cent manganese, up to 1.5 per cent chromium and up to 1.2 per cent copper; steels containing chromium in addition to manganese do not offer advantage for structural purposes over usual type of steel containing high manganese only; addition of 0.5 to 1.2 per cent of copper to steels containing up to 1 per cent of copper to steels containing up to 1 per cent of chromium leads to marked improvement in properties.

PROPERTIES. The Properties of Some Steels Containing Chromium, A. R. Page and J. H. Partridge. Iron and Steel Inst.—Advance Paper (Lond.), May 1930, 23 pp., 11 figs. Experiments were originally designed to determine properties of steels suitable for exhaust valves of air-cooled internal-combustion engines; two important properties are: good mechanical strength combined with toughness at ordinary and elevated temperatures, and resistance to oxidation or scaling at temperatures to which exhaust valve may be heated under bad engine conditions; this temperature may reach 800 to 900 deg. cent.

COMBUSTION

SURFACE. Surface Combustion, M. V. Hurst. Foundry Trade Jl. (Lond.), vol. 42, no. 711, Apr. 3, 1930, p. 252, 1 fig. Description of Cox system of surface combustion, the invention of Bone; system utilizes gas from coal, etc., which, mixed with correct proportion of air at pressure of 3 in. of water, is fed to "combustors" formed of granulated material compressed into various shapes, on surface of which mixture burns without visible flame. Abstract of paper read before Junior Instn. of Engrs.

COLUMNS, CONCRETE

TESTING. Reinforced Concrete Column Investigation, W. A. Slater. Am. Concrete Inst.—Jl., vol. 1, no. 6, Apr. 1930, pp. 601-612 and (discussion) 613-615, 3 figs. Progress report of committee 105; tests of plain and reinforced concrete columns in United States, Canada and Europe; programme of tests for column investigation.

COLUMNS, STEEL

TESTING. Transverse Tests of H-Section Column Splices, J. H. Edwards, H. L. Whittemore and A. H. Stang. U.S. Bur. of Standards—Jl. of Research, vol. 4, no. 3, Mar. 1930, pp. 395-413, 18 figs. Plates were welded to outer edge of inside faces of flanges of 3-ft. lengths of 10, 12 and 14-in. H sections, joined in pairs by splice plates bolted to these welded plates to represent spliced section of column for use in steel-frame building; specimens were tested as beams on 66-in. span with loads at quarter points; method of stress analysis suitable for use in designing similar splices is developed.

CONCRETE ABSORPTION

TESTING. Testing Concrete for Absorption, F. Weigel. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 514-521, and (discussion) 521, 3 figs. It is probable that at no time do hydration products become entirely crystalline and hydrated cement will always contain sufficient quantity of gel to cause cement paste to exhibit properties of colloidal gel; under conditions of high-temperature gel tends to lose water; under conditions of low temperature of high humidity it tends to take on water; tests described seem to bear out these conclusions quite closely. Paper indexed in Engineering Index 1929, p. 487, from Advance Paper for mtg., Feb. 12-14, 1929.

CONCRETE CONSTRUCTION

FIELD CONTROL. Three and One-Half Years Experience of the Detroit Edison Company in Concrete Control, A. S. Douglass and J. S. Nelles. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 100-151, 36 figs. Detroit Edison Co. in field laboratory has proportioned and controlled all its concrete according to best practice which it was possible to determine; aggregates; first control job; equipment; analysis of costs; variation in consistency; low cement; description of new Delray power plant No. 3; durability; winter methods; advantages of control. Paper indexed in Engineering Index 1929, p. 493, from Advance paper Feb. 12-14, 1929.

CONCRETE CURING

TEMPERATURE EFFECT. Effect of Temperature on the Curing of Concrete, R. A. Foley. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 556-572, 3 figs. Manager of Superior Products Co., Detroit, Mich. presents general discussion and report on original experimental study; compression-strength curves for specimens of reinforced and plain concrete pipe showing effect of curing temperatures.

CONCRETE MIXING

SALTS, USE OF. British Report on Use of Salts in Concrete Mixing Water, W. N. Thomas. Concrete, vol. 36, no. 4, Apr. 1930, p. 24. Abstract of report by Building Research Board of British Department of Scientific and Industrial Research; sodium chloride and calcium chloride studied; action differs with different brands of cement; corrosive action on steel; recommendations on use of each salt.

WATER-CEMENT RATIO. Water Tables and Curves for Use in Designing and Estimating Concrete Mixtures, H. J. Gilkey. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 292-313, 4 figs. Tables and graphs covering water-cement ratio by loose or bulk volume, gallons of water per bag of cement, pounds of water per bag of cement, water-cement ratio by absolute volume and ratio of water to cement by weight; for all units, corresponding estimated strengths according to two well-known Abrams equations; strength ratios based upon Abrams curves. Paper previously indexed, in Engineering Index 1929, p. 498, from Advance Paper, Feb. 12-14, 1929.

CONCRETE REINFORCING BARS

SPECIFICATIONS. Standard Specification for Billet-Steel Reinforcing Bars. Eng. Standards Assn. (Ottawa), no. G. 30, Apr. 1930, 10 pp. This specification covers three classes of billet-steel concrete reinforcing bars, namely: plain, deformed, and cold-twisted.

Standard Specifications for Rail-Steel Reinforcing Bars. Can. Eng. Standards Assn. (Ottawa), no. G. 31, Apr. 1930, 11 pp. This specification covers three classes of rail-steel reinforcing bars, namely; plain, deformed, and hot-twisted.

CONCRETE SPECIFICATIONS

DEVELOPMENT OF. The Development of Specifications for Reinforced Concrete, G. J. Eyrick, Jr. Am. Concrete Inst.—Proc. vol. 25, 1929, pp. 622-629 and (discussion) 630-631, 4 figs. General review of evolution of reinforced-concrete specifications in United States; types of cylinder test reports and graphs.

CONSISTOMETERS

NEW TYPE. A. New Consistometer and Its Application to Greases and to Oils at Low Temperatures, R. Bulkley and F. G. Bitner. Rheology—Jl., vol. 1, no. 3, Apr. 1930, pp. 269-282, 8 figs. Construction and method of operation of consistometer alleged to be rugged, simple, speedy, and can be employed for opaque and clear materials of wide range of consistencies; material may be passed through capillary any number of times; determinations of rate of flow are made by passing very small volume through capillary; unworked, as well as worked, consistency may be closely approximated; calibration of capillaries; sources of error; flow-pressure graphs of plastic lubricants.

CONVEYORS

CONTROL. Speed Regulation and Control of Conveyors, A. F. Redman. Cassier's Mech. Handling (Lond.), vol. 17, no. 1, Jan. 1930, pp. 10-16, 16 figs. Improvement in design of conveyor equipment during last few years has made rapid progress, and inclusion of specialized reduction and control gear has become matter of importance; speed variation by electrical means; mechanical reduction gears; "Veratio" gear; Humfrey Sandberg uni-directional clutch; ring of rollers; J.F.S. reduction gear; O.I.V. chain gear; Crofts gear; variable speed transmission by oil-gear.

COOLING TOWERS

CALCULATION OF. Cooling Towers and Spray Ponds and Their Calculation, L. Hansen. Southern Power Jl., vol. 48, no. 2, Feb. 1930, pp. 105-106. Discussion of good judgment in selection of cooling tower or spray pond; atmospheric or natural draft and forced-draft cooling towers; determination of amount of air necessary to cool given quantity of air per minute.

CONCRETE. Reinforced-Concrete Cooling Towers, A. T. J. Gueritte. Structural Engr. (Lond.), vol. 8, no. 3, Mar. 1930, pp. 117-125, and (discussion) no. 4, Apr. 1930, pp. 141-143, 15 figs. Evolution of cooling-tower construction; several modern examples of concrete cooling tower construction in Europe.

COPPER ALLOYS

P. M. G. P. M. G. Metal for Replacing the Bronzes, M. A. Hunter. Heat Treating and Forging, vol. 16, no. 3, Mar. 1930, pp. 344-345. Hardened copper alloy can be utilized in all situations where high tensile strength is required; alloy as cast contains as its major constituents 2 per cent of iron and 3.4 per cent of silicon with 2 per cent of zinc; hardening is presumably due to presence of iron silicide; this compound dissolves at high temperatures in molten copper; on cooling, iron silicide precipitates from solid solution in such manner as to increase hardness of solidified alloy; metal can be readily forged hot.

COPPER ORE TREATMENT

CANADA. Copper Concentration as Applied to Canadian Ores, W. B. Maxwell. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 16, Apr. 18, 1930, pp. 367-371, 1 fig. Discussion of Canadian copper ores, some of which are complex and most of which contain values in gold and silver; milling practice at Britannia plant, at Granby Consolidated Anyox and Allenby plants, and at Noranda concentrator in Quebec; reagent consumption and milling data are given; some cost data on Britannia. Paper read before Empire Min. and Met. Congress in S. Africa.

CRANES

CABLEWAY. Installation of Cableway Cranes (Installation de grue à cables). Génie Civil (Paris), vol. 96, no. 13, Mar. 29, 1930, pp. 301-304, 10 figs. Description of cableway crane installation at Beuthe, to serve triangular area, for Graeflich Schaffgotsche Werke coal mines; span is 290 m. long, steel frame towers are 36.6 m. high and lifting capacity is 14 tons.

ELECTRIC. ALUMINUM-ALLOY. 10-Ton Crane Built of Aluminum Alloy, F. V. Hartman and E. C. Hartmann. Elec. World, vol. 95, no. 11, Mar. 15, 1930, p. 552, 3 figs. New application of strong alloys of aluminum in field of structural engineering is found in 10-ton travelling crane installed in works of United States Aluminum Co., Massena, N.Y.; crane is three-motor, single-hook machine with lift of 22 ft.; girders are constructed of aluminum alloys and have span of 72 ft. 2 in.; built by Alliance Machine Co., Alliance, Ohio.

CULVERTS

CONCRETE. Joint Concrete Culvert Pipe Committee. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 606-621, 5 figs. Second report on standard specifications for reinforced concrete pipe to be used for railway and highway culverts; tentative standard specifications for materials, design, physical tests and inspection.

CUPOLAS

DESIGN. Main Dimensions of Foundry Shaft Furnaces (Cupolas) (Die Hauptabmessungen von Giessereischachtoefen), B. Osann. Giesserei (Duesseldorf), vol. 17, no. 13, Mar. 28, 1930, pp. 293-297. Different methods of calculating main dimensions are developed and critically evaluated.

CUTTING TOOLS

TUNGSTEN CARBIDE. Alloys With Hardness of Diamonds (Diamantharte Legierungen), S. Malowan. Giesserei-Zeitung (Berlin), vol. 27, no. 8, Apr. 15, 1930, pp. 219-220, 4 figs. Brief note on same alloys used as cutting tools, including tungsten-carbide; Lohmann volomit, consisting of tungsten-cobalt, nickel, and chromium carbides; thoran, which is carbice of thorium and tungsten; and new Widia alloys of Krupp; advantages of hard alloys are set forth.

D

DAMS

DESIGN. Design and Economics of Concrete and Reinforced-Concrete Dams (Entwurf und Witschaftlichkeit von Staumauern aus Beton und Eisenbeton), E. Probst and F. Toelke. V.D.I. Zeit. (Berlin), vol. 74, no. 13, Mar. 29, 1930, pp. 385-394, 44 figs. Function of dams, their cost in comparison with total cost of hydraulic project; general critical review of evolution of dam design, including gravity, flat and arch designs as well as their combinations; buttress design and observations on crack formation in buttresses. (To be concluded.)

DAMS, CONCRETE

CONSTRUCTION. Thomson Dam and Reservoir, H. C. Ash. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 29-38 and (discussion), 38-46, 7 figs. Description of early construction in which particular attention is given to such details as selection of materials, and mixing, placing and curving of concrete. Paper indexed in Engineering Index 1929, p. 545 from Am. Concrete Inst.—Reprint for mtg., Feb. 12-14, 1929.

EARTHQUAKE RESISTANCE. Earthquake Resistance Provided in Design for Gravity Dam. Eng. News Rec., vol. 104, no. 15 Apr. 10, 1930, pp. 606. See editorial comment on pp. 597. Discussion of earthquake-resistance provisions incorporated in design of Pine Canyon dam, to be built on San Gabriel River as part of water supply project for Pasadena, Calif.; dam, which is of concrete gravity type, straight in plan and 375 ft. above lowest foundation, is designed to resist horizontal earthquake acceleration of 0.1 g.; this necessitates base width 0.8 of height, which adds 9.38 per cent to volume.

DAMS, MULTIPLE ARCH

ITALY. The Lake Salarno Dam (La Diga del Lago Salarno), F. Pagliaro. Annali deo Lavori Pubblici (Rome), vol. 68, Jan. 1930, pp. 15-29, 9 figs. Report on design and construction of reinforced-concrete multiple-arch dam, of curved alignment, for Societa Generale Elettrica dell'Adamello, in upper basin of Oglio River; maximum height of dam is about 38 m., total length along axis of crown is about 265 m.; results of geological investigation of foundation site; tests of materials used in construction; regimen of reservoirs.

DIE CASTING

BRASS ALLOYS FOR. Brass Pressure Die Castings (Der Messing-Pressguss), W. Mueller. Giesserei Zeitung (Berlin), vol. 27. no. 6, Mar. 15, 1930, pp. 155-156, 9 figs. Brass as successor to tin-zinc-aluminum die casting is said to be latest discovery in field of die castings; its advantages are set forth and casting method is described.

DIES

STAMPING. Metal Stamping Dies—Die Layout and Construction, E. E. Clark. Metal Stampings, vol. 3, no. 4, Apr. 1930, pp. 323-328, 10 figs. Discussion of factors affecting choice between built-up and solid types of die construction; including type of tool, materials available and their characteristics, costs, repairs, etc.

STEEL FOR. New Tool and Die Steels Give High Production, O. K. Parmiter. Iron Trade Rev., vol. 86, no. 16, Apr. 17, 1930, pp. 52-54, 4 figs. Desirable properties of chromium-molybdenum-vanadium steel; fields of application; comparative value of die steels; evolution of high-speed steel.

DIESEL-ELECTRIC POWER PLANTS

BRITISH COLUMBIA. The Selection of a Mine or Mill Power Plant, G. R. Frizell. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 14, Apr. 4, 1930, pp. 317-319, 1 fig. Notes on power plant of Base Metals Mining Corp. at Field, B.C.; two 400-hp. six-cylinder, Fairbanks-Morse Diesel engines, each direct connected to 375-kva. alternator; one 180-hp., three-cylinder Fairbanks-Morse Diesel engine direct connect to 150-kva. alternator, with alternator shaft of last mentioned engine extended through outboard bearing and connected through friction clutch to 18-in. x 11-in. x 14-in. right-angle compound air compressor; current gathered is three-phase, 60-cycle, 480 volts.

LA CROSSE, KAN. Nine-Year Operating Record of Diesel Plant. Power Plant Eng., vol. 34, no. 9, May 1, 1930, pp. 502-504, 2 figs. Care in keeping complete records and in analyzing operating costs aids materially in reducing costs of maintenance and operation at Diesel engine plant of La Crosse, Kansas; summary of nine years operating record; table showing operating costs for nine-year period.

SWIFT CURRENT, SASK. Diesel Engines as Electric Load Builders in Swift Current, Sask., C. P. Town. Disel Power, vol. 8, no. 4, Apr. 1930, pp. 190-191, 3 figs. Notes on successful Diesel engine operation in municipal power plant; second-hand 600-hp. Willans and Robinson and new 600-hp. Busch-Sulzer Diesel engines where installed; description of auxiliary equipment and operation.

DIESEL ENGINES

Airless Injection. Recent Developments in the Airless Injection of Fuel in Diesel Engines. Fuel (Lond.), vol. 9, no. 3, Mar. 1930, pp. 130-140, 18 figs. In recents years airless injection has been more and more adopted, since it gives higher thermal efficiency than blast injection by eliminating injection air compressor and power power required to drive it; it also cheapens engine and simplifies attendance; engines with precombustion chambers and with supplementary compression; phenomena in fuel piping; there is tendency to do away with camshaft altogether in two-cycle engines, especially in double-acting engines.

Balancing. Balancing of Oil Engines (Ueber den Massenausgleich von Oelmotoren), F. Schmidt. Werft Reederei Hafen (Berlin), vol. 11, no. 3, Feb. 7, 1930, pp. 49-54, 27 figs.; see also translated abstract in Mar. Engr. and Motorship Bldr , vol. 53, no. 631, Apr. 1930, p. 157. To facilitate task of engine designer in ensuring absence of vibration, author investigates by method of harmonic analysis, balancing reciprocating and rotating masses of Diesel engines having from 3 to 9 cylinders; rigidity of whole engine is of greatest importance to successful balancing; as example, case of 5-cylinder engine, consisting of two blocks of three balanced against each other, is given.

Combustion in. Combustion in Diesel Engines, H. R. Ricardo. Automobile Engr., vol. 20, no. 266, Apr. 1930, pp. 151-156, 18 figs. Discussion of combustion problem in high-speed Diesel engines, operating at piston speeds in excess of 1,500 ft. per min.; factors upon which building up of self-propagating nucleus of flame and spread of flame throughout working fluid depend.

M.A.N. Marine. Large Two-Stroke Double-Acting Oil Engines for Land and Marine Work. Engineer (Lond.), vol. 149, no. 3875, Apr. 18, 1930, pp. 430-431, 4 figs. Installation at Hennigsdorf peak-load substation comprises two 10-cylinder M.A.N. two-stroke double-acting engines operating on airless-injection principle; each has designed output of 11,700 b.hp. at 214 r.p.m.; details are also given of 6-cylinder two-stroke, double-acting, airless-injection engine which is first of this type, and forms one of two sets to be installed in 15-knot, 10,000-ton cargo liner under construction at yard of Yokohama Dock Co. for service of Kishimoto Kisen Kaisha.

Solid-Injection Double-Acting Two-Stroke Diesel Engines, A. Heller. Eng. Progress (Berlin), vol. 11, no. 4, Apr. 1930, pp. 110-112, 2 figs. Engine is one of six which Yokohama Dockyard Co. is installing in three of their ships; bore 23.7 in.; stroke 35.5 in.; speed 130 r.p.m.; b.hp. 3,600-3,750 hp.; M.A.N. scavenging process employs slots in cylinder wall both for exhaust and for admission of scavenge air, so that no valves are necessary; adoption of solid fuel injection for so large outputs represents important stage in development of double acting two-stroke Diesels, possibilities of which M.A.N. were first to put into practice.

E

ELECTRIC CABLES

Aluminum. Experimental Aluminum Transmission Lines. Metallurgist (Supp. to Engineer, Lond.), Mar. 1930, p. 48. In order to test behaviour of aluminum transmission cables under most severe service conditions, experimental line bas been erected on German island of Sylt with fullest possible exposure to gales of North Sea; line has been erected by Lautawerk Aluminum Co., but behaviour of various cables is being observed by State Testing Laboratory at Berlin-Dahlem; results of investigation which have been obtained up to present; examination has so far revealed nothing that could be properly called corrosion.

Testing. Cable Testing with High-Voltage D.C. Current (Kabelpruefung mit hochgespanntem Gleichstrom), Mehlhorn. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 9, Mar. 2, 1930, p. 187-191, 6 figs. Operating conditions for voltage doubling connection in cable testing described; it is shown that connection cannot be utilized; in short-circuit operation; improvement is obtained by arranging tubes in parallel to condensers; cable-testing car equipped with this arrangement is described.

ELECTRIC CIRCUIT BREAKERS

Oil. The Harland Oil Circuit Breaker. Engineering (Lond.), vol. 129, no. 3354, Apr. 25, 1930, p. 557, 2 figs. Details of circuit breaker for 6,600- to 11,000-volt draw-out steel-clad truck cubicle; it is completely dirt-proof and vermin-proof, and is fitted with full range of usual interlocks which ensure safety in operation, and with automatic safety shutters, so that no contact with movable parts is possible when carriage is withdrawn.

ELECTRIC FURNACES

Heat-Treating. Heat Treatment Furnaces, A. G. Lobley. Automobile Engr. (Lond.), vol. 20, no. 265, Mar. 1930, pp. 110-111, 4 figs. Two primary advantages of electric furnace are exactitude of control and flexibility; comparison between working costs of electric and gas-fired furnaces; calculated differences of temperature between resisters and furnace.

Small Parts Heated on Time Schedule, W. S. Scott. Iron Age, vol. 125, no. 17, Apr. 24, 1930, pp. 1214-1216, 3 figs. Advantages of electric heat-treating furnaces as determined by Black and Decker Co., Towson, Md., manufacturers of portable electrically driven tools; type of equipment; improvement in quality of work and reduction in cost; production and cost data are given.

The Tangible Advantages of Electric Heat Treatment, W. S. Scott. Iron and Steel Engr., vol. 7, no. 3, Mar. 1930, pp. 118-122. 3 figs. Savings resulting from use of electric heat-treating furnaces are classified according to quality of product; these savings briefly discussed.

ELECTRIC GENERATORS

Voltage Regulation. Voltage Control of Large Alternators, H. W. Taylor. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 399, Mar. 1930, pp. 317-331 and (discussion) 331-333, 28 figs. Voltage control is considered, with special reference to large high-speed machines being installed in capital stations; deals descriptively with exciter stability and response; alternator stability and response; combined response of alternator and exciter.

ELECTRIC INSULATING MATERIALS

Testing. Testing Insulation Without Destroying It, R. Sparks. Elec. Jl., vol. 27, no. 4, Apr. 1930, pp. 229-230 and 237, 4 figs. Power factor of insulation gives measure of its quality; with Schering bridge, these exceedingly low power-factors can be accurately measured without injuring insulation in any way. Bibliograpby.

ELECTRIC LINES

Towers. Centre-Supported Gin Pole Permits Better Towers, J. E. Housley. Elec. World, vol. 95, no. 12, Mar. 22, 1930, p. 584, 1 fig. Plan for suspending gin pole in centre of tower rather than lasbed to one leg was developed; line was for 150-kv., of 500,000-circ. mil aluminum cable steel-reinforced construction, and 64 single-circuit and 28 double-circuit towers were erected by centred gin pole metbods with entirely satisfactory results.

ELECTRIC LINES, HIGH TENSION

Lightning. Travelling Waves on Transmission Lines—Tests with Artificial Lightning Surges, K. B. McEachron, J. G. Hemstreet, and W. J. Rudge. Gen. Elec. Rev., vol. 33, no. 4, Apr. 1930, pp. 254-263, 16 figs. In 1929. joint investigation witb 100,000-volt impulse generator, for obtaining definite figures for various effects wbicb take place when over-bead circuits are subjected to travelling waves, as begun by General Electric Co. and Consumers Power Co.; results with respect to attenuation; effect of parallel conductors; polarity, length of waves and ground wire; results are given in tables and curves. Paper presented before Am. Inst. Elec. Engrs. previously indexed from Advance Paper, no. 25, for mtg. Jan. 27-31, 1930.

Fault Location. Fault Location Measurements on High-Tension Overhead Lines (Fehlerortmessung an Hochspannungsfeileitungen), H. Poleck. Siemens Zeit. (Berlin), vol. 10, no. 2, Feb. 1930, pp. 88-94, 4 figs. Classification of faults and various methods of location; fundamental line characteristics; mathematical and graphical principles of fault location methods by double measurement of reactive and effective resistance components.

Losses. The Impedance and Power Losses of Three-Phase Overhead Lines, P. D. Morgan and S. Whitehead. Instn. Elec. Engrs. (Lond.), vol. 68, no. 399, Mar. 1930, pp. 367-408 and (discussion) 408-409, 9 figs. Effects of transposing line conductors on operation characteristics, power losses, impedance of line conductor and earth return when one phase is accidentally earthed. Bibliography.

ELECTRIC MANUFACTURING INDUSTRY

Canada. Power Finance and Imperial Preference. H. Quigley. World Power (Lond.), vol. 13, no. 75, Mar. 1930, pp. 238-243. Article restates case, drawn up in previous article, that British electric industry has to fight, in Canada, financial interests directly opposed to fair recognition of its merits; reply is made to some Canadian critics of previous article, and tables are given showing Canadian trade with Great Britain; second half contains statements made in reply to British case, by Directors of Canadian power companies. See reference to previous article in Engineering Index 1929, p. 665.

ELECTRIC RAILROADS

Substations. Lackawanna Electrification Relies Upon Mercury-Arc Rectifiers, E. L. Moreland. Elec. World, vol. 95, no. 14, Apr. 5, 1930, pp. 704-707, 6 figs. Mercury-arc rectifiers are used exclusively; multiple unit trains. total absence of any feeds to sections except through catenarics, 3,000-volt d.c. operation, and supply from three utility companies at four voltages are features discussed; wiring diagrams showing general arrangement of rectifiers, feeders and protective equipment in substation, and comparative efficiency curves of rectifier and motor generator are given. From address before Am. Inst. Elec. Engrs.

ELECTRIC RELAYS

Testing. Testing Network Relays, C. W. Evans. Elec. World, vol. 95, no. 11, Mar. 15, 1930, pp. 550-552, 1 fig. Importance of acceptance and routine tests upon these relays is emphasized; testing and adjusting of electric characteristics of relays is problem for laboratory or test room; test for reverse current and phasing relay test.

ELECTRIC TRANSFORMERS

High Tension. A 60,000-Kva. Three-Phase Transformer. Engineer (Lond.), vol. 149, no. 3872, Mar. 28, 1930, p. 360, 1 fig. Details of 132,000/2,200-volt transformer built by Ferranti, Ltd., for South-East England electricity scheme; it is star-connected on 132,000-volt side and delta connected on 22,000-volt side, and is designed to operate as naturally cooled unit up to output of 30,000.

ELECTRIC WELDING

Arc. Transfer of Electrode Metal in the Welding Arc, A. Hilpert. Welding Engr., vol. 15, no. 4, Apr. 1930, p. 44, 1 fig. Welding arc was photographed in 1927 upon suggestion by author; Society of German Engineers conducted systematic investigation of transfer of metal; shadowgraphs are shown of transfer of molten metal from electrode tip to weld seam; shape changes considerably within 1/100th second, hence it is necessary to operate with very large number of pictures when investigating transfer of working metal in arc welding. Abstract translated from V.D.I. Zeit., 1929.

Welding Iron and Steel by Electric Arc, O. A. Tiiton. Welding, vol. 1, nos. 4 and 5, Feb. 1930, pp. 229-231, and Mar., pp. 314-317, 9 figs. Feb.: Fundamental principles and various applications are discussed; data pertaining to electrodes and fillets; potential of welding current; capacity of welding equipment. Mar.: Important factors for obtaining good welds; fabrication costs; training welding operators.

Resistance. Design of Resistance Welding Machines, W. E. Smith. Welding Engr., vol. 15, no. 2, Feb. 1930, pp. 55-56, 2 figs. Strength of parts, method of applying pressure, elimination of magnetic losses, and insulation, are some of factors to be considered.

Riveting and Upsetting Operations by Resistance Welding, A. E. Hackett. Welding, vol. 1, no. 5, Mar. 1930, pp. 301-304, 9 figs. Examples of application of resistance welding process to alloy-steel studs, propeller sbaft, and ventilating fan; use of electric welding machine for cutting steel cables.

EVAPORATION FORMULAE

Insolation. Evaporation as a Function of Insolation, B. Richardson. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 5, May 1930, pp. 945-960. Study of effect of insolation, or exposure to rays of sun; measurement of quantity of radiant heat imparted by sun and sky to water and bottom of reservoir; insolation as recorded by United States Weather Bureau pyrheliometer; insolation computed as geometric problem; insolation by tracing radiant heat energy; comparison between observed and computed evaporation show discrepancies ranging from fraction of one per cent to about 30 pei cent.

F

FEEDWATER TREATMENT

High-Pressure System. Development of a High-Pressure System for Boiler Water Conditioning, A. A. Markson. Combustion, vol. 1, no. 10, Apr. 1930, pp. 27-30 and 34, 3 figs. Description of high-pressure system, using Hall phosphate treatment, as developed at Kip's Bay Station of New York Steam Corporation and later installed at Station A, operated by same company; theoretical aspects of work are fully discussed, and equipment and operation described in some detail; definite conclusions offered based on nearly 12 months experience. Abstract of paper presented before Am. Soc. Mech. Engrs.

Phosphate Treatment. Phosphate Treatment of Boiler Water, E. P. Price. Combustion, vol. 1, no. 7, Jan. 1930, pp. 35-38, 5 figs. Brief review of principal difficulties incident to rapid changes in operating practice and results of experiments conducted on strictly commercial bases extending over period of two and one-balf years; description of feedwater testing apparatus.

Softening. Experience Witb Zeolite and Acid at Beacon St. Plant, J. H. Walker and L. F. Collins. Power, vol. 71, no. 14, Apr. 8, 1930, pp. 552-555, 3 figs. Discussion of operation of zeolite feedwater treating system installed in plant of Detroit Edison Co., which has been in operation for 3½ years; diagram of feedwater system; table of water analyses at various points in cycle; table giving annual operating cost of feedwater treating system.

FIREBRICK

Testing. Cold Crushing Strength of Fire Brick, H. K. Mitra. Am. Ceramic Soc.—Jl., vol. 13, no. 2, Feb. 1930, pp. 85-87, 9 figs. Purpose of this investigation was to determine cold crushing strength of firebrick in three directions, flat, edge, and endwise; possible mathematical relationsbip between values of tbese crushing strengths, and best procedure for testing fire-brick.

FOUNDATIONS

Construction. A Practical Method for Bracing Deep Wall Trenches. Am. Contractor, vol. 51, no. 14, Apr. 5, 1930, pp. 15-17, 5 figs. Thin walled steel pipe sections, which remain as integral part of retaining or foundation wall, provide means for bracing trench lining and permit uninterrupted concrete placement; results of tests made on deep trench struts, sbowing penetration into walers.

FUELS

CALORIFIC VALUE. Determination of Calorific Values of Liquid and Gaseous Fuels (Etwas ueber Heizwertbestimmungen fluessiger und gasfoermiger Brennstoff). Waerme and Kaelte Technik (Muehlhausen), vol. 32, no. 5, Mar. 18, 1930, pp. 4-6. Brief discussion of methods and their reliability, and precautions to be observed in measuring calorific values of liquid and gaseous fuels.

FURNACES

MELTING, OIL-FIRED. Schury Furnace (Der Schury-Ofen), F. Brocke. Giesserei-Zeitung (Berlin), vol. 27, no. 7, Apr. 1, 1930, pp. 195-197, 4 figs. Description of German patented steel-melting furnace especially well adapted for foundries with fluctuating load; advantages include short heating and melting period which, together, require only 5½ to 6 hrs.; it is a hearth furnace with regenerator, and can be fired with tar, tar oil, or other oils; comparison of heat balance of this intermittent furnace with that of continuous gas-fired open-hearth furnace.

MELTING, PULVERIZED-COAL. Melting Iron in the Rotary Furnace (La fusion de la fonte au four rotatif), C. Bouvard. Fonderie Moderne (Paris), vol. 23, Dec. 10, 1929, pp. 575-580, 3 figs. Processes of melting iron; advantages of pulverized-coal-fired rotary furnace lie in attaining very high temperatures without oxidation of metal; securing quality of finished iron differing very little from constituents of charge; possible diminution of carbon contents due to elevated temperatures; furnace heated by pulverized coal.

G

GAS INDUSTRY

CANADA. Canadian Gas Industry Sets New Records, A. Hewitt. Am. Gas Assn.—Monthly, vol. 12, no. 3, Mar. 1930, pp. 108 and 137. Production in 1929 reached over 36 billion cu. ft.; annual sales have increased 80 per cent; development of use of gas for domestic purposes.

GEARS

GRINDING. Some Developments in the Art of Gear Grinding. Engineer (Lond.), vol. 149, no. 3874, Apr. 11, 1930, pp. 397-400, 7 figs. Methods and equipment employed at works of Gear Grinding Co., Birmingham, which receives from makers of different equipment cut and hardened spur wheels, and returns them with flanks and roots and teeth finished by grinding to high degree of accuracy; it also undertakes grinding of multiple-spline shafts; grinding process employed consists of traversing through gaps of work abrasive wheel, shape of which is maintained by means of three diamonds in form requisite to give correct shape and thickness to teeth.

REDUCTION. Reduction Gears, J. A. MacMurchy. Elec. Jl., vol. 27, no. 4, Apr. 1930, pp. 213 and 227. High-grade gear of present day is as reliable as any other machine built; with proper lubrication of bearings and gear teeth, modern reduction gear system will outlast either driving or driven apparatus.

GEOLOGY

NOVA SCOTIA. Horton-Windsor District, Nova Scotia, W. A. Bell. Canada Dept. of Mines—Geol. Survey (Ottawa), no. 2176, 1929, 263 pp., and index, 14 figs. I map and 36 plates. Report of investigation concerned primarily with detailed faunal study of Windsor series, of carboniferous age, in type area in vicinity of Windsor, Nova Scotia; purpose was to so illustrate and describe faunas that they might be readily identical in other localities, and to fix their stratigraphic position more precisely than heretofore.

GEOPHYSICAL EXPLORATION, ELECTRIC

QUEBEC. Practical Results of Electrical Prospecting at Abana, J. B. DeMille. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 14, Apr. 4, 1930, pp. 314-316, 3 figs. Review of electrical survey involving three days' field work in July, 1927, on property of Abana Mines, Ltd., in northwestern Quebec; indication, according to field engineer's report quoted, gave definite results; later underground development has to large extent proved accuracy of possibilities indicated.

GLIDING

DYNAMIC. Observations of Dynamic Gliding (Beobachtungen ueber dynamischen Segelflug) L. Prandtl. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 21, no. 5, Mar. 14, 1930, p. 116, 2 figs. Description is given of how seabirds (brown albatrosses) actually soar on ocean surface, based on author's observations on voyage from Yokohama to Honolulu.

GOLD MINES AND MINING

ONTARIO. Howey Gold Mines, R. M. P. Hamilton. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 8, Feb. 21, 1930, pp. 176-179, 5 figs. Notes on rapid development of gold mine in Red Lake district; use of airplanes has been important factor; two years after discovery of property, shaft was down 600 ft. and about 12,000 ft. of lateral work had been done on four levels; ore developed over average 15 foot wide running better than $7.00 in gold; flow sheet and details of mill are given.

H

HEAT-INSULATING MATERIALS

MASONITE. The Masonite Process, R. M. Boehm. Indus. and Eng. Chem., vol. 22, no. 5, May 1930, pp. 493-497, 5 figs. History of process used by Masonite Corp., Laurel, Mass., for manufacture of insulating board by exploding wood chips under 1,000 lbs. per sq. in. steam pressure; description of products including Insulation Board, Insulation Lath, Quarterboard, and Presdwood.

HEAT TRANSMISSION

RESEARCH. Studies in Heat Transmission, A. P. Colburn and O. A. Hougen. Indus. and Eng. Chem., vol. 22, no. 5, May 1930, pp. 522-539, 20 figs. Measurement of fluid and surface temperatures; flow of heat through tubular gas condenser, heat-transmission coefficients were measured separately for water film, metal, condensate layer, and adjoining gas film; flow of fluids at low velocities.

HYDRAULIC TURBINES

DESIGN. Features of New Low-Head Hydraulic Turbine Design, H. J. Muth. Power, vol. 71, no. 17, Apr. 29, 1930, pp. 664-667, 9 figs. New development in low-head hydraulic turbine design and power house construction that provides flexibility between turbine unit and power house structure and reduces cost of construction is described.

KAPLAN. Hydro Efficiency Increase 10 per cent, C. L. Dowell. Elec. World, vol. 95, no. 14, Apr. 5, 1930, pp. 684-686, 6 figs. Subjected to severe tests of its ability to perform efficiently and continuously, first Kaplan automatic adjustable blade waterwheel installed in America has successfully completed more than nine months service at Lake Walk Plant of Central Power and Light Co.; flow of Devil's River was extremely low; performance curve based on 33-ft. net head and 277 r.p.m. are given; efficiency and horsepower curves are compared.

VIBRATIONS. On the Vibration of Draft Tube of Water Turbine, S. Uchimaru and S. Kito. Tokyo Imperial Univ. Faculty of Eng.—Jl. (Tokyo), vol. 18, no. 8, Feb. 1930, pp. 213-270, 39 figs. Theoretical mathematical analysis of causes and methods of preventing of vibrations of draft tubes, of hydraulic turbines running on part load, based on theory of vibration of columnar vortex confined in cylindrical space; also report on experiments on vibrations of cylindrical draft tubes; effect of placing disc at bottom of tube; effect of introduction of air into draft tube. (In English.)

HYDRO-ELECTRIC POWER PLANTS

BRITISH COLUMBIA. Alouette. Power Engr. (Lond.), vol. 25, no. 289, Apr. 1930, pp. 145-152, 14 figs. Description of automatic hydro-electric plant operated in conjunction with power system of British Columbia Power Corporation Ltd.; general layout; map showing location of Alouette Plant in relation to Vancouver; turbine construction; governing and automatic operation; graphs showing efficiency of turbine and alternator in relation to load.

QUEBEC. Burroughs Falls, J. R. Desloover. Elec. News, vol. 39, no. 7, Apr. 1, 1930, pp. 31-34, 6 figs. New 2,000-kva. automatic plant of Southern Canada Power Company in Province of Quebec has horizontal unit which may be used as synchronous condenser; wooden headgate; wood stave penstock; notes on surge tanks are given.

Construction Methods of Small Power Plant at Difficult Site, H. L. Mahaffy. Contract Rec. (Toronto), vol. 44, no. 13, Mar. 26, 1930, pp. 361-365, 12 figs. Report on construction of hydro-electric undertaking of Southern Canada Power Co., on Nigger River, 32 mi. from Sherbrooke, Que., including 5-ft. wood stave penstock, 2,200 ft. long; also gravity concrete dam 62 ft. high; features of horizontal shaft Francis type turbine, of 2,000 hp. capacity and of electrical equipment.

SASKATCHEWAN. 44,000-hp. Hydro-Electric Plant on the Churchill River, Canada. Engineering (Lond.), vol. 129, no. 3351, Apr. 4, 1930, pp. 442-443. Main unit will operate at 163.6 r.p.m., and head will be 60 ft.; turbines will be directly connected to three 12,000-kva., three-phase 60-cycle generators; power will be generated at 6,600 volts and stepped up to 110,000 volts for transmission to Flin Flon and Sherritt Gordon mines; dam is gravity-type concrete structure with four gate-controlled under sluices.

I

ICE INDUSTRY

UNITED STATES. The Ice Industry Today, C. C. Small. Ice and Refrig., vol. 78, no. 1, Jan. 1930, p. 10, General discussion of present standing of ice industry; effect of commercial refrigeration; outlook of business conditions. Paper presented before Am. Soc. of Refrig. Engrs.

ICE PLANTS

DESIGN. Advantages of Two Suction Pressures for Ice Plant, G. T. Voorhees. Ice and Refrig., vol. 78, nos. 1, 2, 3, and 4, Jan., Feb., Mar., and April, 1930, pp. 66-67, 156-157, 264-266, and 353-356, 6 figs. Jan.: Forecooler's part in power economy; old method's seasonable reduction thereof eliminated by new process; analysis of high suction effort and how to utilize it with all types of compression apparatus; indicator diagram showing condenser pressures in hot and cold months. Feb.: Forecooler's part in power economy; old method's seasonable reduction thereof eliminated by new process; analysis of high suction effort and how to utilize it with all types of compression apparatus; comparative indicated compressor horsepower diagram, reproduced at exact size, is given. Mar.: Diagram of suction pressure in pounds per square inch gauge for solving power problems. April: Diagrammatic illustration of can forecooler cycle; indicator diagrams for various clearances; displacement and power chart, no clearance, for ammonia compressors, also tons of refrigeration per ton of ice.

INSTITUTE OF METALS

GREAT BRITAIN. The Institute of Metals—Presidential Address, R. Seligman. Mech. World (Manchester), vol. 87, no. 2257, Apr. 4, 1930, pp. 315-317. Abstract of address before Inst. of Metals, previously indexed, from Advance Paper, no. 527, for mtg. Mar. 12-13, 1930.

INTERNAL-COMBUSTION ENGINES

ELECTRIC DYNAMOMETERS FOR. Electrical Dynamometers for Testing Internal-Combustion Engines. Engineering (Lond.), vol. 129, no. 3351, Apr. 4, 1930, pp. 438-439, 5 figs. Details of dynamometers exhibited by Highfield Electrical Co. at British Industries Fair; two types were shown, one known as production type and other as research type; latter is of enclosed protected type armature being specially constructed to withstand high speeds up to 6,000 r.p.m.; in production type power developed by engine is returned in form of electrical energy to mains, thus greatly reducing operating costs.

(*See also Airplane Engines; Automobile Engines; Diesel Engines.*)

IRON DEPOSITS

CANADA. Canadian Mineral Resources. Elec. Rev. (Lond.), vol. 106, no. 2730, Mar. 21, 1930, p. 536. Ontario has produced more than 5 million tons of iron ore and concentrates since 1869, but for several years practically all iron ore fed into blast furnaces of this country has come from United States and Newfoundland; reason for this condition is not that Canadian iron ore is very low in iron content, but that ores of Minnesota, whence most of Canadian imports come, are richer than those commonly used in other countries; imported material cheaper.

IRON AND STEEL PLANTS

FUEL ECONOMY IN. Developments in Fuel Economy at Skinningrove, F. Bainbridge. Iron and Steel Inst.—Advance Paper (Lond.), May 1930, 23 pp., 8 figs. Attempt is made to bring into balance outputs of various producing departments at Skinningrove to make available greater quantities of surplus gas by installation of automatic burners on stoves and boilers, further quantities so liberated being made use of in production of steel; economies have also been achieved by application of coke-oven gas to open-hearth furnace through water-cooled ports or burners.

L

LEAD ORE TREATMENT

ROASTING. Roasting and Sintering of Lead Ore in a Rotary Furnace (Grillage et Agglomération du minerai de plomb au four rotatif), N. C. Kyriacou. Revue de Métallurgie (Paris), vol. 27, no. 1, Jan. 1930, pp. 49-53, 2 figs. Discussion of theory and development of rotary roasting furnace; details of Kyriacou system of rotary furnace.

LEAD-ZINC MINES AND MINING

NOVA SCOTIA. The Stirling Mine, J. Nolan. Canadian Min. Jl. (Gardenvale, Que.), vol 51, no. 18, May 2, 1930, pp. 413-415, 1 figs. Description of mine on Cape Breton island, 36 mi. east of St. Peters and 40 mi. southwest of Sydney; float rock was found in stream in 1914; work on deposit began in 1915; prospecting work; drilling by American Zinc Co., and by New Jersey Zinc Co.; property is now in hands of British Metal Co., who completed 250-ton oil-flotation mill; brief note on silver-lead prospect 18 mi. to north.

LEAD-ZINC ORE TREATMENT

AUSTRALIA. Metallurgical Practice at the Broken Hill South, New South Wales. Eng. and Min. Jl., vol. 129, no. 7, Apr. 7, 1930, pp. 349-350, 3 figs. Brief description of practice at plant milling 7,000 long tons per 128-hr. week of crude ore averaging 14 per cent lead, 5.0 oz. silver per ton and 11½ per cent zinc; gangue minerals are quartz, quartzite, calcite, rhodonite and garnet; screen analysis of ball mills feed and discharge; analysis of zinc concentrate; flow sheet and milling data on differential lead flotation, zinc flotation, and general mill-recovery statement; reagent consumption; no costs data are given.

FLOTATION. Treatment of Old Mill Tailings by Flotation (Tratamiento de Antiguos Jales de Concentracion por Flotacion), C. Bruchhold. Boletin Minero (Mexico, D. F.), vol. 28, no. 4, Oct. 1929, pp. 262-268, 1 fig. on supp. plate. Notes on plant of San Nicolas Mining and Milling Co. at Vacas, Durango; old mill tailings pile has about 218,000 tons of oxide and sulphide material, more or less caked and cemented by exposure; average content of material treated during three months of 1929 was 212 grams silver per ton, 3.4 per cent lead and 8.2 per cent zinc; flow sheet, operation, and equipment are described; milling cost $2.17 per ton.

Utah. Metallurgical Control at the Tooele Concentrator, O. E. Keough. Min. and Met., vol. 11, no. 280, Apr. 1930, pp. 202-205. Description of routine tests by which technical control is maintained; twice each year tests are correlated with mill operation. Reference is made to complete description of plant as indexed in Engineering Index 1929, p. 1063, from Eng. and Min. Jl., Aug. 24, 1929.

LIGHTING

Industrial. Daylighting Industrial Buildings, A. J. Martin. Am. Architect, vol. 137, no. 2583, May 1930, pp. 36-37, 4 figs. General discussion with curves illustrating principles of daylighting; light cut off by obstructions; increase of daylighting on lower floors; increasing height of windows at lower storeys; treating walls of obstruction to reflect more light.

Modern Methods of Factory Lighting. Cassier's Mech. Handling (Lond.), vol. 17, no. 2, Feb. 1930, pp. 51-52, 3 figs. Discussion of good illumination which is essential to operatives' safety; elimination of glare; three lighting systems are discussed.

LIGNITE DEPOSITS

Ontario. Onakawana Lignite, W. S. Dyer. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 12, Mar. 21, 1930, pp. 271-273, 3 figs. Notes on lignite deposits on Abitibi River; progress in exploration by drill holes; description of lignite seams; comment on analyses of samples, which show high moisture content but less than 7 per cent ash in over 65 per cent of seam. Abstract of paper presented before Can. Inst. of Min. and Met.

LIGHTNING ARRESTERS

Thyrite. Thyrite: A New Material for Lightning Arresters, K. B. McEachron. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 5, May 1930, pp. 350-353, 7 figs. Original of paper presented before Am. Inst. Elec. Engrs., previously indexed from Power Plant Eng., Apr. 1930, and Gen. Elec. Rev., Feb. 1930.

LIQUID AIR

Containers for. Theory and Design of Metal Vacuum Jacket Containers for Liquified Gases, Especially Liquid Hydrogen (Theorie und Konstruktion der Vakuummantegefaesse aus Metall fuer verfluessigte Gase), etc., W. Meissner. Zeit. fuer die Gesamte Kaelte-Industrie (Berlin), vol. 37, no. 3, Mar. 1930, pp. 41-48, 7 figs. Discussion of heat supply through conductivity of metal and through radiation; heat transfer through conductivity of remaining gas; description of container used in German National Physico Technical Institute; result of test with liquid hydrogen and liquid air to determine relation between evaporation and supplied heat are tabulated.

LOCKS

Electric Control. Electrical Operation of the World's Largest Lock on the Welland Canal, A. L. Mudge. Elec. News, vol. 39, no. 6, Mar. 15, 1930, pp. 45-49, 6 figs. Equipment for electric operation of lock no. 8; general plan of cable layout and specifications of power requirements; control of motors; remote control; indicating lights; water level indication.

LOCOMOTIVE REPAIR SHOPS

Point St. Charles, Que. Point St. Charles Shops of the Canadian National. Ry. Mech. Engr., vol. 104, no. 3, Mar. 1930, pp. 117-124 and 130, 9 figs. Modern locomotives repair shop placed in operation last July turns out average of 36 class repairs per month; three-page list of machine tools and shop equipment is given; natural and artificial lighting, electric welding circuits, overhead travelling cranes, piping, floors and machine foundations, heating system, and present production and forces, are discussed.

LOCOMOTIVE TERMINALS

Hamilton, Ont. New Locomotive Terminal, Toronto, Hamilton and Buffalo Railway. Can. Ry. and Mar. World, vol. 384, Feb. 1930, pp. 65 and 80-82, 2 figs. Illustrated description of proposed layout of modern locomotive terminal.

LOCOMOTIVES

Canadian Pacific. Powerful Canadian Pacific Locomotives. Ry. Jl., vol. 36, no. 3, Mar. 1930, pp. 16-17, 2 figs. Brief description of 2-10-4 type locomotives to be used for heavy grades and winter service in Canadian Rockies; cylinders 25½ by 32 in.; diam. of drivers 63 in.; boiler pressure 275 lbs. per sq. in.; tractive effort, with booster, 89,200 lbs.; weight of engine and tender, 752,500 lbs.; o.a. length 98 ft., 1¾ in.

Electric. A 7,200 Horse-Power Single-Phase Locomotive. Engineer (Lond.), vol. 149, no. 3872, Mar. 28, 1930, p. 359. 1 fig. For Swiss Federal Railways Oerlikon Company is building what is believed to be largest locomotive so far constructed in Europe; it is described as 1 Bo 1 plus 1 Bo 1 Bo 1 type of engine, symbol 1 meaning one carrying axle, and symbol Bo two driving axles with individual drive.

Electric Locomotive Built by Railroad, R. L. Kimball. Ry. Age, vol. 88, no. 16, Apr. 19, 1930, pp. 911-912, 3 figs. Piedmont and Northern completed and placed in service 100-ton, 1,500-volt, d.c. lcoomotive; equipment includes eight traction motors, Westinghouse type 562-D5; forced ventilation; battery control; electrically heated cab; K-14-D Westinghouse air brakes; 2 Westinghouse two-stage 75-C compressors; and pedestal mounted motorman's brake valves; inclined catenary type of construction used; total length over knuckles, 64 ft. 10 in.; total height 15 ft. 9½ in.; total wheelbase 54 ft. 6½ in.; continuous tractive force, 18,550 lbs.

Permissible Storage-Battery Locomotives and Power Trucks, L. C. Illsley, E. J. Gleim, and H. B. Brunot. U.S. Bur. of Mines—Bul. 313, 1929, 120 pp., 49 figs. Essential data in regard to construction of approved storage-battery locomotives and power trucks; where number of approvals have been granted to one manufacturer they have been grouped for clearness and brevity; paper has been prepared in three separate sections as follows: Jeffrey-type locomotives and power trucks; Mancha-type locomotives and power trucks; approved locomotives representing product of six manufacturers.

Low-Grade Fuel Used in. Screenings Successfully Burned in C. and E. I. Road Test. Ry. Mech. Engr., vol. 104, no. 3, Mar. 1930, pp. 131-135 and 144, 8 figs. Chicago and Eastern Illinois recently conducted some carefully supervised road tests of steam locomotives which demonstrated that with mechanical stoker equipment and Hulson tuyère-type grates, it is entirely feasible to burn 1¼-in. screenings at slightly reduced efficiency as compared with mine-run coal; graphs and tabular data are given.

LUBRICATING OIL

Germ Process. Outline Advantages of Germ Process, B. H. Lincoln. Oil and Gas Jl., vol. 28, no. 42, Mar. 6, 1930, pp. 62 and 236, 1 fig. Small percentages of fatty acid in mineral lubricating oils greatly reduce coefficient of friction; blending fatty acids with mineral oils was called germ process, by analogy, because when suitable acid is dissolved in mineral oils it gives latter life and activity as more perfect instrument of lubrication. Bibliography.

M

MACHINE TOOLS

Fabrication by Welding. Machine Tools Fabricated by Welding, T. H. Booth. Welding, vol. 1, no. 5, Mar. 1930, pp. 321-323, 9 figs. Use of arc-welding machine by Buffalo Forge Co.; brief account of economies effected.

MATERIALS HANDLING

Foundries. Compact Foundry Handling System, S. G. Koon. Iron Age, vol. 125, no. 15, Apr. 10, 1930, pp. 1069-1072, 6 figs. Combination of vertical hoop handling sand and horizontal loop handling moulds and castings in operation in iron foundry of General Electric Co., Pittsfield, Mass., for last year; it is said to have been productive of gratifying results in lowering cost of making castings and at same time improving their quality; approximately half of moulding and of service force, for given production of casting, was eliminated by this system.

Mechanical Handling Operations at Foundry of a Large Motor Works. G. F. Zimmer. Cassier's Mech. Handling (Lond.), vol. 17, nos. 1, and 2, Jan. 1930, pp. 3-4, and Feb., pp. 35-38, 6 figs. Jan.: Description of handling machinery employed at foundry of Morris Motors, Ltd., Conventry; system is most complete of its type in country, no operation being carried out by manual labour that can be performed by mechanical appliances. Feb.: Preparation of moulding sand; conveyor details; handling of cores; diagram of flight scraper conveyor negotiating horizontal and vertical paths.

Machine Shops. Handling Materials by Modern Methods. Machy. (.N.Y.), vol. 36, no. 7, Mar. 1930, pp. 540-544, 9 figs. Important developments in efficient handling and transporting of materials and work in progress in machine shops; cooperation between builders and users of material-handling equipment; types of foot-lift trucks; advantages of foot-lift trucks; Gantry crane for shop use; examples of efficient equipment; new materials-handling methods in forge shop; methods in large electrical manufacturing plant.

Railroad Repair Shops. Handling and Distributing Materials at Railroad Shops, F. A. Westbrook. Matls. Handling and Distribution, vol. 4, no. 1, Apr. 1930, pp. 26-30, 11 figs. Illustrated description of systems for handling and distributing materials in general repair shops and storehouse of New Haven at Readville, Mass.; issuance of supplies to shop; materials handling in locomotive shop.

METAL WORKING PLANTS

Canada. Machine and Erection Shops of Galt Firm are Interesting, J. Breakey. Can. Machy. (Toronto), vol. 41, nos. 5 and 6, Mar. 6, 1930, pp. 35-39, Mar. 20, pp. 39-42, 12 figs. Description of plant of Babcock-Wilcox and Goldie McCulloch, Ltd., Galt, Ont., for manufacture of boilers, pumps, steam engines, turbines, air compressors, condensers, etc.

METALS

Cold-Working. Textures of Cold-Worked Metals (Texturen kaltverformter Metalle), F. Wever and W. E. Schmid. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 4, Apr. 1930, pp. 133-140, 20 figs. X-ray analysis of aluminum and iron was carried out in order to clear up conflicting theories in earlier studies of texture of rolled material; analysis was made of a homogeneous flow phenomenon, the parallel-piped plane deformation, similar to rolling process; behaviour of crystallites in deformation process is discussed on basis of well-known law of slip and bending in single crystal.

Endurance Testing. Endurance Testing Machine for Alternating Torsional Load (Dauerpruefmaschine fuer Torsionswechselbelastung), W. Spaeth. Werkzeugmaschine (Berlin), vol. 34, no. 3, Feb. 15, 1930, pp. 45-49, 3 figs. Description of equipment of Losenhausenwerk Duesseldorf, employing, swinging motor for drive, which allows for quick and exact execution of various tests.

Wear Testing. Recent Research in Wear of Materials (Neue Ergebnisse auf dem Gebiet der Verschleissforschung), M. Fink. Organ fuer die Fortschritte des Eisenbahnwesens (Berlin), vol. 84, no. 20, Oct. 15, 1929, pp. 405-412, 11 figs. Report on recent cooperative abrasion tests of various steels and copper, with special reference to oxidation process accompanying rapid wear of materials; mechanism of corrugation formation on rails.

METALS CORROSION

Cyclic Stresses. Influence of Cyclic Stresses on Corrosion, D. J. McAdam, Jr. Am. Inst. of Min. and Met. Engrs.—Tech. Pub., no. 329, Feb. 1930, 42 pp., 17 figs. Paper discusses influence of cyclic stress on corrosion of carbon and ordinary alloy steels, corrosion-resisting steels, monel metal and aluminum alloys; damage due to corrosion is estimated by comparing fatigue limit of previously corroded specimen with endurance limit of metal; lowering of fatigue limit represents damage caused by corrosion, either with or without cyclic stress; results are expressed in diagrams. Bibliography.

MICA

Report on. Mica, H. S. Spence. Canada Dept. of Mines—Mines Branch (Ottawa), no. 701, 1929, 134 pp. and index, 10 figs., 21 plates, 2 maps and classification chart in pocket. Report embodying condensed data of importance, from earlier publications, review of present status of mica industry in Canada, and presentation of available information relating to mica and mica industry throughout world. Bibliography and patent data.

MICROSCOPES

Engineering Applications of. The Microscope as Applied to Engineering, J. S. G. Primrose. Manchester Assn. Engrs.—Trans. (Manchester), 1928-1929, pp. 13-20 and (discussion) 20-34, 3 figs. Development in design of microscopes and their application in engineering workshops for purposes of making fine measurements and in metallurgical research for determining microstructure of steel.

MINE HOISTS, ELECTRIC

Forced Ventilation. Forced Ventilation Raises Safe Rating of Mine Hoists, C. Lee. Coal Age, vol. 35, no. 3, Mar. 1930, pp. 149-150, 2 figs. Description of duplicate electric shaft hoists at Kincaid mines of Peabody Coal Co., Tovey, Ill.; Ilgner Ward-Leonard type, rated 675 hp., 550 volts, 65 r.p.m., and flywheel set 550 kw., 695 r.p.m.; rating of hoist was based on rise of 49 deg. Cent. above room temperature of 25 deg. Cent.; in original installation, natural circulation was depended upon for cooling equipment; increase in capacity of plant made it necessary to increase cooling facilities by installation of blower supplying 7,000 cu. ft. of air per minute.

Automatic Control. Miami's Automatic Hoist, F. R. Grant. Eng. and Min. Jl., vol. 129, no. 7, Apr. 7, 1930, pp. 347-348, 4 figs. Brief description of equipment and control, put in operation July 1929; hoist is started by skp tender at loading station, who controls mechanism for loading skip; switch then causes one of reversing contactors for pilot motor to close, after which acceleration of hoist is entirely automatic; it is then automatically retarded and finally brought to rest at correct dumping position; speed characteristic of hoist during retardation period can be varied by changing shape of cam.

MINERAL INDUSTRY

Canada. 12.6 Percent Gain in Production of Structural Materials. Contract Rec. (Toronto), vol. 44, no. 15, Apr. 9, 1930, pp. 416-420, Statistical data on Canada's mineral development, with special reference to coal, copper, nickel, cement, asbestos, clay products, stone, sand and gravel, lime, gypsum, bituminous sands and sand-lime brick.

MINERAL INDUSTRY

Saskatchewan. Saskatchewan's Minerals. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 12, Mar. 21, 1930, pp. 273-274. Abstract of annual report of Department of Railways, Labour and Industries shows increased output in 12 months ending April 30, 1929; most striking increase is in value of sodium sulphate produced; notes on clay, sand and gravel, and volcanic ash; briquetting of lignite.

MINES AND MINING

Aerial Transportation. Aircraft's Importance to Mining Industry, R. Joyce. Min. Rev., vol. 32, no. 7, Apr. 15, 1930, p. 9. Brief article, dealing largely with activities in Western Canada and elsewhere, featuring use of Boeing airplanes with 425-hp. Wasp engines. capable of speed of 133 mi. per hr. and rate of climb of 1,000 ft. per min.

DEEP, VENTILATION. Temperature and Ventilation Deep-Level Mines, E. C. Ranson. Eng. and Min. Jl., vol. 129. no. 8, Apr. 24, 1930, pp. 390-391. At greatest depths reached in mines of Witwatersrand, in South Africa, rise in rock temperature is about one degree fahr. per 219 split at temperature much less than 10 deg. below virgin rock temperature at that point; principal cooling influences are enumerated as evaporation of moisture, air movement, and practical mining methods. Brief abstract of paper read before Empire Min. and Met. Congress, in Africa.

NOVA SCOTIA. Mining Operations in Nova Scotia During 1929, S. C. Mifflen. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 5, Jan. 31, 1930, pp. 108-109, 2 figs. Brief general review; coal production largest since World War; electrification of coal mines; increased iron and steel production; Stirling copper-lead-zinc mine in Richmond County; tin prospecting; other copper prospects; slight development of gold mines; 1,000,000 tons gypsum produced; Malagash salt mine; diatomaceous earth; oil-shale distillation.

PUMPING. High Lift Pumping, W. G. C. Nixon. Eng. and Min. Jl., vol. 129, no. 8, Apr. 24, 1930. p. 392. Brief note on pumping costs at Randfontein Estates, lifting 4,000,000 gals. per 24 hrs. from 19th level, 2,600 ft. to surface with centrifugal pumps Abstract from paper read before Empire Min. and Met. Congress, in Africa.

QUEBEC. Preliminary Statement on the Mineral Production in Province of Quebec During the Year 1929. Quebec Bur. of Mines—Dept. of Highways and Mines, 1930 (Quebec), 10 pp. Production of mines and quarries of Province of Quebec during 1929 valued at $44,814,921; tabulation of substances, 1929 quantities and values produced, and 1928 values; metallic ores; non-metallic minerals; building materials.

YUKON TERRITORY. The Mining Industry in Yukon 1929, W. E. Cockfield. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 7, Feb. 14, 1930, pp. 150-152, 2 figs. Brief general review, indicating satisfactory progress; Klondike output slightly reduced; lode gold mining; Mayo district; new ore-bodies found; southern Yukon; transportation much improved.

MINING EXPLORATION

BRITISH COLUMBIA. Prospecting in Northwestern British Columbia, F. A. Kerr. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 15, Apr. 11, 1930, pp. 336-340, 5 figs. Practical instructions for outfitting, travelling and camping in new mining area.

River Navigation and the Prospector, F. A. Kerr. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 6, Feb. 7, 1930, pp. 128-132, 6 figs. General notes on some essentials of transportation in northern British Columbia; comment on wrecks on river during 1928; flat-bottom boats are best; advantages of motor appliances; types of motor required; fuel supply; notes on other necessary equipment.

The Significance of Recent Discoveries in Northwestern B.C., F. A. Kerr. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 10, Mar. 7, 1930, pp. 222-227, 6 figs. Mineral areas well defined; abundance of mineralized outcrops; characteristics of mineralized zones; significance of rusty outcrops; structural trends; conditions favourable to mineral deposition; sources of placer gold.

CANADA. Help the Prospector—and Help Canada, R. C. Rowe. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 15, Apr. 11, 1930, pp. 341-342. Analysis of some factors underlying economic structure of Canada; development of mineral resources depends entirely upon prospector; and prospector, to carry on his work, must have public support.

MINING INDUSTRY

CANADA. Ontario's Mining and Canada's Business, C. McCrea. Can. Min. Jl., (Quebec), vol. 51, no. 17, Apr. 25, 1930, pp. 391-392. Broad review of interrelation of mining and other industries; Sudbury camp is cited as leading example with output of $414,000,000, of which $120,000.000 paid out as dividends; gold mines as colonizers; lignite; chromite. Abstract of address before Canadian Inst. of Min. and Met.

MOULDS, FOUNDRY

ASBESTOS. Production of Asbestos Permanent Moulds (Die Herstellung von Asbestdauerformen), G. Wolf. Giesserei Zeitung (Berlin), vol. 7, no. 6, Mar. 15, 1930, p. 154. Requirements of non-metallic moulds are briefly set forth; best moulding materials is claimed to be asbestos powder alone or mixed with other materials.

MOLYBDENUM MINES AND MINING

QUEBEC. A Northern Quebec Molybdenite Mine. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 11. Mar. 14, 1930, pp. 246-247. Brief article giving details of operations of Molybdenite Reduction Company; property is situated in southwest corner of township of La Corne, about 25 miles south of Amos, Que. and was known some ten years ago as Eureka mine.

MUNICIPAL ENGINEERING

ONTARIO. Water and Sewerage Systems in Ontario, A. E. Berry. Canadian Engr. (Toronto), vol. 58. no. 15, Apr. 15, 1930, pp. 494-496. Review covering activities in field of water purification and sewage disposal in province of Ontario during 1929; newly constructed and proposed water works, sewage disposal plants and sewerage systems.

N

NATURAL GAS

ALBERTA. Waste Gas in Turner Valley, A. W. G. Wilson. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 12, Mar. 21, 1930. pp. 276-278. Report of committee appointed by Provincial Government; wastage takes place through operations, under license, of about 40 producing companies; obvious solution is either to reduce production to point where all products can be utilized, or to curtail production by introduction of conservation methods designed to protect rights of individual operators, to increase recovery of valuable constituents and to reduce present waste as far as possible.

NOISE MEASUREMENT

INSTRUMENT FOR. Noise Recorder (Thorybometer) [Ein Laermzaehler (Thorybometer)], H. Dold and H. Thiele. Gesundheits-Ingenieur (Munich), vol. 53, no. 1, Jan. 4, 1930, pp. 13-14, 2 figs. Noise number is suggested as unit for noise measurements; noise recorder or thorybometer is equipment by which noise is measured by quantity of oxy-hydrogen gas electrically developed in accordance with noise produced.

O

OIL FIELDS

ALBERTA. The Oil Fields of Alberta, E. H. C. Craig. Petroleum Times (Lond.), vol. 23, nos. 579 and 580, Feb. 15, 1930, pp. 277-278, and Feb. 22, pp. 322 and 324, 2 figs. Article previously indexed from Oil Weekly, Feb. 28, 1930.

ORE CRUSHING AND GRINDING

CLOSED-CIRCUIT. Grinding and Classification—Batch Closed-circuit Grinding, A. W. Fahrenwald. U.S. Bur. of Mines—Report of Investigations, no. 2990, Feb. 1930, 11 pp., 5 figs. on supp. plates. Description of laboratory closed-circuit grind technic designed to simulate plant closed-circuit grinding practice; experimental data are given.

ORE CRUSHING MACHINERY

FOUNDATIONS. Novel Crusher Foundation Proves Economical and Efficient. Eng. and Min. Jl., vol. 129, no. 8, Apr. 1930, p. 406, 3 figs. Brief note on installation of 37,000-lb. crushing unit directly above steel ore bin at Santiago mine in State of Morelos, Mexico; set of Traylor rolls is supported on two concrete columns, 38 ft. high and 15 in. thick, to keep weight of unit off ore bin.

ORE SAMPLING

METAL CONTENT. Sampling for Determination of Average Metal Content of Crude Ores and Success of Treatment (Ueber Probenahme zur Ermittlung des Durchschnittsmetallgehaltes von Roherzen und des Aufbereitungserfolges), E. Barnitzke. Metall und Erz (Halle), vol. 27, nos. 3 and 7, 1st Feb. no., pp. 53-56, and 1st Apr. no., pp. 179-187, 7 figs. Suggestions for taking samples; theory of sampling of well-mixed and of unmixed material; comparison of usual sampling methods; factors influencing reliability of sample; practical conclusions.

ORE TREATMENT

FLOTATION. Flotation Research, G. L. Landolt, E. G. Hill and A. Lowy. Eng. and Min. Jl., vol. 129, no. 7, Apr. 7, 1930, pp. 351-352, 2 figs. Notes on investigation to find which of various constituents of commercial cresylic acid were responsible for its flotative properties, and to ascertain relative flotabilities of those components that were affected; value of crude cresylic acid as frothing and collecting agent for galena or sphlerite depends apparently to large extent upon proportion of meta-cresol which it contains, and therefore upon its source.

Possibilities of Ammonia in Complex-Ore Flotation, F. G. Bacon. Eng. and Min. Jl., vol. 129, no. 8, Apr. 24, 1930, p. 404. Brief article, noting similarity between action of cyanide and of ammonia as flotation reagent; present cheapness of ammonia in tank car lots should permit saving of reagent expense; examples of behaviour of ammonia, with different ores, are given.

THICKENING. Thickening of Flotation Pulps (Concentracion de pulpas de flotacion), E. G. Howe. Ingenieria Internacional (New York), vol. 18, no. 2, Feb. 1930, pp. 92-94, 4 figs. Recent installations of equipment show trend to greater tonnage at lower costs; examples of pulp thickeners are given; discussion of types and their advantages; opinion is expressed favouring adaptability of baffled spitzkasten of large area to thickening of flotation pulps. Spanish translation of article indexed in Engineering Index 1929, p. 1341, from Eng. and Min. Jl. Jan. 26, 1930.

P

PAVEMENTS

CONCRETE. Special Characteristics of Concrete for Pavements, F. H. Jackson. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 768-775, and (discussion) 776-777. Discussion of forces which operate to destroy concrete pavements; author considers kind of structure; destructive agencies; weathering; scaling; traffic loads; surface wear; quality of pavement concrete as affected by construction methods. Part of symposium on Standards of Performance of Concrete for Various Uses.

PETROLEUM GEOLOGY

CANADA. Oil in Ontario and Quebec, C. Spearman. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 9, Feb. 28, 1930, pp. 205-207, 1 fig. Notes on possibilities of discovering commercial accumulations of oil and gas in certain paleozoic areas.

PHOSPHOR BRONZE

See Bearing Metals.

PHOTO-ELECTRIC CELLS

CHARACTERISTICS. The Photo-Electric Cell, C. G. Lemon. Television (Lond.), vol. 3, no. 25, Mar. 1930, pp. 23-25, 7 figs. Operating characteristics and general principles; characteristic curves, hook-ups, notes on conductance per lumen and on application are given.

PILE DRIVING

METHODS. Rapid Driving of 2,600 Wood Piles on a Chicago Building, J. D. Levin. Eng. News-Rec., vol. 104, no. 16, Apr. 17, 1930, p. 657, 1 fig. Report on methods of driving piles, during winter, on site of new building of Montgomery Ward and Co.; description of welded pile-driving rigs.

PILES

DESIGN. The Design of Piles, G. B. R. Pimm. Instn. of Civil Engrs.—Selected Eng. Papers (Lond.), no. 78, 1929, pp. 3-16, 4 figs. Relationship between impact and static loading; momentary loading and continuous loading; effect of form and materials of pile on its supporting power; justification for design of piles of specific form; stability of piles, alone among engineering structures, is determined by testing perilously near to destruction, and there is no reason why this should be done when means are available for calculating dimensions upon same principles as are employed in other structures.

PIPE, CONCRETE

CENTRIFUGAL CASTING. Centrifugally Spun Reinforced Concrete Pipe at Tacoma, Washington, W. A. Kunigk. Am. Water Works Assn.—Jl., vol. 22, no. 4, Apr. 1930, pp. 453-461. Report on manufacture of 7,542 lin. ft. of 63 in. and 7,010 lin. ft. of 51 in. diam. centrifugally spun, reinforced-concrete pipe; specifications; laying of pipe.

PIPE, WOOD STAVE

PATCHING. Patching Wood Stave Pipe, B. G. Davis. West. City, vol. 6, no. 4, Apr. 1930, pp. 25-26, 4 figs. Résumé of six years' experience with great variety of leaks.

PLATES

STRESSES IN. Web Stresses in Smooth Plates Subjected to Shearing Load (Ausbeulerscheinungen an ebenen auf Schub beanspruchten Platten), F. Bollenrath. Luftfahrtforschung (Munich), vol. 6, no. 1, Dec. 12, 1929, pp. 1-17, 37 figs. Results of tests on thin, plane, elastic plates fixed in two edges parallel to one another and subjected to load sheared in opposite direction but of equal forces, distributed equally over both edges. Bibliography.

PRESSURE VESSELS

ELECTRIC WELDING OF. Arc Welding at a Large Boiler Works. Engineer (Lond.), vol. 149, no. 3872, Mar. 28, 1930, pp. 344-345, 6 figs. Particulars of English electric welding installation in Thompson Bros. tank shops at Bilston; examples are given of welding chemical vessel tested to pressure of 1,500 lbs. per sq. in.; and welded rotary drier; installation is composed of 12 welding sets, each consisting of 10-hp. squirrel-cage induction motor coupled to steel-frame welding generator capable of giving from 250 to 300 amperes at 30 volts.

PULVERIZED COAL

FIRING WITH. Pulverized Fuel Firing, A. H. Hayes. World Power (Lond.), vol. 13, no. 76, Apr. 1930, pp. 382 and 385. Direct firing versus storage system; rise to prominence of pulverized-fuel firing for boilers has been accompanied by more or less constant controversy as to respective methods of dealing with fuel after grinding; survey of direct system and of storage system is made with view to ascertaining their relative methods for any given set of conditions.

PUMPING STATIONS, ELECTRIC

AUTOMATIC. Automatic Pumping Stations, K. Thuerlemann. Brown Boveri Rev. (Baden), vol. 17, no. 2, Feb. 1930, pp. 67-78, 28 figs. Chief designs of plants installed by Brown Boveri and Co.; most important diagrams of connections for various kinds of current and for different control; description of equipment and photographs of some complete pumping stations.

PUMPING STATIONS, DIESEL

TEXAS. Oil Power for Irrigation Along the Rio Grande, O. Adams. Power, vol. 71, no. 14, Apr. 8, 1930, pp. 556-557, 4 figs. Discussion of economical plant operation of Hidalgo Water Improvement District no. 4, Edinburg, Texas; plant contains 360-hp. Fairbanks-Morse Diesel engines, each equipped with slow-down devices; engines direct connected to 30-in. centrifugal pumps which handles water at rate of 23,300 gals. per minute against total maximum head of 40 ft., with pump efficiency of 84½ per cent; table of plant operation.

PUMPS

AIR-LIFT. Conveying Materials by Means of Air-Lift Pumps, F. Schildberger. Eng. Progress (Berlin), vol. 11, no. 4, Apr. 1930, pp. 100-103, 7 figs. Air-lift pumps operate in manner similar to that of pneumatic conveyors for grain, coal, sawdust, and similar goods, though with difference that air used is under compression instead of under vacuum; although mechanical efficiency of air-lift pumps is low, their absolute operating dependability and all-round freedom from trouble have made them indispensabie, particularly where rough operating conditions prevail; examples of practical application.

WATER HAMMER IN DISCHARGE PIPES. Water Hammer in Discharge Mains of Pumps (Druckstoesse in Pumpensteigleitungen), O. Schnyder. Schweizerische Bauzeitung (Zurich), vol. 94, nos. 22 and 23, Nov. 30, 1929, pp. 271-273, Dec. 7, 1929, pp. 283-286, 20 figs. Mathematical theory of water hammer in discharge pipes of pumps; charts for determination of pressure variations caused by sudden closure; features of special conical valves and other devices for minimizing water hammer, developed and manufactured by L. von Roll Eisenwerke Clus.

PUMPS, AIR LIFT

WATER. Pumping Water With Air Lifts. Power Plant Eng., vol. 34, no. 9, May 1930, pp. 511-512, 5 figs. General principles, calculating of air required and general discussion of type used; curves for simplifying air lift calculations; air lifts in sandy soil.

PUMPS, CENTRIFUGAL

DREDGING. Dredging with Centrifugal Pump, W. A. T. Gilmour. Can. Eng. (Toronto), vol. 58, no. 12, Mar. 25, 1930, p. 439, 2 figs. Wood trash pump attached to automobile chassis employed for dredging creek at Stouffville, Ont.

R

RAIL MOTOR CARS

STEAM. New Articulated Steam Rail Cars for Egyptian State Railways. Ry. Gaz. (Lond.), vol. 52, no. 13, Mar. 28, 1930, pp. 475-478 and 480, 11 figs. Cars built by Birmingham Railway Carriage and Wagon Co.; engine is Yorkshire type; it is of three-cylinder vertical double-acting balances type; cylinders are 5 ft. diam. by 8 in. stroke; steam distribution effected by Joy valve gear operating piston valves; engine develops 150 B.hp. on jack shaft at 308 m.h.p ; principal dimensions are length over cowcatchers 101 ft. 7 in.; engine truck wheelbase 7 ft.; weight on rail at engine truck 30 tons.

RAILROAD CONSTRUCTION

KANSAS CITY SOUTHERN. New K.C.S. Line Completes Ownership to Gulf Ports. Ry. Age, vol. 88, no. 16, Apr. 19, 1930, pp. 907-910, 6 figs. Kansas City Southern opened new line 13.27 mi. long between Grandview, Mo., and Leeds, near Kansas City; shortest rail route from Kansas City to Gulf of Mexico at Port Arthur, Tex., and to Beaumont, and Orange, and Lake Charles, La.; three principal structures on line are reinforced-concrete viaducts over United States Highway No. 50 and Flying Field road, and steel viaduct on Mile 14; old and new alignments and profiles, showing improvement in grade over old line are given.

RAILROAD SIGNALS AND SIGNALING

CENTRAL CONTROL. D. & R. G. W Installs Centralized Traffic Control on 32 Miles od Single Track Line, B. W. Molis. Ry. Signaling, vol. 23, no. 2, Feb. 1930, pp. 48-50, 4 figs. Denver and Rio Grande Western installed centralized control signal system between Provo, Utah, and Midvale as parts of 1929 improvement programme; running time of freight trains reduced over one minute per mile of road; traffic and character of line; general Railway Signal Company's unit-wire type of centralized-control system is used to control power operated switches and signals which direct train movements.

COLOUR-LIGHT. Colour-Light Automatic Block Signals and Automatic Interlocking Installed on Janesville Line of the Milwaukee, L. B. Porter. Ry. Signaling, vol. 23, no. 4, Apr. 1930, pp. 141-144, 8 figs. Recent 18-mile installation includes trial sections of different methods of power supply for signals and track circuits; description of equipment and control scheme; lighting system and power supply.

INTERLOCKING. D. & H. Installs Unique Interlocking Arrangement for Switching Layout, A. H. Rice. Ry. Signaling, vol. 23, no. 3, Mar. 1930, pp. 95-97, 2 figs. Delaware and Hudson has recently completed interesting application of four-power switch machines and signals in main line approaching passenger station layout at Albany, N.Y.; complete installation cost $8,242 and permits savings in wages and operating expenses of $5,550 annually; installation pays for itself in 18 months; layout of switches and location of power machines.

Unique Interlocker, L. Wyant. Ry. Signaling, vol. 23, no. 2, Feb. 1930, pp. 61-64, 6 figs. Description of 42-lever electric interlocking plant including new and novel type of control machine, recently placed in service by Chicago, Rock Island & Pacific at Blue Island, Ill , near Chicago; track layout and traffic; features of new interlocking machine; basis for eliminating mechanical locking; storage-battery power supply.

TRACK CIRCUITS. Alternating Current Track Circuits. Am. Ry. Assn.—Signal Sec., Am. Ry. Signaling Principles and Practice, 1930, 64 pp., 38 figs. Alternating current track circuits on steam roads; bonding of track circuits; insulated rail joints; d.c. and a c. track circuits on electric roads using d.c. propulsion; a.c. track circuits on electric roads using a.c. propulsion; track-circuit formulae and their derivation; instructions for adjustment, maintenance, and operation of a.c. track circuits.

RAILROAD STATIONS

TORONTO. Trainshed, Toronto Union Station. Can. Ry. and Mar. World, no. 386, Apr. 1930, pp. 197-198, 2 figs. Brief discussion of construction features of trainshed which is 1,200 ft. long by 145 ft. wide and approximately 21 ft. 4 in. high; outstanding feature of trainshed is lighting scheme.

RAILROAD TERMINALS

WAREHOUSES. D. L. and W. Builds Large Terminal Warehouse. Ry. Age, vol. 88, no. 14, Apr. 5, 1930, pp. 816-820, 7 figs. Illustrated description of one of largest and most up-to-date railway terminal warehouses in country which is located in Jersey City, and which provides 1,240,000 sq. ft. of floor space for general storage, light manufacturing and l.c.l. freight handling; building is of reinforced concrete; floors are designed for heavy service; typical section through warehouse and viaducts showing details of construction; track viaducts; sawtooth platforms on first floor; upper floors are largely for storage; method of construction; facilities offer advantages to shippers.

Design of Lackawanna's Reinforced-Concrete Freight Terminal Warehouse at Jersey City, M. Hirschthal. Eng. News Rec., vol. 104, no. 13, Mar. 27, 1930, pp. 519-524, 7 figs. Design and construction of eight-storey structure, 848 x 162 ft., flanked by flat-slab viaducts carrying tracks and trackways forming part of extensive terminal development; concrete crib retaining wall used to hold fills.

RAILROADS

SNOW REMOVAL. B. T. U's. vs. Blizzard, S. C. Parker. Am. Gas. Jl., vol. 132, no. 2, Feb. 1930, pp. 46-47, 3 figs. Description of gas burners developed for purpose of keeping railroad switchpoints cleared during severe winter snows; notes on application of system in use of 376 burners in Chicago railroad yards.

REFUSE DISPOSAL

COLOGNE, GERMANY. Scientific and Constant Attention to Details in Refuse Collection and Disposal at Cologne, Germany, G. A. Soper. Am. City, vol. 42, no. 4, Apr. 1930, pp. 93-96, 8 figs. General description of municipal refuse disposal system; location of cans; regulation of contents of cans; dumping facilities for trailers; separation of refuse; incinerator units; by-products; disposal of fine screenings; cost data.

SWITZERLAND. The Disposal of Domestic Refuse by Incineration, A. Weigel. Eng. Progress, vol. 11, no. 4, Apr. 1930, pp. 104-109, 8 figs. Description of new refuse-disposal plant of city of Zurich erected by Bamag-Meguin A.-G. in accordance with system developed by Heenan and Froude of Worcester; refuse pretreatment; furnace plant; utilization of heat.

REFUSE INCINERATORS

ELMIRA, N.Y. Modern Incineration Solves Another Garbage Problem, M. W. Wipfler. Am. City, vol. 42, no. 5, May 1930, pp. 101-105, 4 figs. Problem of garbage committee in selecting site; layout of plant 60 ft. sq. and 60 ft. high costing $7,900; method of operation of plant and collection of garbage.

SARNIA, ONT. Construction of Incinerator at Sarnia, Ont., W. B. Batty. Can. Engr. (Toronto), vol. 58, no. 14, Apr. 8, 1930, pp. 473-474, 1 fig. Description of two-cell Hankin high-temperature type incinerator having guaranteed capacity of 25 tons of garbage in 10 hours; plant equipped with forced draft at 300 deg. fahr.; temperature of 1,900 deg. fahr. in combustion chamber.

STEAM GENERATION. Utilization of City Refuse for Heat Production (Die waermetechnische Ausnuetzung des staedtischen Muells), H. Koschmieder. Gesundheits-Ingenieur (Munich), vol. 53, no. 3, Jan. 11, 1930, pp. 17-21, 3 figs. Data of calorific value of city refuse; features of several systems of refuse utilization, including those of Doerr, Herbertz, and Humboldt methods of preparation for increasing calorific value.

RESERVOIRS

SILT REMOVAL. Silting and Life of Southwestern Reservoirs, R. G. Hemphill. Am. Soc. Civil Engrs.—Proc., vol. 56, no. 5, May 1930, pp. 967-979. Paper cites records of silt load of several of principal streams of Southwest to indicate importance of silt problem and necessity for comprehensive study of it; descriptions of methods used, records obtained, and some tentative conclusions drawn from investigation of silt in Texas streams, which is now entering its sixth year; removing silt from reservoirs; prevention of silting; estimating effective life of reservoirs.

ROAD MACHINERY

DESIGN. Design Developments in Road Machinery, G. S. Brady. Product Eng., vol. 1, no. 2, Feb. 1930, pp. 58-59, 6 figs. Four years have made remarkable changes in design of road-building and allied machinery, of which more than $10,000,000 worth are sold annually in United States and large quantities exported; brief discussion of recent developments and description of specific machines.

ROAD MATERIALS

COLD EMULSIONS. Asphalt Emulsions for Low-Cost Roads, H. L. Bowlby. Contract Rec. (Toronto), vol. 44, no. 13, Mar. 26, 1930, pp. 371-373, 4 figs. British practice indicates that cold application of emulsified asphalts is meeting with complete success; methods employed; use of emulsions with gravels.

ROADS

SNOW REMOVAL. Keeping Ontario Highways Open for Winter Motor Vehicle Traffic. Can. Ry. and Mar. World, no. 384, Feb. 1930, pp. 106-107, 5 figs. Description of equipment and methods employed for snow removal of Ontario highways.

ROADS, ASPHALT

DESIGN. Rational Design of Asphaltic-Oil Roads, H. G. Nevitt. Eng. News Rec., vol. 104, no. 17, Apr. 24, 1930, pp. 686-689, 2 figs. Review and appraisal of previous formulae and statement of improved formula for determining oil content for various materials in surface-mixed asphaltic-oil roads, with tables and charts of values of factors in formula.

ROADS, CONCRETE

RESURFACING. Bituminous Surface for Concrete Roads, W. H. Sharp. Can. Engr. (Toronto), vol. 58, no. 12, Mar. 25, 1930, pp. 437-438. Resurfacing concrete roads with bituminous wearing surfaces, in Connecticut; with various types of premixed bituminous pavements; causes of failure; experiments with Colprovia; semi-rigid type pavements. Paper presented before Asphalt Paving Conference.

RUBBER

STRENGTH. The Tensile Strength of Java Plantation Rubber, O. de Vries and R. Riebl. India-Rubber Jl. (Lond.), vol. 79, no. 12, Mar. 22, 1930, pp. 419-420. Tables are given supplementing statistics published in same magazine in 1927-1928 investigating supposed deterioration in tensile strength of plantation rubber; both sets of figures show steady increase in tensile strength and no deterioration.

S

SCREW THREADS

GAUGES. Improved Screw-Thread Measuring Equipment (Verbessertes Gewindemessgeraet), F. Goepel. Zeit. fuer Instrumentenkunde (Berlin), vol. 50, no. 1, Jan. 1930, pp. 33-42, 10 figs. partly on supp. plate. Measuring equipment described in Zeitschrift fuer Feinmechanik und Praezision, 1924, has been improved; improved equipment and its applications are described.

SEWAGE DISPOSAL

REVIEW. Engineering Applications of Trade Waste Treatment Processes, H. N. Jenks. Surveyor (Lond.), vol. 77, no. 1990, Mar. 14, 1930, pp. 351-353, 3 figs. Review of engineering practice in separation of solids from liquid, disposal of solids, and stabilization of liquid residue; effectiveness of mechanical aeration; value of stage treatment; diagram showing use of typical time-oxygen demand curve for computing probable oxygen requirements throughout stream-flow sewage treatment plant; probable pumping requirements for mechanical aeration of domestic sewage containing trade waste; stream-flow aeration tanks; declogable biologic filters.

SLUDGE DIGESTION. The Progress of Separate Sludge Digestion, C. A. Smith. Mun. Sanitation, vol. 1, no. 2, Feb. 1930, pp. 70-73, 3 figs. Definitions of terms; history of sludge digestion; structural design progress; mechanical transfer of sludge preferred; research developments; opposite reactions; advantages.

STREAM FLOW AERATION. Sewage Treatment by Stream-Flow Aeration, H. N. Jenks, and M. Levine. Engineering (Lond.), vol. 129, no. 3353, Apr. 18, 1930, p. 504. Improvement in activated-sludge method based on application of stream-flow principle; effect of recirculation on retention period; efficiency effect of biologic staging; cost of construction. Abstract of report no. 1248 of U.S. Pub. Health Reports, indexed in Engineering Index 1929, p. 1656, from Water Works and Sewerage, Sept. 1929.

SEWAGE DISPOSAL PLANTS

BLACKSBURG, VA. Initial Operation of Imhoff Tank and Contact Beds at Blacksburg, Va., F. H. Fish. Indus. and Eng. Chem., vol. 22, no. 5, May 1930, pp. 511-513, 3 figs. Description and operation of plant equipped with rectangular Imhoff tank 31 x 41 ft. and 27 ft. depth inside; character and amount of sewage; analyses of effluent and water supply.

COLUMBUS, OHIO. Activated Sludge Process for Columbus, Ohio Water Works and Sewerage, vol. 77, no. 3, Mar. 1930, p. 78. Engineering features and costs of two plans submitted for preventing pollution of Scioto River.

PRIVATE, GERMANY. Instructions for Examination and Licensing of Private Sewerage Installation (Richtlinien fuer die Beurteilung und Zulassung von Hausklaergruben und Grundstueckskläeranlagen). Gesundheits-Ingenieur (Munich), vol. 53, no. 7, Feb. 15, 1930, pp. 105-110, 7 figs. Rules on treatment and disposal of sewage and wastes from small private plants, as formulated by Landesanstalt fuer Wasser, Boden und Lufthygiene in Berlin-Dahlem.

SEWER SIPHONS

DOUBLE. Construction of a Double Sewer Siphon Under the Rhine near Cologne (Der Bau eines Schutzwasser-Doppelduekers under dem Rhein bei Koeln), O. Werken. Bautechnik (Berlin), vol. 8, no. 10, Mar. 7, 1930, pp. 137-139, 3 figs. General discussion of conditions which led to adoption of project involving construction of twin sewer siphon, 1.85 m. interior diam., to be laid at depth of 17 m. under water. (To be continued.)

SHAPERS

HYDRAULICALLY-DRIVEN. Hydraulically-Driven Shaping Machine. Engineer (Lond.), vol. 149, no. 3872, Mar. 28, 1930, p. 360, 2 figs. Details of new shaper by Lange and Greilen, of Halle, Germany; reciprocating head of machine is actuated directly by oil pressure, and oil pressure is also used for traverse of table, and serves as means of speed regulation; machine is driven primarily by flanged electric motor.

SHEARS

CANADA. Build Huge Shear in Canada. Can. Foundryman (Toronto), vol. 21, no. 2, Feb. 1930, p. 2, 1 fig. John Bertram & Sons Co. have completed shearing machine which is largest machine of its type ever made in Canada; it will shear through bar of mild steel 22 in. wide, ¾ in. thick; extra rigidity had to be embodied in design, and, for this purpose, cover plate is tied into frame and is provided with tie bars having double nuts on each end.

SHEET METAL WORKING

STAMPING. Flow Phenomena in Deep Drawing of Sheet Metal and Cause of Crack Formation in Stampings (Fliesserscheinungen bei Tiefstanzblechen, etc.), I. Fetschenko-Tschopiwski and M. Opalko. Zeit des Oberschlesichen Berg. u. Huettenmaennischen Vereins Zu Katowice (Katowice), vol. 69, no. 4, Apr. 1930, pp. 182-184, 16 figs. on supp. plates. Flow lines appear on surface of sheet metal as result of process and these have influence on punching quality and crack formation by Erichsen tests; this test is not always dependable; supplementary test for determining stamping quality of materials is described.

SHEET PILING

DESIGN. Design of Anchored Sheet Piling Walls (Die Berechnung verankerter Bohlwerke), Lohmeyer. Bautechnik (Berlin), vol. 7, no. 5, Jan. 31, 1930, pp. 60-65, 10 figs. Theoretical mathematical analysis of stresses in sheet piling walls, lower portion of which is embedded in ground and top of which is braced and anchored; problem is varied by assuming or not assuming fixedness at lower end of wall.

SIPHON SPILLWAYS

SMALL. Small Siphon Spillway Serves City Distribution Reservoir, J. R. Grant. Eng. News-Rec., vol. 104, no. 18, p. 726, 2 figs. Description of siphon spillway of compact design recently built to discharge 100 sec.-ft. overflow from Vancouver Heights distributing reservoir at Vancouver, B.C.; design check secured by means of quarter size test model.

SILVER MINES AND MINING

BRITISH COLUMBIA. Silver Producing Mines of British Columbia, V. L. Eardley-Wilmot. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 6, Feb. 7, 1930, pp. 134-135. Largest silver producers in British Columbia are mines in which silver content is low and metal is of only secondary importance; Sullivan mine is largest individual producer of silver in British Empire; Slocan and Boundary silver-lead mines; notes on coast and northern silver producers.

STEAM ACCUMULATORS

PEAK LOAD USES OF. Steam Storage in Its Relation to the Peak Load Problem in Industrial Steam Plant, E. G. Ritchie. S. Wales Inst. of Engrs.—Proc., vol. 46, no. 2, Mar. 13, 1930, pp. 69-89, 9 figs. Discussion of "bottle-neck" effect in industry; limitations of boiler equipment; effect of steam-pressure variations; thermal flywheel; Ruths steam-storage system; steam storage and industrial peak load; other systems of thermal storage; steam storage in steel works, and at coal mines; steam storage in relation to efficient operation of waste-heat boilers.

STEAM CONDENSERS

CORROSION. The Prevention of Trouble due to Aquatic Growths in Condenser Systems. D. V. Onslow. World Power (Lond.), vol. 13, no. 76, Apr. 1930, pp. 379-381. Article is based on replies received by British Electrical and Allied Industries Research Association to their questionnaire sent to manufacturers of condensers and to large users of condensing plant with regard to troubles caused by accumulation of mussels and other aquatic growths in condenser tubes.

STEAM-ELECTRIC POWER PLANTS

GREAT BRITAIN. The Extension Plant at Leicester. Elec. Times (Lond.), vol. 77, no. 2000, Feb. 20, 1930, pp. 373-377, 11 figs. New section will contain four water-tube boilers, two 25,000-kw. generating sets, two house service turbo-generator sets of 1,500 kw. each; steam pressure is 350 lbs. per sq. in. and there is no re-superheating; large boilers of 180,000 lbs. per hour for two hours on overload are used together with steel tube economizers, Murray water-tubewalls and ashpit water screen; coal storage and reclaiming plant, new 25,000-kw. English Electric turbo set and exciter, switchgear etc., are illustrated.

Reconstruction of Lots Road Power Station. Engineering (Lond.), vol. 129, no. 3351, Apr. 4, 1930, pp. 443-444, 2 figs. Account of reconstruction of station in Chelsea from which most of electric energy required for London underground railways is derived; four cross-drum marine-type boilers, with output of 50,000 lbs. of steam each, and operating at 200 lbs. and 700 deg. fahr., were erected; three of 6,000-kw. sets have been removed, their place being taken by equal number of 15,000-kw. machines; further 15,000-kw. unit is in course of erection; as result of this reconstruction, capacity of station will be raised from 48,000 to 105,000 kw.

MILWAUKEE. Lakeside's Second High-Pressure Unit, T. Wilson. Power, vol. 71, no. 16, Apr. 22, 1930, pp. 618-621, 7 figs. Station's nine-year record of operating economy is expected to be further enhanced by added 1,300 lbs. unit; feedwater flow and steam flow are maintained coincident; water level checked by means of periscope; flue gas mill drying improves boiler room efficiency and reduces investment.

STEAM ENGINES

TRACTION TYPE. The Development of the Locomobile, H. Scharbau. Eng. Progress (Berlin), vol. 11, no. 1, Jan. 1930, pp. 1-4, 9 figs. Review of development from early model to modern superheated type; modern locomobile for combined power and heat supply.

UNIFLOW. New Vertical Uniflow Engine. Plant Eng., vol. 34, no. 8, Apr. 15, 1930, pp. 464-466, 5 figs. Illustrated discussion of Skinner 3-cylinder, vertical uniflow engine equipped with expansion-compensating, double-seat pippet admission valves; sectional and end elevation views are given; description of valve arrangement and operation.

STEAM PIPE LINES

EXPANSION IN. Study of Design of Steam Pipe Line with Regard to Expansion (Etude d'un tracé de tuyauterie à vapeur au point de vue de la dilatation), H. Carlier. Chaleur et Industrie (Paris), vol. 11, no. 120, Apr. 1930, pp. 174-177, 13 figs. Study of elastic deformations; importance of investigation of supports is set forth.

HIGH-PRESSURE. Measurement of Fatigue of High-Pressure Steam Pipe Lines (La mesure de la fatigue des tuyautcries de vapeur à haute pression), F. L. Atthalin. Technique Moderne (Paris), vol. 22, no. 8, Apr. 15, 1930, pp. 274-278, 10 figs. Experimental study of additional strength due to oval shape of cross-section in bends; results of tests are recommended for application in 44-kg., 450-deg. cent. pipe-line system in Issy-les-Moulineaux power plant.

STEAM POWER PLANTS

HIGH-PRESSURE. High Pressure and Temperature in Power Generation, G. A. Orrok. World Power (Lond.), vol. 13, no. 74, Feb. 1930, pp. 185-186 and 189. Article deals with progress in thermal efficiency of central stations; emphasizes reasons and itemizes causes which have brought gratifying results; indications of commercial efficiency as compared with thermal efficiency are given and progress in system economy through interconnection and community interest is stressed. Paper presented before World Power Conference, Tokyo.

The Power Plant of I.C.I., Ltd., H. A. Humphrey, D. M. Buist, and J. W. Babsall. Elec. Rev. (Lond.), vol. 106, no. 2730, Mar. 21, 1930, pp. 562-563 and (discussion) 563. Account of pulverized-fuel, high-pressure, high-temperature, industrial plant installed by Imperial Chemical Industries, Ltd., for supplying steam and electricity to Billingham-on-Tees factory of Synthetic Ammonia and Nitrates, Ltd.; steam pressure is 800 lbs. per sq. in. gauge; maximum temperature of 856 deg. fahr. Extracts from paper read before Instn. Elec. Engrs.

INDUSTRIAL DESIGN. Trend in Design and Operation of Industrial Plants with Special Reference to Furnace Volume, H. Kreisinger. Engrs.' Soc. of West. Penn.—Proc., vol. 45, no. 9, Dec. 1929, pp. 426-440 and (discussion) 441-450, 5 figs. Trend in industrial plants is toward larger steam-generating units; special advantages of high pressures; discussion of fuels burned, furnace design, and process of combustion.

STEAM TURBINES

MARINE. The Design of Single-Reduction Gearing for Compound Turbines, T. Gardner. Engineering (Lond.), vol. 129, no. 3353, Apr. 18, 1930, pp. 500-502. Notes refer to usual arrangement of geared steam turbines, such as are used in high-powered destroyers or flotilla leaders in which reduction of weight to minimum combined with maximum loading of power elements, is primary consideration.

STEEL

CHROMIUM. *See Chromium Steel.*

COLD DRAWING. Selection of Sheet Steel for Deep Drawing, W. H. Graves. Am. Mach., vol. 72, no. 18, May 1, 1930, pp. 718-719, 3 figs. Criteria for workability and physical properties discussed; Erichsen and Rockwell tests for no. 19 gauge steel; specifications of steel for extra deep drawing and deep drawing recommended.

CREEP AT HIGH TEMPERATURES. Creep of Steel at High Temperatures, F. H. Norton. Brit. Non-Ferrous Metals Research Ass.—Bul., no. 28, Mar. 1930, pp. 15-18. Author's object is to provide engineers with data on safe stresses for various steels, especially at high temperatures.

MANUFACTURE—DUPLEX PROCESS. Duplex Practice, J. E. Carlin. Am. Soc. Steel Treating—Trans., vol. 17, no. 5, May 1930, pp. 631-637. Article is prompted by fact that duplex process embodies two features whose successful utilization will very materially assist in changing basic open-hearth process from art to science; these two features are change of slag by use of tilting furnace and deoxidation with carbon; as long as slag contains iron oxide, oxidation is predominant; if oxidizing slag is replaced by neutral one made up of lime and spar, it should be possible to reduce remaining oxide by residual or additional carbon.

NITRIDED ANNEALING OF. Annealing or Softening of Nitrided Steels by Chemical Decomposition of the Nitrides, W. J. Merten. Am. Soc. Steel Treating—Trans., vol. 17, no. 5, May 1930, pp. 638-644 and (discussion), 644-645, 4 figs. Method of softening nitrided case of aluminum-molybdenum and aluminum-chromium nitriding steels by chemical decomposition of nitrides in fused sodium-potassium chloride bath; temperature of bath is low; points out service conditions under which nitrided steel parts do not perform satisfactorily since, due to atmospheric conditions, deterioration by chemical reactions are inevitable.

QUENCHING. A Study of the Quenching of Steels, H. J. French. Am. Soc. Steel Treating—Trans., vol. 17, no. 5, May 1930, pp. 646-727, and (discussion) 728-730, 54 figs. Paper is based upon researches carried out by author and former associates at U.S. Bureau of Standards; description of test methods; characteristics of cooling curves obtained in different coolants; effects of size and shape of sample upon cooling of steels; consideration is given to both centre and surface cooling in different coolants, and data for centre cooling are summarized graphically and in equations.

STEEL CASTINGS

ALLOY-STEEL. Alloyed Steel Castings in Theory and Practice (Legierter Stahlguss in Theorie und Praxis), A. Rys. Stahl und Eisen (Duesseldorf), vol. 50, no. 14, Apr. 3, 1930, pp. 423-438, 56 figs. Improvements of ingot steel to meet present mechanical, physical, and chemical requirements. by addition of alloying elements; investigation of different alloy-steel castings to determine strength, high-temperature resistance, effect of heat treatment, endurance, corrosion resistance, impact hardness, etc.; magnetic and non-magnetic acid- and heat-resisting steels.

HEAT TREATMENT OF. Continuous Equipment for Heat-Treating Steel Castings, A. C. Jones. Fuels and Furnaces, vol. 8, no. 4, Apr. 1930, pp. 475-478, 4 figs. Two continuous, oil-fired, pusher-type furnaces used in heat-treating steel castings; heat to 1,650 deg. fahr., quench in air and draw at 1,225 deg. fahr.

TEMPERATURE EFFECT. Strength of Steel Castings at Elevated Temperature with Special Regard to Influence of Nickel (Die Dauerstandfestigheit von Stahlguss bei erhoehten Temperaturen), A. Thum and H. Holdt. Giesserei (Duesseldorf), vol. 17, no. 14, Apr. 4, 1930, pp. 333-339, 10 figs. Results of tests on steel castings with varying nickel content in annealed and unannealed state to determine impact and notch hardness, tensile strength, elastic limit, elongation and shrinkage at temperatures ranging from 20 to 500 deg. cent.; nickel content up to 1.5 per cent improves all properties.

STEEL FOUNDING

COPPER MOULDS. The Casting of Steel in a Water-Cooled Copper Ingot Mould, W. Oertel. Iron and Steel Industry (Lond.), vol. 3, no. 5, Feb. 1930, pp. 137-139 and (discussion) 140-141, 8 figs. Paper deals with investigation of properties of some steels cast in water-cooled copper ingot moulds, including mechanical strength, crystalline structure, and, to some extent, hardness ranges of quenched specimens; number of times specimens could be quenched without cracking, and resulting magnetic properties, are also dealt with. Abstract of report no. 145, of Verein duetscher Eisenhuettenleute, indexed in Engineering Index 1929, p. 1772, from Stahl u. Eisen, May 9.

PLANT FOR LARGE CASTINGS. Plant for Making Large Steel Castings, C. Longenecker. Blast Furnace and Steel Plant, vol. 18, no. 4, Apr. 1930, pp. 622-623 and 626, 5 figs. Description of plants of Ohio Steel Foundry Co., Lima and Springfield, Ohio; at Springfield plant, steel is melted in electric furnaces; at

Lima, melting is done in open hearth furnaces; metal of which castings are composed is either straight carbon or alloy steel; output of Lima plant is approximately 2,200 tons of castings per month; smaller castings are manufactured at Springfield plant which has monthly capacity of 600 tons of small electric steel castings and 100 tons of heat and corrosion-resisting castings.

Rustless Castings. Make Rustless Steel Castings. Iron Age, vol. 125, no. 14, Apr. 3, 1930, pp. 993-996, 6 figs. Specialized foundry for manufacture of heat-resisting alloy castings, designed as model plant built by Ohio Steel Foundry Co. at Springfield, Ohio; foundry has capacity of 100 tons of castings per month; centrifugal castings machine, designed by company, for making pipe 4 to 16 in. in diam., is included in equipment; foundry building is steel frame structure 200 ft. long and 100 ft. wide; melting is done in 1-ton standard type Swindell electric furnace; usual furnace heat is 2,500 lbs.; gas-fired ovens dry moulds and cores.

STEEL STRUCTURES

Design. Some Moot Points in Steelwork Design, C. S. Gray. Structural Engr. (Lond.), vol. 8, no. 4, Apr. 1930, pp. 155-166, 21 figs. Discussion of end reactions on I beams, concentrated loads and shear stresses in I beams, riveting of flange plates to I sections, principal stresses in I beams, diagonal compression, stiffeners of plate girders.

STOKERS

Travelling-Grate. Recent Developments in Travelling-Grate Stokers (Die neuere Entwicklung der Wanderrostfeuerung), Presser. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 4, Apr. 1930, pp. 131-136 ,18 figs. Review of recent improvements; chain-grate stoker and experiences made with it outside of Germany; results obtained with forced-draft zone grate, and suggestions for improvement; influence of coal burned per unit grate area on temperature of firebars; prospects for travelling-grate stokers.

STOVES

Manufacture. The Guelph Stove Plant of the T. Eaton Co., J. Breakey. Can. Foundryman (Toronto), vol. 21, no. 1, Jan. 1930, pp. 9-12, 7 figs. Methods and equipment of stove foundry at Guelph, Ont.; details of moulding machines; and iron and coke supplies.

STREET RAILROAD TRACKS

Construction. A Successful Reinforced Concrete Base for Street Railway Tracks, I. O. Mall. Concrete, vol. 36, no. 4, Apr. 1930, pp. 13-18, 6 figs. Roadbed design of 4 mi. of single track in Canal Street, New Orleans; description of roadbed slab and resilient anchor plate or diaphragm; filling with asphalt and testing of diaphragm; provision for temperature changes; use of granite block along rails; construction of track.

Design. Track Without Ties, I. O. Mall. Elec. Ry. Jl., vol. 74, no. 3, Mar. 1930, pp. 154-157, 9 figs. Design adopted after prolonged experimentation has little resemblance to usual types; reinforced-concrete foundation acts as unit to hold rails in position; first cost is $75,000 per mile; maintenance cost is estimated at less than $100 per mile per year; diagram illustrating details of double anchorage unit for use under castings of special work.

STREET RAILROADS

Snow Removal. Snow Fighting Methods Used in Toronto, J. Metcalf. Elec. Traction, vol. 26, no. 2, Feb. 1930, pp. 57-59, 6 figs. Operating department of Toronto transportation commission charged with responsibility of snow removal; efficient apparatus employed.

STRUCTURAL STEEL

High-Grade. Improvements in Structural Steel, E. H. Schulz and H. Buchholtz. Metallurgist (Supp. to Engineer, Lond.), Mar. 1930, pp. 38-39. Survey of developments in structural steel; "Union Baustahl," developed at research institute of Vereinigte Stahlwerke A.G., is as good as silicon steel and there is no lowering of its properties in large sections; high copper content renders it resistant to rusting; it has been used considerably for heavy bridge construction, and found very satisfactory; results of aging tests; possibility of using it for forgings was investigated with very encouraging results. Abstract translated from V.D.I. Zeit., Nov. 2, 1929, indexed in Engineering Index 1929, p. 1807.

Welding. Arc Welding of Structural Steel, J. J. Wallace. Am. Welding Soc.—Jl., vol. 9, no. 3, Mar. 1930, pp. 61-66, 6 figs. Experiences of Joliet Engineering Co., Joliet, Ill., in use of arc welding for fabrication of trusses, towers, porch rails, gates, etc.

Strength Investigations on Welded Beam Connections, C. H. Jennings and A. A. Jakkula. Am. Welding Soc.—Jl., vol. 9, no. 4, Apr. 1930, pp. 22-41, 19 figs. Investigation of strength of flexible connections; properties of various beam connections were determined; design and preparation of test specimens; discussion of results.

STUCCO

Concrete. Standards of Performance of Concrete for Stucco, W. D. M. Allan. Am. Concrete Inst.—Proc., vol. 25, 1929, pp. 794-800. Discussion is limited to requirements for portland-cement stucco materials and does not touch on workmanship or construction details; durability; workability; watertightness; resistance to frost action; freedom from discoloration; freedom from crazing; windproofness and fire resistance. Part of symposium on Standards of Performance of Concrete for Various Uses. Paper indexed in Engineering Index 1929, p. 1810, from Advance Paper, for mtg. Feb. 12-14, 1929.

SUPERHEATERS

High-Temperature. Superheaters for High Steam Temperatures (Ueberhitzer fuer hohe Dampftemperaturen), W. Orth. Waerme (Berlin), vol. 53, no. 12, Mar. 22, 1930, pp. 227-229, 7 figs. New method is described showing that superheater tubes of SM steel are subject to internal corrosion even when steam is free from impurities and air, when steam temperature of 500 deg. cent. is exceeded; suggestions are given for design of superheaters for steam temperatures.

SURVEYING

Canada. The Engineer's Work in Surveying and Mapping, F. H. Peters. Eng. Instn. of Canada—Jl. (Montreal), vol. 13, no. 4, Apr. 1930, pp. 235-264 and (discussion) p. 283, 13 figs. Report of progress of geodetic and topographic surveying in Canada; mapping using vertical aerial photographs; phototopographic methods; four-mile maps using oblique aerial photographs; method of making marine charts; Canada's contribution to international map of world.

Triangulation, Canada. Progress in Triangulation During 1929, C. H. Ney. Can. Engr. (Toronto), vol. 58, no. 12, Mar. 25, 1930, pp. 425-426. Abstract of report of Geodetic Committee of Association of Dominion Land Surveyors, presented at annual convention; activities of divisions of triangulation, geodetic astronomy, levelling, etc.

T

TRACTORS

Manufacture of. All-Modern Equipment Produces Allis-Chalmers Tractor, W. Watson. Am. Mach., vol. 72, no. 11, Mar. 13, 1930, pp. 436-443, 13 figs. Description of machine tools used in new Allis-Chalmers Manufacturing Co. designed for production of 50 Model U tractors per day; special-purpose equipment and tooling predominate; analysis of equipment employed on different operations is given; layout of floor plans; transportation of parts by means of Louden overhead monorail system.

TUBES

Cold-Working. Study of Cold-Worked, Thick-Walled Tubes With Special Regard to Changes in Properties of Materials (Untersuchungen an kaltgereckten, dickwandigen Rohren, unter besonderer Beruecksichtigung der Veraenderungen der Werkstoffeigenschaften), H. Klein, Mitteilungen aus dem Wilhelm-Institute fuer Eisenforschung (Duesseldorf), vol. 11, no. 20, 1929, pp. 331-341, 13 figs. Theory of thick-walled hollow cylinders; calculation of stresses in such cylinders for elastic failure of materials; tests were carried out on specimen tubes of nickel-chromium and nickel-tungsten steel and of unalloyed steel.

TUNNELS, RAILROAD

English Channel. Channel Tunnel Gets Indorsement. Eng. News-Rec., vol. 104, no. 16, Apr. 17, 1930, pp. 659-660, 3 figs. Majority of committee appointed to consider practicability of 36-mi. link under water between England and France gives cautious and qualified approval; no difficult technical problems; cost would exceed $150,000,000; proposed tunnel plan; military aspects. See editorial comment on pp. 636-637, entitled Channel Tunnel Prospects are Poor.

Repair. Railroad Tunnel Refloored under Traffic when Walls Settle. Eng. News-Rec., vol. 104, no. 17, Apr. 24, 1930, pp. 689-690, 2 figs. Report on repairing tunnel no. 4 on main line of Southern Pacific Railway, leading out of San Francisco to south; concrete invert reconstructed with 12 in. I-beam reinforcing, under double track carrying more than 100 trains per day.

TUNNELS, VEHICULAR

Detroit. Tunnel Lining of Welded Steel, S. A. Thoresen. Iron Age, vol. 125, no. 14, Apr. 3, 1930, pp 985-989, 4 figs. Feature of Detroit-Windsor vehicular tunnel, largest shield-driven tunnel, lined with structural steel instead of conventional segments of heavy cast iron; relative advantages of cast iron and steel; design of steel lining; fabrication by pressing and welding; steel lining proves flexible when erected; comparison of weight and cost.

TURBO-GENERATORS

Breakdown of. Mechanical Degree of Safety in Large Turbo-Generators, H. Ricklu. Engineering (Lond.), vol. 129, no. 3350, Mar. 28, 1930, pp. 421-423, 4 figs. Serious accidents to 3,000-r.p.m. turbo-rotors have been reported during last two years; some of these have occurred at as early a stage as during overspeed tests at works in question, and others after plant had been in operation, sometimes after long period of service; cause of breakdowns appears to reside in certain properties of material. Abstract of paper read before World Power Conference in Tokyo.

V

VIADUCTS, STEEL

Reconstruction. Reconstruction of Liskeard Viaduct; and Scheme for Reconstruction of the Approach Spans of Royal Albert Bridge, Saltash, H. D. Smith. Instn. Civil Engrs.—Minutes of Proc., no. 4760, 1930, pp. 3-17, 9 figs. Reconstruction of concrete-steel viaduct up to 135 ft. in height, having 12 spans up to 66 ft. in length; reconstruction of railroad bridge carrying single line of Great Western Railway over river Tamar at height of 100 ft.

W

WATER BACTERIOLOGY

Study. The Relation of Direct Bact. Coli and Bact. Aerogenes Counts to Sources of Pollution, F. O. Tonney and R. E. Noble. Am. Water Works Assn.—Jl., vol. 22, no. 4, Apr. 1930, pp. 488-500 and (discussion) 500-501. Results of original study which showed that direct plating method with cyanide-citrate agar offers easy and reliable means of obtaining separate Bact. coli and Bact. aerogenes indices, also numerical ratio of organisms to each other, thus presenting new and more exact routine information on which to base sanitary judgment of water supplies. Bibliography. Paper presented before Water Purification Division of Toronto Convention.

WATER PIPE LINES

Pressure. High-Pressure Hydraulic Pipe Lines, F. G. Schranz. Baldwin Locomotives, vol. 8, no. 4, Apr. 1930, pp. 63-64, 4 figs. Discussion of high pressures in pipe lines; table giving characteristics of various grades and sizes of pipe used for hydraulic pipe lines; precautions to be taken in design and co-operation of high-pressure.

WATER POWER

Canada. Water Power Resources in the Dominion. Can. Engr. (Toronto), vol. 58, no. 14, Apr. 8, 1930, pp. 467-470. Review of available and developed water power resources of Canada, issued by Dominion Water Power and Reclamation Service of Department of Interior of Canada; central electric station industry; pulp and paper industry; capital invested in water power; statistics of developed water power distribution by industries and per 1,000 population, and developed power utilized in central electric station industry.

WATER TREATMENT

Iola, Kansas. Building Small Purification Plant at a Minimum Cost in Restricted Area, M. P. Hatcher. Water Works Eng., vol. 83, no. 8, Apr. 9, 1930, pp. 487-488 and 525, 1 fig. Description of new plant of Iola, Kans., having total capacity of 2,000,000 gals. per day; aeration and carbonation; method of handling lime and alum. Abstract from paper read before Am. Water Works Assn.

WATER WELLS

Water Wells. Wells as a Source of Municipal Water Supply, W. Kiersted, Jr., Am. Water Works Assn.—Jl., vol. 22, no. 4, Apr. 1930, pp. 470-479. Statistical data on use of wells as sources of water supply in United States; preliminary investigations; spacing of wells; importance of continuous records; Amarillo, Texas, operating results; comparison of modes of pumping wells.

WATER WORKS

Sioux Falls, S.D. Wells, Iron Removal Plant and Diesel Pumping Equipment at Sioux Falls, S.D., F. G. Gordon. Am. Water Works Assn.—Jl., vol. 22, no. 4, Apr. 1930, pp. 480-487, 1 fig. Description of water works deriving supply from two large circular, open wells, each 50 ft. in diameter, and from five closed wells of type patented by Maury.

WELDS

Stresses in. The Theory of Stresses in Welds, L. C. Bibber. Am. Welding Soc.—Jl., vol. 9, no. 4, Apr. 1930, pp. 104-137, 36 figs. Certain theories regarding strength of welds as affected by quantity and disposition of weld metal; design data and tables that will enable designers and draftsmen to use this information.

WIRE

Machines for Forming. Wire and Strip Metal Forming Machines. Machy. Market (Lond.), no. 1537, Apr. 18, 1930, p. 21, 2 figs. Description of improved four-slide automatic wire-forming machine and single-blow cold-heading machine built by E. White of Windsor Works, Redditch; machine will head wire up to 2½ times diameter of wire at single blow.

Z

ZINC ORE TREATMENT

Electrolytic. Status of Electrolytic Metallurgy of Zinc According to Latest Literature (L'état actuel de la métallurgie électrolytique du zinc d'après les dernière publications), A. Sanson. Revue de Métallurgie (Paris), vol. 27, no. 3, Mar. 1930, pp. 125-132, 7 figs. Details of Tainton process and plant in Kellogg, Idaho; results of tests; roasting, filtration, and purification; advantages of Tainton process.

Waelz Process. Zinciferous Slags and the Waelz Process (Zinkhaltige Schlacken und das Waelzverfahren), W. Stahl. Chemiker-Zeitung (Koethen), vol. 53, no. 8, Jan. 25, 1930, p. 79. Method of recovering zinc by roasting slag with coke in rotary kilns is described; during this process deposits containing considerable proportion of metallic iron are formed in them.

Engineering Index

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A

AERIAL SURVEYING

Air Photography. Air Photography Surveys, J. Durward. Roy. Aeronautical Soc.—Jl. (Southampton), vol. 34, no. 34, no. 232, Apr. 1930, pp. 344-358, 7 figs. Various methods and phases of aerial photography and surveying are described; vertical photographs; aerial camera mounting; overlapping, mosaic and oblique photographs; vertical and oblique stereoscopic photographs; interpretation of air photographs; survey flying organization; procedure on air photo-survey reconnaissance; air-photograph cadastral mapping.

AERONAUTICAL INSTRUMENTS

Artificial Horizon. The Artificial Horizon, E. A. Sperry. Am. Soc. Mech. Engrs.—Advance Paper for mtg., May 19 to 22, 1930, 3 pp., 2 figs. Description of instrument developed recently to aid blind flying; through use of gyroscope gravity device is constructed with very slow rate of motion that will maintain horizontal position in airplane with sufficient accuracy to make most useful instrument; test data for instrument are given.

AIR COMPRESSORS

High-Pressure. High-Pressure Air Compressors. Engineering (Lond.), vol. 129, no. 3353, Apr. 18, 1930, pp. 506-507, 6 figs. G. and J. Weir, Ltd., have completed series of high-pressure air compressors, for manufacture on production basis with attendant advantages of interchangeability and decreased costs; of this series, some account is given and examples are shown.

AIRPLANE ENGINES

Design. Trend in Aircraft Engine Development, H. Caminez. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. May 19-22, 1930, 10 pp. Enumeration of important factors determining performance; detailed comparison of air and water cooling; large European water-cooled engine develops one hp. per 1.2 cu. in. and weighs 0.80 lb. per hp.; difference between military and commercial engine; possibilities of Diesel cycle.

Diesel. Development of the Junkers-Diesel Aircraft Engine, Gasterstaedt. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 565, May 1930, 20 pp., 20 figs. Design and performance of 650-hp. 2-cycle engine; details of fuel injection and scavenging systems; vibration test.

Manufacture. Automotive Methods and Practices Involved in Aircraft Engines, O. E. Szekely. Am. Soc. Mech. Engrs.—Advence Paper for mtg., June 9-12, 1930, 13 pp., 6 figs. Comparison between cost of standard parts in automobile manufacturing and cost of parts in airplane manufacturing; metals that enter in automobile manufacturing can be secured in market at apparently very much lower price than when it is known they are intended for use in airplanes; relations are illustrated by formulae and graphs.

Supercharging. The Present Status of Superchargers for Aviation Engines, S. A. Moss. Am. Soc. Mech. Engrs.—Advance Paper for mtg. May 19-22, 1930, 4 pp. Review of application and possibilities of centrifugal superchargers; typical designs are illustrated and discussed; geared and exhaust drive types; manufacture at River Works of General Electric Co., Lynn, Mass.

Vibration. Vibration Characteristics of Aircraft-Engine Crankshafts, F. L. Prescott. Am. Soc. Mech. Engrs.—Advance Paper for mtg., May 19, to 22 1930, 11 pp., 22 figs. Report on tests with recording torsiometer by Material Division of United States Air Corps at McCook Field, Dayton, O.; diagrams show record of torsional vibration of Liberty crankshaft with metal and wood propellers; method of determining acceleration from records. Bibliography.

AIRPLANES

Autogiros. *See Autogiros.*

Design. Aeronautical Progress, 1914-1930, R. V. Southwell. Engineer (Lond.), vol. 149, no. 3878, May 9, 1930, pp. 512-514; see also Engineering (Lond.), vol. 129, no. 3356, May 9, 1930, pp. 611-613. Author maintains that kernel of present knowledge of aerodynamic theory is contained in lectures delivered in 1912 and 1914, by Mallock and Lanchester, respectively; in past 16 years safety has been attained; what mainly delays comfort is noise; aero-dynamic efficiency is slightly improved in spite of increased speeds; range has been multiplied by 13, rate of climb by 3, altitude by nearly 3, speed by nearly 4; structural design has not fallen behind. Paper read before Instn. Civ. Engrs., May 6, 1930.

Light Alloys For. Some Characteristics of Light Alloys for Aircraft, H. W. Gillett. Am. Soc. Mech. Engrs.—Advance Paper, for mtg., May 19 to 22, 1930, 6 pp. Description of various light alloys that might be used to advantage in aircraft construction; their advantages and drawbacks; cost and data; brief notes on forging and casting. Bibliography.

AIRSHIPS

Mooring Masts. Airship Mooring-Strain Indicator. Engineering (Lond.), vol. 129, no. 3355, May 2, 1930, pp. 584-585, 4 figs. At mast in Cardington, forces are transmitted through steel mooring tube, bending of which is measure of their magnitude; to measure bending two electric strain gauges are mounted on outer tube which is co-axial with mooring tube but not exposed to stress; spring-controlled plungers extending radially inwards from gauges rest on outer surface of mooring tube, so that any bending of latter is transmitted to gauges by inward or outward movement of plungers.

ALLOY STEELS

Properties. Physical Properties of Pure Chromium and Tungsten Steels (Die physikalischen Eigenschaften von reinen Chromund Wolframstaehlen), F. Staeblein. V.D.I. Zeit. (Berlin), vol. 74, no. 17, Apr. 1930, p. 541. Notes on specific gravity, specific resistance, magnetic properties, thermal conductivity and heat expansion of alloys containing about 25 per cent chromium or tungsten. Indexed in Engineering Index, 1929, p. 151, from Archiv fuer das Eisenhuettenwesen (Duesseldorf), Oct. 1929.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Brass. *See Brass.*
Copper. *See Copper Alloys.*
Light. *See Airplanes, Light Alloys for.*

ALUMINUM ALLOYS

Light. Recent Progress in Light Aluminum Alloys (Les récents progrès des alliages légers d'aluminium), L. Guillet. Génie Civil (Paris), vol. 96, no. 19, May 10, 1930, pp. 449-454, 5 figs. Properties of aluminum-silicon-magnesium, and aluminum-copper alloys, also of alloys of aluminum-copper-silicon with or without manganese.

Properties. Brinell Hardness, Elastic Limit, and Tensile Strength of Commercial Aluminum Alloys (Brinellhaerte, Elastizitaetsgrenze und Zugfestigkeit verguetharer Aluminiumlegierungen), P. Melchior. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 5, May 1930, pp. 175-176, 3 figs. Results of author's investigation of relations between Brinell hardness, elastic limit and tensile strength, as reported by H. Bohner, indexed in Engineering Index, p. 157, from Nov. 1929, issue of same journal.

AQUEDUCTS

New York City. New York to Rebuild Century-Old Croton Aqueduct as a Safety Measure, W. W. Brush. Water Works Eng., vol. 83, no. 11, May 21, 1930, pp. 736-738 and 851, 8 figs. Chief Engineer of Department of Water Supply, Gas and Electricity of New York City states that city must have added water soon and Croton system offers best temporary supply; typical sections of old Croton Aqueduct; formation of cracks in old Croton Aqueduct; life of masonry aqueducts.

ARCHES

Stresses. Dependability of the Theory of Concrete Arches, H. Cross. Univ. of Illinois—Eng. Experiment Station—Bul., vol. 27, no. 29, Mar. 18, 1930, pp. 1-34, 11 figs. Study of effect on moments and thrusts resulting from uncertainty as to physical action, under load, of different parts of arch; limit of uncertainty involved in these assumptions; sources of stress in arch; moments at crown and at springings produced by load; temperature change and abutment rotations; departure of stresses in any arch from values given by analysis can scarcely be greater than variations in quality of concrete.

AUTOGIROS

Characteristics of. The Autogiro: Its Characteristics and Accomplishments, H. F. Pitcairn. Franklin Inst.—Jl., vol. 209, no. 5, May 1930, pp. 571-584, 9 figs. Description of development and advantages of autogiro; safety and performance, horizontal speed 120 m.p.h. with 225 hp.; vertical descent 12 ft. per second.

AUTOMOTIVE FUELS

Volatility. Effective Volatility under Driving Conditions, J. E. Miller and G. G. Brown. Indus. and Eng. Chem., vol. 22, no. 6, June 1930, pp. 653-662, 16 figs. Definition of effective volatility under driving conditions and indication of how it may be determined from equilibrium volatility on A.S.T.M. distillation data.

Relation between Atmospheric Temperature, Fuel Volatility, and Engine Performance, C. L. Nickols and G. G. Brown. Indus. and Eng. Chem., vol. 22, no. 6, June 1930, pp. 662-671, 14 figs. Relation of effective volatility to engine performance; A.S.T.M. distillation characteristics required for satisfactory performance under different conditions of atmospheric temperature are suggested.

B

BEAMS

Concrete Tee. Simplified Formula for the Design of Reinforced Concrete Tee Beams, R. W. Reynolds. Engineering (Lond.), vol. 129, no. 3356, May 9, 1930, pp. 591-592, 4 figs. Formulae given are advocated for rapid economic and accurate design, making full use of maximum stresses which are to be permitted.

Concrete-Tile. Test of Composite Beams and Slabs of Hollow Tile and Concrete, D. E. Parsons and A. H. Stang. U.S. Bur. of Standards—Jl. of Research, vol. 4, no. 6, June 1930, pp. 815-849, 23 figs. Sixty reinforced beams or slabs, 12 of concrete and 48 composite beams representing portions of concrete and hollow tile slabs, were fabricated and tested in laboratory to determine value of tiles in assisting concrete to resist shear and bending; results of beam tests indicated that one row of tiles was equivalent in resisting shear to concrete rib of same depth and having width of 1.6 to 2.4 ins.; strength in shear of bond between concrete and hollow tile was affected by factors influencing compressive strength of concrete.

BEARINGS

Friction in. Experimental Research on the Friction of Pivots, A. Jaquerod, L. Defossez, and H. Muegeli. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 566, May 1930, 54 pp., 15 figs. Report on friction experiments with horizontal and vertical pivots, dry and lubricated; graphs show influence of speed and load, viscosity and aging of oil; interpretation of results; comparison with several theories on friction. Bibliography.

Tests on Friction in Journal and Roller Bearings (Versuche ueber die Reibung in Gleit- und Rollenlagern), E. Schneider. Petroleum (Berlin), vol. 26, nos. 7 and 11, Feb. 12, 1930, pp. 221-236, and Mar. 12, 1930, pp. 337-348, 16 figs. Study is based on so-called hydrodynamic theory of bearing friction. Feb. 12: Results of main tests on journal bearings; theoretical considerations, testing methods, and equipment employed. Mar. 12: Tests on friction of roller bearings; evaluation of results. Bibliography.

BERYLLIUM DEPOSITS

MANITOBA. Tin, Lithium and Beryllium Deposits of Southeast Manitoba, J. F. Wright. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 22, May 30, 1930, pp. 514-517, 4 figs. Tin, lithium and beryllium deposits attracting most attention are in that part of Oiseau River area along Winnipeg river east of Pointe de Bois and north to Shatford and Bernic lakes; general geology; general features of pegmatites; tin deposits; lithium deposits; beryllium deposits; summary of economic features; some of pegmatites of district may be in demand in future as source of feldspar.

BLASTING

MISFIRES. How Leakage of Current from an Electric Shot-Firing Circuit Causes Misfires, L. C. Ilsley, A. B. Hooker and D. H. Zellers. U.S. Bur. of Mines—Tech. Paper no. 471, 1930, 16 pp., 12 figs. Report covers tests at Pittsburgh Experiment Station of U.S. Bureau of Mines, that may be helpful in explaining probable cause and in preventing such misfires; firing characteristics of common type of electric detonator; limitations of portable blasting machines; theory of leakage of current from shot-firing circuit; preliminary measurements of leakage; laboratory tests; field tests; leakage through leg-wire coverings; limits of firing current used.

BOILERS

COMBUSTION CONTROL. Automatic Combustion Control for Boiler Furnaces, G. R. Bamber. Inst. Mech. Engrs.—Proc. (Lond.), no. 5, Dec. 1929, pp. 1099-1113, 1 fig. Automatic control of combustion in boiler furnaces is departure of comparatively few years' standing; it owes its development chiefly to United States, although two noteworthy systems are due respectively to Germany and Czechoslovakia; test figures given may be regarded as typical of improvement brought about by installation of automatic control apparatus; they relate to battery of boilers at railway repair works at Cassel, Germany, fitted with Askania control.

DESIGN, FRANCE. Evolution in the Products of French Babcock and Wilcox Co. during 10 years (L'évolution dans les fabrications de la Société française des Constructions Babcock et Wilcox, depuis dix annés). Chaleur et Industrie (Lond.), Apr. 1930, (Special No.) pp. 163-171, 19 figs. Description and sketches of various types of boilers and equipment; sectional W.I.F. boiler; marine boiler; vertical-type Ladd Belleville; superheaters; automatic stokers; air pre-heaters; pulverized fuel.

FURNACES, RADIATION IN. Some Modern Boiler Problems, Petire. Engineering (Lond.), vol. 129, no. 3358, May 23, 1930, pp. 673-674. Editorial comment on report to Manchester Steam Users Assn., dealing with radiation problem; author proposes to base theory of radiation in boiler furnaces on fact that strong absorption bands in infra-red region characterize spectra both of carbon oxide and water vapour; view accords well with experiments of Callendar and Julius; solution of high-temperature boiler problem may be as much matter of eliminating every possibility of defective circulation as it is of improvement of materials.

BRASS

METALLURGY OF. The Effects of Silicon on the Properties of Brass, H. W. Gould and K. W. Ray. Metals and Alloys, vol. 1, no. 11, May 1930, pp. 502-507, 22 figs. Description of tests for specific gravity, hardness, impact breaking strength, tensile strength, percentage elongation, and corrosion resistance made on series of brasses containing varying percentages of silicon; microphotographs, tables, and graph interpret results.

BRIDGE ABUTMENTS

BEARINGS. End Bearings of Bridge Allow for Shifting of Abutments. Eng. News-Rec., vol. 104, no. 22, May 29, 1930, pp. 898-900, 4 figs. Bridge expansion bearings providing for possible extensive shifting of abutments in unstable ground, as well as for normal expansion and contraction of truss spans, form feature of new Sorlie memorial highway bridge built across Red River, between Grand Forks, N.D., and East Grand Forks, Minn.; sliding joint in bridge floor provides for 2 ft. movement of abutment, if shifted by flowing bank.

SINGLE-SPAN. Abutments of a Single-Span Bridge (Widerlager einer Sandversatzsturzbruecke). Zement (Charlottenburg), vol. 19, no. 3, Jan. 16, 1930, pp. 58-60, 4 figs. Construction of abutments for bridge of coal mine under especially unfavourable surface conditions; it was necessary to place foundations 25 ft. below surface since upper layer consisted mostly of soft sandy clay; abutments rest on reinforced-concrete foundations 1.50 and 2.00 m. thick; brick lining and asphalt isolation protect structure against aggressive waters; heavy reinforced-concrete beams, 1.10 m. long, distribute stresses to foundations.

BRIDGE PIERS

CONSTRUCTION. Construction Problems of Lake Union Bridge Substructure, G. W. Crocker. West. Construction News, vol. 5, no. 9, May 10, 1930, pp. 228-232, 8 figs. Report on construction of concrete bridge pier having base 99 ft. long, 64 ft. wide, and 33 ft. deep; in 64 ft. of water; driving of sheet piling; design of struts and wales; plan of cofferdams; jetting equipment; pile driving; pier excavation; leads and gunwales for driving 100 to 130 ft. Douglas fir piles; concreting.

BRIDGES

FLOORS. La Salle Street Bridge, Chicago, Splendid Example of Modern Timber Floor Construction. Wood Preserving News, vol. 8, no. 5, May 1930, pp. 60-62, 3 figs. Floor arrangement consists in main of plank subfloor laid transversely on stringer, and on top of that second layer of tongue and groove strips laid longitudinally; this construction gives very wide distribution of load to subfloor, thus cutting down its thickness and, consequently, weight.

BRIDGES, CONCRETE ARCH

CZECHOSLOVAKIA. New Arch Bridge in Prague (Eine neue Bogenbruecke in Prag), F. Emperger. Tonindustrie-Zeitung (Berlin), vol. 54, no. 22, Mar. 17, 1930, pp. 369 and 371-372, 8 figs. Details of bridge crossing Moldan River, total length 225 m., width 16 m.; road is 10.4 m. wide, with footpath 2.8 m. on each side; it has 4 spans, width of two centre spans 47.2, and outer spans 43.5 m. each; methods of concrete construction are described.

DESIGN. The Design of Masonry Arch Bridges, E. C. Seibert. Arch. Rec., vol. 67, no. 5, May 1930, pp. 403-410, 11 figs. General discussion of structural design and principles of architectural treatment of masonry arch bridges.

BRIDGES, FRAME

DESIGN. A Simplified Method for the Design of Single Span Frame Bridges, G. H. Hargreaves. Surveyor (Lond.), vol. 77, no. 1996, Apr. 25, 1930, pp. 499-501, 10 figs. Discussion by A. C. Hughes and C. S. Gray of paper previously indexed from Instn. Mun. and County Engrs.—Jl. Dec. 24, 1929.

BRIDGES, RAILROAD

RECONSTRUCTION. The Re-Girdering of the Lower Sone Bridge; East Indian State Railway. Engineering (Lond.), vol. 129, no. 3355, May 2, 1930, pp. 562-566 and 23 figs. partly on supp. plates. Reconstruction work was commenced in 1925, old up-track bridge being replaced by mild-steel girders carrying railway track overhead and concrete roadway 16 ft. wide beneath; replacement of old downtrack bridge was undertaken in 1929, and forms subject of this article; total net cost of regirdering was 187,500 pounds.

BRIDGES, STEEL ARCH

HUNGARY. New Tied Arch Design for the Gyoer Road Bridge (Neuartige Verwendung des Versteiften Stabbogens bei der Strassenbruecke in Gyoer), J. Beke. Bauingenieur (Berlin), vol. 11, no. 2, Jan. 10, 1930, pp. 21-25, 8 figs. Description of steel road bridge consisting of main span of 296.8 ft. and two side spans of 57.6 ft.; characteristic feature of design is prolongation of stiffening girder of central arch in form of cantilevers to carry roadway over side spans; suitability of this system for special cases in which height of roadway above lower edges of bridge was limited to about 1 m. by stipulated headroom under bridge and incline at approaches.

SYDNEY, AUSTRALIA. Progress on Sydney Harbour Bridge. Eng. News-Rec., vol. 104, no. 19, May 8, 1930, pp. 761-762, 5 figs. Progress report on steel erection; about half of 28 panels in 1,650-ft. steel arch are in place; cantilever erection without falsework; main boom of erection traveller is mounted on transverse track and serves both trusses; anchorage tunnel is U-shaped so that cables are continuous from one top chord to other.

STRENGTHENING. Reinforcement in Place of the Stoney Creek Arch Bridge, P. B. Motley. Eng. Jl. (Montreal), vol. 13, no. 5, May 1930, pp. 309-314 and (discussion) 314-315, 10 figs. Report on reinforcement, with new arch, of steel railroad bridge, built for Canadian Pacific in 1893, which consists of 336 ft. three hinged arch, on which are supported plate girder spans which extend to abutments at both ends of bridge, making structure 486 ft. long; erecting new arch ribs by cantilever trusses without loading old bridge.

BRIDGES, STEEL TRUSS

LONGVIEW, WASH. The 1,200 Ft. Cantilever Bridge at Longview, Wash., C. E. Paine. Eng. News-Rec., vol. 104, no. 20, May 15, 1930, pp. 803-806, 4 figs. Design and construction of longest cantilever structure in United States, having main span of 1,200 ft. and anchor arms 760 ft. long; clearances above mean low water are 185 ft. at channel pier and 195 ft. at centre of main span; bridge carries 27 ft. roadway and two 3 ft. sidewalks; progress of work.

MONTREAL. Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge, L. R. Wilson. Eng. Jl. (Montreal), vol. 13, no. 5, May 1930, pp. 323-327, 2 figs. Discussion by P. L. Pratley of paper indexed from issue of Jan. 1930.

BRIDGES, SUSPENSION

FOOTBRIDGE ROPES. Manufacturing of High-Modulus Footbridge Ropes for Fort Lee Hudson River Bridge, C. C. Sunderland. Eng. News Rec., vol. 104, no. 18, May, 1930, pp. 714-718, 8 figs. Modulus of elasticity of 6 x 37 rope increased from 12,000,000 to 18,000,000 pounds per sq. in. by prestressing to 125 per cent of working stress; process applied also to strands for main cables of Grand'Mere and St. Johns Bridges; equipment layout for prestressing wire ropes in lengths up to 3,750 ft.; stress-strain diagram of rope before and after multiple stressing; effect of multiple stressing on experimental 1½ in. strand.

BUILDING MATERIALS

SOUND ABSORBING. Tests of Sound Insulation in Trondhjem Hospital, Norway (Lydisolasjonsmalinger I Trondhjems Sykehus), J. Holtsmark. Teknisk Ukeblad (Oslo), vol. 77, no. 19, May 8, 1930, pp. 202-204, 2 figs. Test was carried out to find best sound-absorbing material; results show that non-homogeneous walls are best; composition wall using celotex gave best sound insulation of all materials tried.

BUILDINGS

VIBRATIONS. Vibration Phenomena in High Building (Schwingungserscheinungen an einem Hochhaus), H. Reiher. V.D.I. Zeit. (Berlin), vol. 74, no. 19, May 10, 1930, pp. 601-604, 7 figs. Report on observations made by department of acoustics and thermodynamics of Stuttgart Institute of Technology; records of vibrations registered by Geiger instrument on each storey of tower light 8-storey reinforced concrete building; resonance curve of tower; effect of manufacturing machinery on vibrations in building; eliminating resonance, with its consequent ill-effects on health of workers, by changing speed of steam engine.

BUILDING, STEEL

PROTECTIVE COATINGS. Rust Prevention: Effect of Wall Materials on Steel Parts of Steel-Frame Buildings (Rostschutz, etc.), A. Guttmann. Stahlbau (Supp. to Bautechnik, Berlin), vol. 3, no. 2, Jan. 24, 1930, pp. 15-16. Protection afforded by dense concrete to steel reinforcement is no criterion of that afforded by porous materials used for curtain walls to steel of steel-frame buildings; high rate of shrinkage of cellular concretes combined with low tensile strength renders cracks inevitable if panels be rigidly held by steel frames; complete protection from corrosion can be achieved only by coating steelwork with paint or cement.

BUILDINGS, STEEL-CONCRETE

FAILURE. Steel Cores for Four-Storey Concrete Building Collapse During Erection. Eng. News-Rec., vol. 104, no. 22, May 29, 1930, pp. 909-910, 2 figs. Derrick being dismantled on new Gottfield bakery building in New York falls, dragging all columns on 100 by 225 ft. site to ground; description of accident.

C

CADMIUM

PLATING WITH. Cadmium as a Protection Against Corrosion (Cadmium als Korrosionsschutz), A Siemens. Zeit fuer Elektrochemie (Berlin), vol. 36, no. 2, Feb. 1930, pp. 101-105; see also translated article in Metal Industry (Lond.), vol. 36, no. 18, May 2, 1930, pp. 481-483. Review giving data and numerous references on production, physical and chemical properties, and methods of applying metal in form of protective coating, especially by electrodeposition.

CAMS

DIFFERENTIAL. Differential Cam Mechanism. Machinery (Lond.), vol. 36, no. 191, May 22, 1930, pp. 233-234, 4 figs. Description and sketches of mechanism for bobbin winding machine; analysis of motion and diagram showing variation of combined throw of cams.

CANALS

WELLAND. The Welland Ship Canal. Engineering (Lond.), vol. 129, no 3356, May 9, 1930, pp. 592-595, 24 figs. partly on supp. plates. Intake and discharge valves for locks of Welland Ship Canal are of Taintor-gate (sector) type, and have been standardized throughout locks to three designs; operating gear has been similarly standardized; description of typical intake and modifications introduced in order to cover requirements of valves for other points. (Continuation of serial.)

CARS

PASSENGER—STEEL. On the Question of All Steel Coaches. Comparison with Vehicles Built of Wood (Subject VIII for Discussion at the Eleventh Session of the International Railway Congress Association), D. Daehnick. Int. Railway Congress Assn.—Bul (English Edition, Brussels), vol. 12, no. 2, Feb. 1930, pp. 635-664, 28 figs. Report covers German cars; advantages of all-metal method of construction; types of cars in service, in construction or being designed; table of recent all-steel, semi-steel and wooden coaches.

CASTINGS

SHRINKAGE AND PIPING. Shrinkage and Piping (Schwindung und Lunkerung—Sschwindmass), W. Claus. Giesserei (Duesseldorf), vol. 17, no. 19, May 9, 1930, pp. 440-455, 20 figs. Problems of iron, steel, and non-ferrous-metal foundries; piping of tin bronze, 10:90 and aluminum bronze 10:90; simple linear shrinkage coefficient; linear shrinkage calculated from cubic shrinkage coefficient; Claus-Gooderitz theory of shrinkage; values for pure aluminum, copper, pure iron, carbon steels, and cast iron.

CEMENT, PORTLAND

HYDRATION. The Rate of Hydration of Cement Clinker, F. O. Anderegg and D. S. Hubbell. Am. Soc. Testing Matls.—Advance Paper No. 63, for mtg. June 23-27, 1930, 7 pp., 2 figs. Part II: Standard portland cement particles were found to be approaching apparently complete hydration in 9 months while at 12 months hydration was practically finished. Part III: Hydration rate of tricalcium aluminate was found quite high, particles of dimension of 25 microns being three-quarters hydrated in 3 hours; tricalcium-silicate particles required 7 days for similar degree of hydration while with dicalcium silicate this amount of hydration was reached after 5.5. months.

CERAMIC INDUSTRY

CANADA. The Ceramic Industry of Canada, R. J. Montgomery. Ceramic Soc. (Lond.), vol. 29, no. 5, May 1930, pp. 103-106. Brief account of developments in manufacture of ceramic products; production statistics for 1929.

CHAINS

STRENGTH OF. Rings, Link and Hooks—Discrepancies between Theory and Practice, A. G. Thompson. Colliery Guardian (Lond.), vol. 140, nos. 3616 and 3617, Apr. 17, 1930, pp. 1463-1465, and Apr. 25, pp. 1561-1562, 7 figs. Notes on tests, mathematical discussion, graphs, and formulae; conclusion is that apparent discrepancy is definitely solved by dispersion, and that other mathematical refinements are of little practical importance.

CHROMIUM-MANGANESE STEEL

DRAWING QUALITIES OF. Rustless Chromium-Manganese Steels Have Deep-Drawing Qualities, F. M. Becket. Iron Age, vol. 125, no. 20, May 15, 1930, pp. 1468-1470, 6 figs. Description of composition and physical properties of stainless chromium-manganese steels of improved deep-drawing qualities; effect of manganese on strength, ductility, toughness, and hardness of low-carbon steel with 17 to 18 per cent chromium; composition ranges, cr 17 to 18 and mn 5 to 7 per cent; addition of copper increases deep drawing properties. Abstract of paper read before Am. Iron and Steel Inst.

CIVIL ENGINEERING EDUCATION

GERMANY. Instruction in the Civil Engineering Departments of German Institutes of Technology (Die Ausbildung an den Bauingenieurabteilungen der deutschen Technischen Hochschulen), O. Ammann. V.D.I. Zeit. (Berlin), vol. 47, no. 18, May 3, 1930, pp. 561-564, 2 figs. General discussion of curricula and methods of instruction, with special reference to limitation of specialization, extension of scientific preparation reducing numbers of lectures and study periods, facilitating transfers from one institution to another, uniform examinations, etc.

COAL HANDLING

EQUIPMENT FOR. Aerial Coal Transporter with Travelling Tower. Engineering (Lond.), vol. 129, no. 3357, May 16, 1930, pp. 629-630, 25 figs., partly on p. 638 and supp. plate. Storage plant of large capacity of aerial-transporter type has been built at pit bank of Hohenzollern coal mines of Graeflich Schaffgotschasche mines at Beuthen, Silesia, by J. Pohlig A. G.; installation embodies fixed tower with moving one working over arc.

COAL MINES AND MINING

UNDERGROUND TRANSPORTATION. Economical Mine Haulage, J. Rusen. Coal Min., vol. 7, no. 2, Feb. 1930, pp. 77-80, 5 figs. Discussion of various factors affecting cost of electric haulage in coal mines; standardization of equipment; maintenance and repair of equipment and tracks; timbering; lighting; side tracks; lubrication; use of sand on grades; automatic mine doors; cooperation of haulage boss and machine boss or electrician with mine foreman.

COAL PULVERIZERS

TESTS OF. Grinding Tests with a Tube Mill Without an Air Separator (Mahlversuche an einer sichterlose Rohrmuehle), Grosse, Foerderreuther and Rammler. Zement (Charlottenburg), vol. 19, nos. 9 and 10, Feb. 27, 1930, pp. 189-194 and Mar. 6, pp. 214-217, 7 figs. Experiments were made to find relation between fineness, power consumption, output, load limit, and moisture of powdered coal; mill was three-compartment compeb (solo mill) mill; coal samples were taken from mill in certain time intervals for sieve analysis; it was possible to calculate composition of coal powder from single test on one standard sieve.

COAL WASHING

THEORY. The Laws of Motion of Particles in a Fluid, R. G. Lunnon. Instn. Min. and Met.—Trans. (Lond.), vol. 38, 1928-1929, pp. 402-413 and (discussion) 413-420, 4 figs. Mathematical discussion, with formulae and graphs; stream lines for sphere; laws of resistance; application to gravity separation; irregular particles; effects of acceleration. Bibliography. Article indexed in Engineering Index 1929, p 469, from various sources.

COLUMNS

DESIGN. Designer Certification and Column Formulae in New York Building Code, W.L. Unger and J. C. Schulze. Eng. News-Rec., vol. 104, no. 19, May 8, 1930, pp. 779-780, 1 fig. Discussion of importance of competent design and supervision under conditions set up in revised building code of New York City; comparison of column formulae.

COLUMNS, CONCRETE

STEEL CORE. Tests on Columns With High Tensile Steel Reinforcement (Versuche an Saeulen mit hochwertiger Stahlbewehrung), R. Saliger. Beton u. Eisen (Berlin), vol. 29, no. 1, Jan. 5, 1930, pp. 7-12, 11 figs. In lower storeys of high buildings, steel columns with fireproofing concrete encasement only are employed; in Bauer method of obtaining strength in reinforced-concrete columns of smaller section, reinforcement consists of fabricated framework of verticals secured near ends by horizontal bands and surrounded by spiral reinforcement or perforated metal sheath, delivered at site as single unit.

CONCRETE

SLAG. Behaviour of Concrete at High Temperatures with Special Regard to Concrete Containing Blast-Furnace Slag (Verhalten von Beton bei hohen Temperaturen unter besonderer Beruecksichtigung von hochofen-schlackenhaltigem Beton), R. Gruen and H. Beckmann. Archiv fuer das Eisenhuettenwesen (Duesseldorf), vol. 3, no. 11, May 1930, pp. 677-683 and (discussion) 683, 11 figs. Investigation of portland blast-furnace cement and different aggregates, including blast-furnace slag, and concrete made therefrom, to determine chemical and physical behaviour at temperatures up to 1,200 deg. cent.

SURFACE TREATMENT. The Treatment of Monolithic Concrete Surfaces, N. C. Johnson. Am. Concrete Inst.—Jl., vol. 1, no. 7, May 1930, pp. 717-730 and (discussion) 730-731, 7 figs. Discussion of methods of treatment of form-cast surfaces; wash and float work; costs; bush hammering or tooling of concrete surfaces; machine grinding of surfaces; hand grinding and acid treatments of concrete surfaces; painting concrete surfaces; veneers of mortar; economic advantages of veneered surfaces over form-cast concrete; chemical surfacing of monolithic concrete; examples of chemical surfacing work.

CONCRETE CONSTRUCTION

RAPID. Rapid Construction in Reinforced Concrete (Rasches Baustempo im Eisenbetonbau), W. Petry. Bauingenieur (Berlin), vol. 11, no. 3, Jan. 17, 1930, pp. 35-39, 17 figs. Speed with which reinforced-concrete buildings can be erected is illustrated by construction photographs, and attention is drawn to use of rapid-hardening cements, sliding forms, and other agencies by means of which work has been accelerated.

SUBAQUEOUS. Pouring Concrete Under Water (Unterwasserschuettbeton), W. Nakonz. Bautechnik (Berlin), vol. 8, no. 3, Jan. 17, 1930, pp. 35-36, 6 figs. Methods of placing concrete under water by means of travelling chute and funnel, and number of funnels fixed laterally but capable of being raised as work proceeds; advantages and disadvantages of two methods are compared, and necessary precautions discussed.

CONCRETE CURING

TESTS. Some Tests of Concrete Masonry Units Cured with High Pressure Steam, P. M. Woodworth. Am. Concrete Inst.—Jl., vol. 1, no. 4, Feb. 1930, pp.504-511, 3 figs. Technical Engineer, Cement Products Bureau, Portland Cement Association reports on effect of high pressure steam curing on early and ultimate strength, strength as affected by time interval between moulding and curing; effect of curing and condition at test on strength of vibrated concrete tile; shrinkage of concrete masonry panels; units cured in high pressure steam developed strength at two days greatly in excess of strength obtained at 28 days by moist curing or low pressure steam curing.

CONCRETE DESIGN

METHODS FOR. Design of Structural Members Under Eccentric Compression (Verfahrenzur Berechnung von Konstruktionslgiedern mit aussenmittiger Druckbeanspruchung), S. Szegoe. Beton u. Eisen (Berlin), vol. 29, no. 1, Jan. 5, 1930, pp. 18-20. Simple methods for designing reinforced-concrete structural members to resist eccentric compression; application illustrated by numerical examples of continuous beams and frameworks; it is stated that all tables and nomograms generally used in designing reinforced-concrete structures can be replaced by two formulae and one table here presented.

CONCRETE MIXING

COLD WEATHER. Winter Concreting Methods, R. C. Johnson. Am. Concrete Inst.—Jl., vol. 1, no. 4, Feb. 1930, pp. 397-406, 2 figs. Report of Committee 604 on recommended practice for use in building construction; effect of curing conditions on the strength of concrete; strength for different temperatures; freezing of concrete; winter protection plant; heating materials; period of protection; stripping of forms.

CONCRETE SLABS

DESIGN. Design of Reinforced Concrete Slabs, W. L. Scott. Concrete and Constr. Eng. (Lond.), vol. 25, nos. 3 and 4, Mar. 1930, pp. 167-177, and Apr. pp. 221-231, 16 figs. Mar.: Theoretical mathematical analysis of thin rectangular slabs supported along their edges, with special reference to solution developed by Pigeaud; methods of calculating bending moments; calculation of shear on slab panels; effect of panel shapes and shapes of loaded areas. Apr.: Comparison of bending moments as load-spread increases; numerical example illustrating use of graphs. (To be continued.)

CONVEYORS

PNEUMATIC. Handling Raw Materials by Pneumatic Conveying. Ceramic Industry, vol. 14, no. 5, May 1930, pp. 541-543, and 546, 7 figs. Handling types of pneumatic conveyors are described; chief advantages of pneumatic conveying are, improved labour conditions through elimination of dust and fume hazards; reduction of labour costs through elimination of manual handling, reduction of wasted material through elimination of spillage; conservation of space through compactness of collecting station and conveying pipelines, and flexibility.

SCREW. Economical Portable Screw Conveyor for Handling Sacks. Concrete, vol. 36, no. 5, May 1930, pp. 118-119, 2 figs. Description of conveying equipment by Clark Tructractor Co. consisting of two parallel tubular screws which are turned toward each other by power head; material may be carried forward at speed of 90 ft. per min.; capacity of conveyor is about 1,200 sacks per hr.; joints may be turned.

COPPER ALLOYS

COPPER-NICKEL. British Standard Specification for Nickel-Copper (Cupro-nickel) Sheets and Strip. Brit. Eng. Standards Assn. (Lond.), no. 374, Apr. 1930, 7 pp. Standard specifications covering quality of material, chemical test, freedom from defects, dimensions, provision of test pieces, mechanical tests, re-tests, inspection, and testing facilities.

COPPER-ZINC. Heat Treating of Zinc-Copper Alloys (Ueber den Verguetungsvorgang in Zink-Kupferlegierungen), M. Hansen. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 5, May 1930, pp. 149-154, 8 figs. Trend in aging of quenched zinc-copper alloys is shown in resistance-time curve; influence of temperature, composition, and speed of cooling; change in hardness of quenched alloys in relation to aging temperature and composition.

The Significance of Hardness Values for Some Copper-Zinc Alloys, C. H. Davis and E. L. Munson. Am. Soc. Testing Matls.—Advance Paper no. 49, for mtg. June 23-27, 1930, 7 pp., 6 figs. Effect of grain size on hardness of both annealed and cold-worked alpha-phase copper-zinc alloys has been observed; significance of variables which affect hardness values is shown by series of curves.

HARDENING. Hardening of Copper-Silver, Beryllium-Copper, and Zinc-Copper Alloys (Beitrag zum Haertungsproblem von Kupfer-Silber, Beryllium-Kupfer- und Zink-Kupfer-Legierungen), M. Haas and D. Uno. Zeit. fuer Metalkunde (Berlin), vol. 22, no. 5, May 1930, pp. 154-158, 11 figs. With aid of structure analysis, dilatometry, and measurement of electric conductivity, trend of hardening is followed. Bibliography.

PROPERTIES. Copper and Copper Alloys, W. H. Bassett. Nat. Elec. Light Assn.—Bul., vol. 17, no. 5, May 1930, pp. 275-278, 7 figs. Properties of copper drawing practice; copper alloys used in transmission work; tables showing comparative physical properties of steel and everdur; comparative properties of copper and copper alloys; comparison of beryllium alloys with copper-tin and copper-cadmium alloys; curves showing copper-beryllium alloys and strength and conductivity of 0.125 diam. wire of 0 to 1.6 per cent beryllium.

SPECIFICATIONS. Report of the Special Committee on Promotion of General Use of Specifications for Copper Alloys in Ingot Form. Am. Soc. Testing Matls.—Advance Paper No. 29, for mtg. June 23-27, 1930, 3 pp. Tabulation of specifications clearly developed fact that it is possible to greatly reduce number of alloys now used in industry; there are 40 different specifications for one of most widely used alloys of industry, namely, 85 per cent copper, 5 per cent tin, 5 per cent lead, and 5 per cent zinc; it is certain that these 40 specifications could be condensed into one.

COPPER-NICKEL INDUSTRY

ONTARIO. The Copper-Nickel Industry of Ontario, T. W. Gibson. Min. Jl. (Lond.), vol. 169, no. 4937, Apr. 5, 1930, p. 281. Large lenses of mixed pyrrhotite and chalcopyrite occurring at contact of norite and granite, or greenstone, in Sudbury area of Ontario, provide about 90 per cent of nickel requirements of world; ores contain about 3 per cent of nickel and 1.50 or 1.75 per cent of copper; appreciable quantities of gold, silver, and platinum metals; 1,476,604 short tons treated in 1928; two successful operating companies; brief historical review and development notes.

COPPER STEEL

PROPERTIES. Mechanical Properties of Copper-Bearing Steel with Special Regard to Heat Treatment (Ueber die mechanischen Eigenschaften kupferlegierter Staehle unter besonderer Breuecksichtigung der Waermebehandlung), F. Nehl. Stahl und Eisen (Duesseldorf), vol. 50, no. 20, May 15, 1930, pp. 678-686, 15 figs. Properties of copper steels; corrosion resistance; improvement in strength properties, especially yield point and heat resistance, by suitable heat treatment; dispersion hardening; use of copper steel as building material, for forgings, and for castings.

COPPER-ZINC MINES AND MINING

MANITOBA. "Manitoba Metal," R. H. Channing, Jr. Eng. and Min. Jl., vol. 120, no. 9, May 8, 1930, pp. 446-447, 4 figs. Summary description of property of Hudson Bay Mining & Smelting Co., in northern Manitoba; 18,000,000 tons proven ore, to be mined by underground and open pit methods; upon completion of hydro-electric power plant, production will be 3,000 tons of ore daily; flotation plant; roasting of zinc concentrate; electrolytic zinc plant; copper smelter; water supply. Abstract from company report.

COUPLINGS

FLEXIBLE. What's What in Flexible Couplings, F. A. Annett. Power, vol. 71, no. 19, May 13, 1930, pp. 742-744, 16 figs. Continued illustrated description of several types of flexible couplings.

CRANES

ALUMINUM-ALLOY. Crane Built of Strong Aluminum Alloy, F. V. Harman and E. F. Hartman. Iron Age, vol. 125, no. 23, June 5, 1930, pp. 1689-1690, 4 figs. Crane described is 3-motor, single-hook machine with lift of 22 ft.; bridge is fabricated from two double-web girders spaced 7 ft. on centres; girders are constructed of strong aluminum alloys and have span of 72 ft. 2 in.; aluminum was used also in walkway, handrails, and operator's cage; bridge girders frame into cast steel carriages at their end, and one-piece cast-steel trolley carrying hoisting mechanism is mounted on girder rails.

CUTTING TOOLS

TUNGSTEN CARBIDE. Tungsten Carbide Tools, R. D. Prosser. Am. Soc. Steel Treating—Trans., vol. 17, no. 6, June 1930, pp. 749-764, 12 figs. Great interest aroused by development of cemented tungsten carbide at Krupp Works has resulted in considerable discussion of freak or trick results obtainable with these tools; author confines himself principally to description of some of results being obtained in everyday actual production work; definite and practical advice as to methods of application, grinding, and use which should be employed to take full advantage of remarkable properties of these tools.

D

DAMS

ALGERIA. The Wad Fodda and Ghrib Dams. Extension of Port of Algiers (Barrages de l'Oued Fodda et du Ghrib. Les travaux d'extension du port d'Alger), Truffot. Annales des Ponts et Chaussées (Paris), no. 1, Jan.-Feb. 1930, pp. 41-64, 8 figs. Descriptive report based on notes made during trip of April 1929; Wad Fodda gravity concrete dam, 93 m. high, is located between Algiers and Oran; Ghrib rock-filled dam, 65 m. high, is located near Dolfusville; new construction in port of Algiers included over 3,000 m. of new piers and seawalls, up to 18 m. in height, made of precast concrete blocks.

DAMS, CONCRETE

CONSTRUCTION. Concreting Methods at the Chute à Caron Dam, I. E. Burks. Am. Concrete Inst.—Jl., vol. 1, no. 4, Feb. 1930, pp. 315-358, 34 figs. Description of methods used in construction of gravity concrete dam, 200 ft. high and 3,015 ft. long, on Saguenay river, about 80 miles above its mouth at St. Lawrence; prospecting for materials at 30 deg. below, under 4 ft. of snow; how materials were sampled, chosen, transported, heated and proportioned; how concrete was mixed, conveyed, deposited, protected; use of large aggregate with big gap in sizes to prevent raveling in stock piles and bins, harshness and segregation after mixing; stiff mix placed with vibrators.

DAMS, CONCRETE ARCH

CONSTRUCTION. Extensive Chuting Plant on a Large Dam, K. L. Parker. Contractors and Engrs. Monthly, vol. 20, no. 4, Apr. 1930, pp. 72-74, 2 figs. Report on construction of Chalaveras River concrete-arch dam, 1,500 ft. long, 160 ft. high, 40 mi. east of Stockton, Calif.; excavation; handling aggregate and cement; concrete chutes; electric power used; construction camp.

DIE CASTING

ALUMINUM ALLOYS FOR. Designing for Aluminum Die Castings, D. B. Hobbs. Product Eng., vol. 1, no. 2, Feb. 1930, pp. 60-62, 6 figs. Die-casting process consists in forcing molten metal under considerable pressure into steel dies; main characteristics of die castings, their extreme accuracy, uniformity, and superior finish are result of not only method by which castings are made but also fine art developed in die construction; fact that aluminum alloys have higher melting point than lead, tin, and zinc alloys required development of special alloy steel dies; general description of casting process.

DIESEL-ELECTRIC POWER PLANTS

COSTS. Report on Oil Engine Power Cost for 1929. Am. Soc. Mech. Engrs.—Advance paper, for Nat. Oil and Gas Power mtg., June 12-14, 1930, 21 pp. Report contains information covering 36 oil engine plants; tabular data covering lubricating oil, fuel oil, maintenace, and power cost.

DESIGN. Diesel Power-Plant Layouts, E. W. Hammond, Am. Soc. Mech. Engrs.—Advance Paper, for Nat. Oil and Gas Power mtg., June 12-14, 1930, 7 pp. Information applies to Diesel power plants in general; consideration of plant site, plant equipment, buildings and foundations, plant layout, cooling-water system, fuel-oil system, starting air supply, and auxiliaries.

QUEBEC. Oldest Commercial Canadian Plant Adds Large Stationary Diesel, G. H. Johnson. Elec. News (Toronto), vol. 39, no. 10, May 15, 1930, pp. 43-45, 3 figs. Pembroke Electric Light Co. have installed 1.250 hp. Diesel engine direct connected to 60 cycle generator to take care of short daily peak during late autumn and early winter months; with generator efficiency of 92½ per cent and when operating at or near full load, engine will produce slightly in excess of 13 kw.-hr. per Imperial gallon of fuel oil; fuel cost per kilowatt hour will run approximately 73 cents.

DIESEL ENGINES

COMPRESSORLESS. Compressorless Double-Acting Two-Cycle Diesel Engines of 12,000 hp. (Kompressorlose doppelwiekende Zweitakt-Dieselmotoren von 12,000 PS), W. Laudahn. V.D.I. Zeit. (Berlin), vol. 74, no. 15,, Apr. 19 1930, pp. 489-496, 19 figs. Description of operation, installation, and design of M.A.N. engines for Diesel-electric power plant; sketches show principal details.

COUPLINGS. Vulcan Gearing and Hydraulic Couplings. Mar. Engr. and Motorship Bldr. (Lond.), vol. 53, no. 632, May 1930, pp. 175-179, 10 figs. Flexible hydraulic clutch or coupling, originated by inventions of H. Foettinger, has extended in scope of its application by patents granted to Gustav Bauer; principle of hydraulic coupling and some practical and special installations.

HIGH-SPEED. Development of High-Speed Heavy Oil Engines (La Réalisation des moteurs; Rapides à Huile Lourde), E. Marcotte. Arts et Métiers (Paris), vol. 83, no. 113, Feb. 1930, pp. 33-47, 10 figs. Discussion of factors controlling design and performance; thermodynamics of different cycles; injection; pulverized fuel turbulence; volumetric efficiency; carburation possibilities; notes on Junkers and M.A.N. designs. Bibliography.

The Design of High-Speed Heavy-Oil Engines, Ricardo. Engineering (Lond.), vol. 129, no 3356, May 9, 1930, pp. 607-608. Editorial comment on paper read before Diesel Engine Users' Assn., previously indexed from Shipbldr., Apr. 1930; it may be doubted whether speeds much above present limit are practicable with engines of two conventional types; essential condition for high speed and details of Ricardo-Brotherhood type of engine; there appears to be no sound reason why engines of this airless-injection type should not successfully be applied to rail cars and even heavy commercial vehicles.

TESTING. Results of Tests on Diesel Engines of Peak-Load Plant in Henningsdorf (Ergebnisse von Versuchen an den Dieselmotoren des Spitzenkraftwerkes Hennigsdorf), W. Laudahn. V.D.I. Zeit (Berlin), vol 74, no. 18, May 3, 1930, pp. 570-575, 10 figs. Tests were carried out by Maschinenfabrik Augsburg-Nuernberg on compressorless double-acting two-stroke Diesel of 12,000 hp. built for Hennigsdorf Plant of Maerkischen Elektricitaetswerke; results are tabulated and critically analyzed.

VIBRATIONS. Calculation of Torsional Vibrations in Diesel-Engine Installations (Zur Berechnung von Dreshschwingungen bei Dieselmotorenanlagen), E. Goeller. V.D.I. Zeit. (Berlin), vol. 74, no. 16, Apr. 19, 1930, pp. 497-498, 6 figs. Development of two simplified formulae for calculating frequencies of systems, "engine—single mass" and "engine—two single masses"; graphs show relations of variables; numerical example.

E

ECONOMIZERS

VALUE OF. The Economizer in Boiler Installations, G. E. Tansley. Iron and Coal Trades Rev. (Lond.), vol. 120, no. 3244, May 2, 1930, p. 721. Value of economizer as investment; tabular comparison of ordinary investment of 2,000 pounds sterling and investment of same amount in steam economizer; boiler outlet-gas temperatures and gas velocities; economizer in relation to boiler pressure. Abstract of paper read before North of England Inst. of Min. and Mech. Engrs.

ELECTRIC CABLES

FAULT LOCATION. Making Bridge Measurements with Voltage, F. E. Reeves. Elec. World, vol. 95, no. 19, May 10, 1930, p. 928. Boston Edison Co. has made successful bridge measurements using kenotron sets on several faults, two of which were made at about 30,000 volts with intermittent fault current; greatest error was 512 ft. in cable whose total length was 27,270 ft.

LEAD SHEATHING. Flow Characteristics of Some Lead Cable Sheath at Temperatures Above Atmospheric, C. L. Clark, and C. Upthegrove. Am. Soc. Mech. Engrs.—Advance Paper for mtg., no. 1, June 9 to 12, 1930, 5 pp., 10 figs. Investigation on three types of lead sheath differing only in antimony content, respectively, 0.06, 0.6, and 1.2 per cent; at room temperature compositions elongated at more or less fixed rates with loads as low as 245 lbs. per sq. in.; increasing antimony content not results in decrease in rate of flow at lower temperatures but in lowered resistance to creep; at temperature of 80 to 120 deg. cent. higher antimony contents result in decrease in rate of creep.

RUBBER INSULATED. Relations of D.C. and A.C. High- and Low-Voltage Measurements on Rubber Cable, C. L. Kasson. Am. Inst. Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 5 pp., 12 figs. Results and comparison of d.c. and a.c. measurements on 10,000-volt rubber insulated lead-covered cable at room temperatures; results confirm and extend those already presented by author before American Institute of Electrical Engineers in paper, High Voltage Measurements on Cables and Insulators; and those in paper entitled D.C. High and Low Voltage Measurements on Cables and Insulators.

UNDERGROUND—TEMPERATURE. The Calculation of Cable Temperatures in Subway Ducts, W. B. Kirke. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 13 pp., 14 figs. Comprehensive survey of problem of cable temperatures by consolidating information on cable temperature characteristics with equally important problem of ascertaining characteristics of duct structure when cable circuits are subjected to cycle loads usually found in practice; information herein presented to subject of duct bank temperatures is result of investigation in metropolitan New York district which was carried on for several years under widely varying conditions.

ELECTRIC CAPACITORS

PHASE DEFECT ANGLE. Phase Defect Angle of an Air Capacitor, W. B. Kouwehnoven and C. L. Lemmon. Am. Inst. of Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 7 pp., 4 figs. Investigation to determine conditions of atmosphere under which air capacitor may be regarded as having zero loss; measurements were made of effect of humidity at temperatures from 60 deg. fahr. to 100 deg. fahr. humidity varied from 40 to 95 per cent approximately; conduction was zero and phase defect angle of air capacitor was less than three seconds for values of humidity below 90 per cent; effect of introduction of ions and dust particles into condenser chamber.

ELECTRIC CIRCUIT BREAKERS

OIL. New Development in British Switchgear. Elecn. (Lond.), vol. 104, no. 2711, May 16, 1930, pp 608-610, 3 figs. Oil circuit breakers of high rupturing capacity; short-circuit tests; tank and top plate; operating mechanism; contacts and bushings; venting and insulation; tables of short-circuit tests at 13,200 volts and 600 amp. and oscillograms tests are given.

ELECTRIC CONDENSERS

DISCHARGE. Successive Unidirectional Condenser Discharge, S. Sano. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 5, May 1930, pp. 370-373, 9 figs. Phenomenon of successive unidirectional discharges of condenser across gap placed between its terminals, when condenser is connected in series with inductance having such constant that resonance occurs in system when supplied with alternating e.m.f., is described; application of system as generator of successive unidirectional voltage impulses is discussed.

ELECTRIC CONDUITS

UNDERGROUND. Underground Conduits Connects Superpower System, J. E. Gruner. Elec. Light and Power, vol. 8, no. 3, Mar. 1930, pp. 38-41, 9 figs. Transmission lines are being constructed which, together with existing lines, will form complete loop connecting three steam generating plants and two water-power plants operated by Union Electric Light and Power Co. and its subsidiaries; 66-kv. two-circuit underground transmission lines described, constructed across city of St. Louis, will form part of this superpower ring.

ELECTRIC EQUIPMENT

VOLTAGE. Preferred Voltage Ratings for A.C. Systems and Equipment. Nat. Elec. Light Assn.—Pub., no. 043, Apr. 1930, 13 pp. Tables included are preferred voltage ratings for a.c. systems and equipment as agreed upon by Joint Committee of National Electrical Manufacturers Association and National Electric Light Association; notes on application of tables, historical summary, basic principles, committee personnel, tables of preferred voltage ratings and Report of NEMA-NELA Joint Committee on preferred voltage ratings for a.c. systems and equipment.

ELECTRIC FURNACES

ARC. Industrial Electric Heating, N. R. Stansel. Gen. Elec. Rev., vol. 33, no. 5, May 1930, pp. 316-322, 14 figs. Characteristic curves of furnace circuit; diagrams of connections and typical three-phase transformer design; characteristic curves of standard reactors.

Heat-Treating. Electric and Fuel Costs for Four Heat-Treating Installations, W. S. Scott. Elec. World, vol. 95, no. 20, May 17, 1930, pp. 996-997. Comparative heat-treating costs for hardening and tempering of axes, automobile axles, shovels, and hardening of ball bearing races.

Melting. Electric Melting Improves Quality and Cuts Cost. Elec. World, vol. 95, no. 19, May 10, 1930, pp. 948-949, 1 fig. First vertical-ring induction furnace for melting nickel-silver in Naugatuck Valley went into service year ago; results obtained have been so satisfactory as to improved quality of alloy and melting costs that four furnaces are now in operation and five more have been purchased; lining life has increased from 400 heats to more than 800 heats, or about 500,000 lbs. per lining; on this basis cost for lining is $1.40 per ton and is not likely $2 per ton of metal poured.

ELECTRIC GENERATORS

Shaft Straightening. Straightening a 15-Ton Shaft Without Shop Facilities, G. E. Decker and C. G. Heckman. Elec. West, vol. 64, no. 5, May 1, 1930, pp. 240-242, 4 figs. Field methods and equipment effectively reduce 0.021-in. curvature in 35-ft. vertical generator shaft; problem arose when 28,000-kv. vertical unit at Big Creek No. 3 hydro-electric generating plant of Southern California Edison Co. developed vibration which requires its removal from service.

Alternating Current. Reduction of Eddy Current Losses by the Inverted Turn Transposition and the Twisted Lead Transposition, J. M. Lyons. Am. Inst. of Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 13 pp., 19 figs. Theory underlying determination of extra copper lcsses in armature windings carrying alternating currents; extension of study of inverted turn transposition to special case of three-phase windings having two phases connected in series to form single-phase winding and third phase left idle; formulae and tables to show what reductions in copper losses may be expected; formulae and tables.

The Calculation of Alternator Swing Curves. The Step-by-Step Method, F. R. Longley. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 22 pp., 19 figs. Explanation of step-by-step calculations of synchronous rotor oscillations and other transients, when faults or other sudden changes take place; general formulae for calculations where any number of salient or non-salient pole machines are operating at various points on impedance network; simplified example; numerical calculations of swing curve. Bibliography.

Assembly. Record Unit Assembled Under Difficulties at Southern California Hydro Plant, J. P. Stratford. Elec. West, vol. 64, no. 3, Mar. 1, 1930, pp. 136-137, 3 figs. Assembly of 25,000 kva. unit in San Francisquito power plant No. 1 is described; shaft has maximum diameter of 38 in. and weighs 40.5 tons, while cast steel rotor spider has outside diameter of 208¾ ins. and weighs 74.7 tons; to expand rotor hub to permit insertion of shaft it was necessary to raise temperature of rotor to 125 deg. cent.; three means of heating were employed, magnetic induction, hot air and radiation.

Direct Current. Voltage Irregularities in D.C. Generators, J. T. Fetsch. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 17 pp., 40 figs. Description of irregularities, cause of their occurrence, magnitude of their values, their effect on radio circuits, and problem encountered in their measurement; method for measurement of these voltage irregularities by use of oscillograph, blocking condenser, and current transformer; oscillograph records taken under various electrical and mechanical conditions are given and these records are made; conclusions as to features desirable in d.c. generators.

Speed Measurement. Determination of Generator Speed and Retardation During Loss Measurements, O. E. Charlton and W. D. Ketchum. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 6 pp., 7 figs. Instrument developed to make graphic records of generator revolutions and time as generator slows down under action of its losses during retardation tests; construction of speed-time curves from records; principle of numerical differentiation and its application to determination of slope of speed-time curve is pointed out; example illustrating application of this principle is included in paper. Bibliography.

ELECTRIC LIGHT AND LIGHTING

Modern Tendencies. Modern Tendencies in Illumination, W. Cary. Elec. Jl., vol. 27, no. 3, Mar. 1930, pp. 131-135, 7 figs. Illumination as discerned from early use of electric lamps is discussed; possibilities of electric incandescent lamp in all its forms and obligations are given; notes on automatic control of lighting; colour; dividends from lighting; highway lighting awaits state legislation; good street lighting at $2.50 per capita; airport lighting; windowless building; aesthetic lighting; ultra-violet light; electric eye; illumination engineering.

ELECTRIC LINES

Towers. A New Transmission Line Construction. Post Type Towers, P. H. Thomas. Am. Inst. Elec. Engrs.—Advance Paper for mtg. May 7-10, 1930, 6 pp., 7 figs. Construction to secure sturdy and simple tower, not sensitive to irregularities in footing conditions; generally applicable where horizontal arrangement of conductors is feasible; wide base structure secured has substantially no resultant uplift on footings offering large saving in foundation costs; this together with lesser material and erecting costs and ease with which it is adapted to varying ground conditions make it very economical type of tower.

ELECTRIC LINES, HIGH TENSION

Overhead. Electric Transmission Lines (Om Kraftoverforinger), J. C. Holst. Fjarde Nordiska Elektroteknikermotet—Foredrag I (Helsingfors), 1929, pp.67-81, 19 figs. Construction of overhead electric transmission lines, mostly 60 kv. and larger, is discussed; design of poles; materials employed; line connectors, insulators, snow load, sag, protection against corrosion, construction of lines and machinery employed. Paper read at Fourth Northern Congress for Electrotechnic in Finland, June 1929.

Studies in. Transmission Research and Design with the Field as a Laboratory, F. E. Andrews and C. L. Stroup. An. Inst. Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 10 pp., 9 figs. Improvements in design of wood-pole lines of 33,000-volt class, have been developed and applied and which, it is believed, will greatly reduce characteristic troubles; explanation of flashovers on wood structures; facts found in field investigations which form basis for improvements adopted, and method used fo field investigations and analysis of troubles; studies and investigations given in reference, deal primarily with matter of insulation. Bibliography.

Circle Diagrams. A Proof that the Induction Motor Circle Diagram Applies to the Transmission Line, F. Creedy. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 5, May 1930, pp. 381-385, 5 figs. It is shown that circle diagram for induction motor, is in reality applicable to general network, however complicated, and therefore to transmission line; double-frequency power diagram is criticized as needlessly complicated and constructions applied to all quantities of interest in transmission line. Bibliography.

Grounding. Arcing Grounds and Effect of Neutral Grounding Impedance, J. E. Clem. Am. Inst. of Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 19 pp., 21 figs. Review and extension of theory of overvoltages due to arcing grounds because of increasing tendency to use impedances between neutral point and ground; analysis for three-phase circuit is newly developed for case in which there is impedance between neutral and ground; method of determining various reductions or damping factors; relation of overvoltages on non-grounded and effectively grounded system; criterion for determining whether or not system is grounded is proposed. Bibliography.

Protection. Calculation of Protection of a Transmission Line by Ground Conductors, H. B. Dwight. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 5, May 1930, pp. 354-357, 6 figs. Calculation of degree of protection afforded by ground conductors on assumption of sudden disappearance of vertical potential gradient caused by charged cloud; formulae are given for protective ratio due to one and two ground conductors; it is shown that for any number of ground conductors, it is not necessary to compute charges on power conductors.

Fused Grading Shields, H. A. Frey and E. M. Skipper. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 5, May 1930, pp. 393-396, 5 figs. Fused grading shield was developed primarily to reduce number of outages due to insulator flashovers on transmission lines; fused grading shields in later practice lines provides means of obtaining reduced insulation without increasing outages; laboratory and field data showing characteristics of device and results of several years of operating experience.

ELECTRIC MACHINERY, SYNCHRONOUS

Hunting. Effect of Armature Resistance Upon Hunting of Synchronous Machines, C. F. Wagner. Am. Inst. of Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 14 pp., 13 figs. New proof is given for relation previously derived by Nickle and Pierce whicb states that macbine without amortisseur windings is stable for certain operating angles; arguments are presented which sbow that any standard type of damper installed in generators for other incidental reasons, possesses property of preventing spontaneous hunting except for most abnormal conditions met in practice. Bibliography.

ELECTRIC MOTORS, INDUCTION

Performance. Synchronous Motor Effects in Induction Machines, E. E. Dreese. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 8 pp., 14 figs. It is found that certain combination of phases, rotor slots, and poles cause motor to run as synchronous motor at some intermediate speed between zero and normal no-load induction motor speed; this synchronous motor effect in induction machines is shown to be due to locking of harmonic fields, generated by rotor windings; method of avoiding tbis trouble by proper selection of number of rotor slots is given.

ELECTRIC NETWORKS

Analyzers. The M.I.T. Network Analyzer—Design and Application to Power System Problems, H. L. Hazen, O. R. Schurig and M. F. Gardner. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 12 pp., 6 figs. Analyzer, a static miniature a.c. power system, constructed jointly by Massachusetts Institute of Technology and General Electric Co. for computation of actual power networks is described and its operation outlined; fields of its application include study of normal operating conditions, stability, and short circuits; example illustrating its application to solution of normal operation problem is given. Bibliograpby.

ELECTRIC RECTIFIERS

Mercury Arc. Mercury Arc Rectifiers Meet Transportation Demands, C. E. Baker. Elec. Ry. Jl., vol. 74, no. 6, June 1930, pp. 311-314, 4 figs. Development in design and manufacture have made possible construction of rectifiers of large ratings and high voltages; these machines are now suitable for installations where synchronous converters previously were considered necessary; air-tight seals essential to operation; many large rectifier installations made.

ELECTRIC RESISTORS

Shunt. Shunt Resistors for Reactors, F. H. Kierstead, H. L. Rorden and L. V. Bewley. Am. Inst. of Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 17 pp., 27 figs. Effect of resistors shunting current-limiting reactors on impulse behaviour of typical system employing them; typical system is reduced, without loss of essential generality, to comparatively simple analytic network, and impulse behaviour of this network is calculated mathematically; through use of shunting resistor some beneficial results are obtained. Bibliography.

ELECTRIC TRANSFORMERS

Design. Effect of Transient Voltage on Power Transformer Design, K. K. Palueff. Am. Inst. Elec. Engrs.—Advance Paper for mtg., May 7 to 10, 1930, 12 pp., 19 figs. Results of theoretical and oscillographic study of transient voltage phenomena in shell type and core type transformers with neutral isolated from ground, also with neutral grounded through impedances of different characteristics; grounding device, called impedor, can be designed to have impedance at operating frequency equal to any desired value and to act at transient voltage frequencies as if its impedance were practically zero. Bibliography.

Windings. Transformer Ratio and Differential Leakage of Distributed Windings, R. E. Hellmund and C. G. Veinott. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. May 7 to 10, 1930, 10 pp., 14 figs. Paper develops in as simple manner as possible necessity for concept of differential leakage wbere transformer action takes place between two equally distributed windings and transformer ratio in case of such unequally distributed windings is also given. Bibliograpby.

Transformer Ratio and Differential Leakage of Distributed Windings, R. E. Hellmund and C. G. Veinott. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 6, June 1930, pp. 474-478, 9 figs. Paper previously indexed from Advance Paper, for mtg. May 7 to 10, 1930.

ELECTRIC WELDING

Flash Welding Machines. New Heavy-Duty Flash Welding Machines. AEG Progress (Berlin), vol. 6, no. 3, Mar. 1930, pp. 98-100, 3 figs. Invention about 15 years ago of flash butt-welding process opened way to welding of objects of fairly large cross-sections economically by agency of electricity; from this time onwards, electric process commenced to force forge-welding method entirely into background; flash butt-welding machinery and table of results of strength testing.

ENAMELING PLANTS

Ontario. They Can Make Anything in Enameled Ware. Ceramic Industry, vol. 14, no. 4, Apr. 1930, pp. 432-434, 436, 438, 440 and 442, 21 figs. Plant design, equipment and operation of General Steel Wares, Ltd., at London, Ont.

ENGINEERING

Canada. Canadian Development and the Engineer. C. H. Mitchell. Can. Engr. (Toronto), vol. 58, no. 18, May 6, 1930, pp. 557-558. Engineering development in Canada during past 50 years discussed in report presented at Fiftieth Anniversary of American Society of Mechanical Engineers, Washington, D.C.; valuable natural resources only partially developed; land and water transportation.

ENGINEERING EDUCATION

Specialization. Specialized Education and Its Vices, D. B. Keyes. Scientific Monthly, June 1930, pp. 538-540. Author argues that broad training in fundamental sciences is far superior to premature specialization for boy wbo wishes to do industrial research.

ENGINEERING RESEARCH

Technique and. The Influence of Technique on Research, F. A. Freeth. Engineering (Lond.), vol. 129, no. 3357, May 16, 1930, pp. 640-641; see also Engineer (Lond.), vol. 149, no. 3879, May 16, 1930, pp. 541-542. Number of maxims are laid down which have been means of stimulating discovery in past; examination of importance of technique to those engaged in study of metals. Abstract of paper read before Inst. of Metals.

F

FLOORS, GYPSUM

APPLICATION. Use Pre-cast Gypsum Floors and Ceilings in New York. Am. Contractor, vol. 51, no. 17, Apr. 26, 1930, pp. 13-15, 2 figs. Manner of applying precast gypsum slabs for floor and ceiling construction in nineteen-storey New York apartment house building; considerable saving and early completion date because material could be used in extremely cold weather, with little or no winter protection.

FLOORS

RUBBER COVERINGS. Rubber Floor Coverings Compared to Other Floor Coverings (Gummifussboden im Vergleich mit anderen Fussbodenarten), F. J. Schoeps. Gummi-Zeitung (Berlin), vol. 44, no. 20, Feb. 14, 1930, pp. 1044-1046. Advantages of rubber floor coverings are, their sound-damping and heat-insulating properties; disadvantage is high price; table is given showing comparison of different floor materials for gymnasiums and their adaptability viewed from twelve different aspects.

FLOW OF WATER

MEASUREMENT. Comparative Water-Discharge Measurements of the Walchensee Hydro-electric Plants (Vergleichs-Wassermessungen am Walchenseewerk). O. Kirschmer. V.D.I. Zeit. (Berlin), vol. 74, no. 17, Apr. 26, 1930, pp. 521-528, 19 figs. Report on results of comparative determination of discharge of penstock, 2.25 m. in diameter, by means of following methods and instruments: (1) Allen salt-velocity method, (2) Ott current meter, (3) Pilot tube of British make, and (4) the Gibson time-pressure method; discharge ranged from 2.5 to 8.2 cu. m. per sec.; results show considerable discrepancies and indicate reliability of current meters of propeller type.

FORGINGS

STEEL. Snow Flakes in Alloy Steel Forgings, H. H. Ashdown. Iron Age, vol. 125, no. 19, May 8, 1930, pp. 1380-1381 and 1429, 3 figs. Description of "snow flake" phenomenon occurring mostly in nickel-chrome alloys, including those containing molybdenum and occasionally in tool-steel forgings in large section; origin is in ingot and mass action ultimate cause; heat treatment will not cure it.

FORMING MACHINES

ROTARY. Rotary Forming, C. V. Lundeen. Am. Mach., vol. 72, no. 23, June 5, 1930, pp. 912-913, 4 figs. Description of design and operation of forming machines at Hawthorne plant of Western Electric Co.; in forming small parts of many designs, roller method has advantages over punch press; output from 18,000 to 43,200 per hour.

FUELS

OIL. *See Oil Fuel.*
PULVERIZED COAL. *See Pulverized Coal.*

G

GAUGES

TAPER. Checking a Taper Gauge. Machy. (Lond.), vol. 36, no. 920, May 29, 1930, p. 263, 2 figs. Description of method of checking angle and diameter of tapered discs; master taper gauge with setting discs in place for checking working gauges of male bevel-side taper type.

GALVANIZING

HOT. Bending Resistance of Hot Sheet Galvanizing (Biegefaehigkeit von Zink-Ueberzuegen), H. Bablik. Zeit. fuer Metallkunde (Berlin), vol. 22, no. 5, May 1930, pp. 171-173, 10 figs. This process is assurance against corrosion only when coating is non-porous and when it does not break under bending stress; based on tests, author seeks to show that, it is not thickness of whole coating, but presence or thickness of iron-zinc layer that has influence on bending strength.

GAS ENGINES

INDUSTRIAL POWER PLANTS. The World's Biggest Gas Engines. Power, vol. 71, no. 19, May 13, 1930, pp. 736-738, 5 figs. Illinois Steel Company has added to gas-electric power plant two 6,600-kw. units operating at 83⅓ r.p.m. on blast furnace gas; physical dimensions and weights of gas-electric units are given.

GEARS

BURNISHING. Three Master Gears Employed for Burnishing Pinions, C. H. Logue and C. O. Hersam. Automotive Industries, vol. 62, no. 19, May 10, 1930, pp. 722-723 and 737, 4 figs. Description of new process and machine built by Hersam and Sherwood, Philadelphia, Pa., in which pinion is constrained to definite relation with its apex point, but it is left free otherwise to move and finds its own natural operating position; 60 to 90 pinions may be burnished; burnishing gears is expected to produce about 20,000 pinions before replacement.
TOOTH MEASUREMENT. Constant Chord Gauging, W. A. J. Chapman. Am. Mach., vol. 72, no. 19, May 8, 1930, pp. 753-754, 3 figs. Constant-chord method differs from means of tooth measurement now in use solely in computations involved; substitution of constant for variable measurements of gears; since pitch and pressure angle are uniform in set or train of gears, whereas tooth number usually differs, measurements are greatly simplified by possibility of using constant dimensions for chordal length and depth.

GOLD DEPOSITS

ALASKA. The Gold Resources of Alaska, P. S. Smith. Economic Geology, vol. 25, no. 2, Mar.-Apr. 1930, pp. 176-196, 3 figs. Brief historical note of gold mining in Alaska; tabular production statistics of placer gold and lode gold, 1880 to 1929, total value $380,838,000; general description of placer gold deposits; reserves estimated as $360,000,000 or more; general features of lode gold deposits; facts are not available for estimate of lode gold reserves, but it is considered quite possible that reserve of lode gold far exceeds that of placers; tabular summaries of principal placer and lode regions and districts of Alaska. Bibliography.

GRINDING MACHINES

GEAR. Grinding Helical Gears. Automobile Engr. (Lond.), vol. 20, no. 267, May 1930, pp. 184-185, 3 figs. Description of design and operation of a new machine particularly for automobile work built by Maag Gear Co. Ltd., Zurich; special feature is means for setting wheel heads over desired spiral angle with simple method of imparting additional rolling motion to gear to follow spiral.
PNEUMATIC. New Air Grinder for Use in Diemaking. Machy. (Lond.), vol. 36, no 916, May 1, 1930, pp. 133-134, 5 figs. Description of design and use of tool built by Madison-Kipp Corp., in United States; capable of finishing irregularly curved surfaces in die-casting dies rapidly, and also for touching up such surfaces to correct any distortion produced in hardening; simple speeds in excess of 40,000 r.p.m. obtainable for grinding wheels of very small sizes.

H

HEAT INSULATION

LAWS, APPLICATION OF. Heat Insulation, A. B. Winterbottom. Instn. Mech. Engr.—Prod. (Lond.), no. 5, Dec. 1929, pp. 1075-1086, 2 figs. Paper is devoted first to laws which govern flow of heat through insulation, and their application, and second, to survey of practical requirements, and of types of insulation developed to meet them.

HEAT-TRANSMISSION

SURFACE. Surfaces Conductances as Affected by Air Velocity, Temperature, and Character of Surface, F. B. Rowley, A. B. Algren, and J. L. Blackshaw. Heat Piping and Air Conditioning, vol. 2, no. 6, June 1930, pp. 501-508, 22 figs. Investigation is part of cooperative research programme between American Society of Heating and Ventilating Engineers and University of Minnesota; object is to determine effect of air velocity, temperature, and surface characteristics on heat transmission from surfaces; apparatus and method of testing; graphical representation of results for various types of surfaces. Presented before Am. Soc. of Heat and Vent. Engrs.

HEATING AND VENTILATION

BUILDINGS. Analysis of Heat Required for Buildings, X. Y. Zero. Blast Furnace and Steel Plant, vol. 18, no. 5, May 1930, pp. 797-801. Concise explanation of procedure for determining amount of heat which must be supplied to maintain building at desired temperature; estimating size of rooms, glass, doors, and pipes, carpenters rule; effect of paint; cost.

HIGH BUILDINGS

CONSTRUCTION. Building a 71-Storey Skyscraper in 33 Weeks. Eng. News-Rec., vol. 104, no. 20, May 15, 1930, pp. 800-803, 5 figs. Construction speed on Manhattan Company building in New York accomplished by extensive organization of job and coordinating subcontractors; materials expedited from source to job; steel shipped from five shops to meet schedule; general construction schedule; steel schedule.

HOISTS

BRAKES FOR. Centrifugal Brakes, A. W. Knight. Mech. World (Manchester), vol. 87, no. 2261, May 2, 1930, pp. 410-413, 3 figs. Design and calculation of new types of centrifugal brakes suitable for controlling lowering speeds of electric lifting gears; example of brake for 20-ton electric crab is followed through.

HYDRAULIC MACHINERY

SPECIFIC SPEED. Specific Speed and Other Characteristics of Hydraulic Turbines, Centrifugal Pumps, Windmills, and Propellers as Dimensionless Characteristics of Physics of Similitude (Die spezifischen Drehzahlen und die anderen Kenngroessen der Wasserturbinen, etc.), M. Weber. Schiffbau (Berlin), vol. 31, nos. 4 and 7, Feb. 19, 1930, pp. 73-80, Apr. 2, 156-161, 11 figs. Feb. 19: Principles governing specific speed; law of similitude as applied to derivation of dimensionless specific speed and other values. Apr. 2: Derivation of dimensionless characteristics and their relations to one another for this type of machinery and related flow problems.

HYDRO-ELECTRIC POWER DEVELOPMENTS

ALABAMA. Lower Tallassee Development, F. E. Hale. Elec. Light and Power, vol. 8, no. 5, May 1930, pp. 39-41, 6 figs. New Lower Tallassee development was made possible because of arrangements made between Alabama Power Co. and Mt. Vernon-Woodberry Mills Co. which built dam about 25 ft. high at upper edge of falls and power house at lower end; power generation in new plant is accomplished by two 29,000 kva. 100 r.p.m. and one 10,000 kva., 3-phase, 180 r.p.m. generators supplying power at 13,800 volts to main transformer bank.
BRITISH COLUMBIA. B.C. Power Corpn. Has Contributed Vastly to Provincial Prosperity. Elec. News, vol. 39, no. 8, Apr. 15, 1930, pp. 77-82. 10 figs. In 1928 British Columbia Power Corp. was formed to take over operation and control of B.C.E.R. Company and all its subsidiary interests; British Columbia in common with rest of Pacific Coast suffered from shortage of water in December 1929; by organizing some 14 private generating plants in lumber mills and elsewhere, B.C. Electric Railway Co. was able to get past emergency with minimum amount of inconvenience; notes on remote possibility of future shortage, Ruskin development, Bridge river development, transportation, cheap fares and motor coaches.

British Columbia's Water Powers, J. T. Johnston. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, pp. 72-76, 6 figs. Water-power resources of British Columbia are estimated at 1,930,000 hp. minimum and 5,100,000 for six months; large proportion of power resources of this province are of high head variety; 560,000 hp. developed and 4,500,000 hp. undeveloped.

Northern B.C. Power Company. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, p. 92, 1 fig. Making plans for growing power needs of Stewart and Prince Rupert, B.C.; to meet growing needs of Prince Rupert, Northern B.C. Power Co. has decided to develop Falls river and transmit power to Prince Rupert over 45-mi. 66 kv. transmission line; proposed development which will have initial head of 194 ft. and ultimate of 252 ft. takes advantage of natural fall of some 160 ft. in Falls and Ecstall river; 32,000 hp. capacity available.

Powell River Company, J. A. Lundie. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, pp. 99-102, 6 figs. Notes on development on Powell River, penstocks, paper machines. harbour and townsite, grinders, Lois River development, temporary and permanent dam and foot wood stave pipe lines; $8,000,000 extension programme now under way for Pacific Coast's largest newsprint mill; to harness 44,000 hp. in new development at Lois River.
CANADA. Hydro-electric Development in Canada. Elec. Rev. (Lond.), vol. 106, no. 2735, Apr. 25, 1930, pp. 801-802. Total capacity of new installations brought into operation during year amounted to 378,400 hp.: expenditure in building construction in Canada in 1929 outlay involving probably more than $75,000,000, not less than $320,000,000 will be required to complete plans for next three years.

HYDRO-ELECTRIC POWER PLANTS

BRITISH COLUMBIA. Automatic Hydro-electric Plant Proves Its Economies C. W. Colvin. Elec. West, vol. 64, no. 3, Mar. 1, 1930, pp. 128-129. More than year of satisfactory operation of 10,000-kva. fully automatic Alouette hydro-electric generating plant has convinced British Columbia Electric Railway Co. that added expense incurred in providing additional equipment required for fully automatic operation was more than justified.

Big Developments by the West Kootenay Power and Light Co. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, pp. 83-88, 10 figs. Large hydro-electric plants and numerous other sites adjacent to British Columbia's mining districts; among other projects; 300,000 hp. to be developed on Pend d'Oreille River; plant operates under average head of 70 ft. and contains two I.P. Morris 60-in. vertical, Francis turbines; 8,000 hp. at 180 r.p.m.; two Allis-Chalmers, Francis, 65-in. turbines, each 180 r.p.m., 9,000 hp.; totaling 34,000 hp.; generators are four C.G.E. 7,500-kva., 2,200 volt. three-phase 60-cycle machines.

The Rapid Expansion of East Kootenay Power Company's System, G. E. Elkington. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, pp. 89-91, 5 figs. Expansion is due chiefly to rich metal ores in Kimberly district and large coal deposits around Crow's Nest pass in Southern British Columbia; notes on system and equipment; maps of transmission system; data regarding sentinel steam plant; total output of plant will be available for 7 months in year, and for remaining 5 months, two-thirds of this will be available in average years; when development is completed company will have available 37,000 kw. of hydro power and 10,000 kw. steam power.

Ice Control. Ice Problems in Power Development, J. Murphy. Can. Engr. (Lond.), vol. 58, no. 21, May 27, 1930, pp. 607-611. Abstract of paper presented at World Power Conference, Tokyo; frazil ice and its formation; employment of electrical heating apparatus at power house screens.

HYDROMETALLURGY

Electrolysis. Status of Electrolysis as a Metallurgical Process, T. H. Donahue. Am. Electrochem. Soc.—Advance Paper, no. 57-20, for mtg. May 29-31, 1930, pp. 213-232. Brief review of status of copper, zinc, lead, cadmium, silver, bismuth and nickel; difficulties of present electrolytic processes are examined; importance of precious metal by-products is emphasized; improvements in process and possible introduction of new methods are discussed; many novel industrial applications of electrolytic methods to above and to other metals are suggested.

I

INDUSTRIAL MANAGEMENT

Production Control. Production Planning in Stamping Plants, J. W. Hallock. Metal Stampings, vol. 3, no. 5, May 1930, pp 423-426 and 470. Economies of die, tool, jig, and fixture practice, factors to be considered and equations for solution of problems involving fixture costs.

See also Airplanes.

Small Plants. Management of the Small Manufacturing Plant: Its Characteristics and Advantages, C. Field. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. June 9 to 12, 1930, 7 pp., 1 fig. Having ascertained that small plants greatly predominate, paper suggests two reasons: differences of plants in each of their activities are evaluated, and form composite figure having great influence on plant's chances of success; in discussing personnel, relative versatility is stressed, also advantage enjoyed by small plant in having higher incentive of part ownership for higher executive and immediate interrelation between effort and resulting bonuses among subordinate keymen. Bibliography.

INSPECTION

Optical Instruments for. Optical Aids to Engineering Inspection, A. F. C. Pollard. Inspection (Lond.), vol. 1, no. 2, Apr. 1930, pp. 79-102 and (discussion) pp. 103-113, 30 figs. Various types of optical instruments of use in inspection of manufactured products are described and their use is discussed.

INTERNAL-COMBUSTION ENGINES

Exhaust From. The Final State of a Gas Discharged from a Reservoir into a Space under Constant Pressure, F. Modugno. Shipbldr. (Lond.), vol. 37, no. 238, Apr. 1930, pp. 475-476; see also Shipbldg. and Shipg. Rec. (Lond.), vol. 35, no. 16, Apr. 17, 1930, p. 501. Mathematical investigation based on laws of adiabatic expansion, of changes which occur in physical constants, such as pressure volume and temperature of gas discharged from one vessel into another, based on assumption that pressure in second vessel remains constant. Paper presented before Instn. Naval Architects, Apr. 1930.

Inertia Forces in. Inertia Forces in Reciprocating Engines, V. Jensen. Mar. Engr. and Motorship Bldr. (Lond.), vol. 53, no. 632, May 1930, pp. 189-190, 2 figs. For exact calculation of well-designed and proportioned connecting-rod bolts, it is necessary to determine inertia forces in reciprocating parts of engine; simple graphical method for calculation of these forces is explained.

Supercharging Compressors. New Compressor of High Output (Un nouveau compresseur volumétrique à grand débit), R. C. Faroux. Vie Automobile (Paris), vol. 26, no. 942, Mar. 25, 1930, pp. 117-119, 4 figs. Brief review of various systems of compressors; description of design and performance of P.Z. volumetric type; calculations for example of 20 litres output at 2,000 r.p.m., weighing 22 kg.; with regard to supercharging advantages.

(*See also Airplane Engines; Diesel Engines; Gas Engines; Oil Engines.*)

L

LIGHTNING ARRESTERS

Hydro-electric Systems. Lightning Arresters on Hydro-electric Systems, G. C. Dill. Elec. Jl., vol. 27, no. 5, May, 1930, pp. 287-289, 8 figs. Speed and voltage curves when load on 220-kv. system is suddenly disconnected; upper curve shows voltage rise with constant flux linkages on generator field; dotted curve shows how voltage rise is limited by opening main field breaker at end of 0.2 seconds; arresters should be protected from over-voltage during generator over-speed.

LIGHTNING RESEARCH

Measurement. Measuring the Effects of Actual Lightning Surges on Transmission Lines, C. L. Fortescue. Elec. Jl., vol. 27, no. 3, Mar. 1930, pp. 161-167, 14 figs. Results of tests made on 5-mi. line between Rankin and Wilmerding, Pa., with Dufour-type cathode-ray oscillograph and small 50-kv. surge generator on 66-kv. transmission line between Pittsfield and Turner Falls using stationary Dufour oscillograph and portable surge generator of 400,000 volts, and on 220-kv. Roseland-Bushkill line of Public Service Electric & Gas Co. in New Jersey; tests of arrangements, oscillographs and curves, and analysis of tests. (Concluded.)

LITHIUM DEPOSITS

Manitoba. Tin, Lithium and Beryllium Deposits of Southeast Manitoba, J. F. Wright, Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 22, May 30, 1930, pp. 514-517, 4 figs. Tin, lithium and beryllium deposits attracting most attention are in that part of Oiseau River area along Winnipeg River east of Pointe de Bois and North to Shatford and Bernic lakes; general geology; general features of pegmatites; tin deposits; lithium deposits; beryllium deposits; summary of economic features; some of pegmatites of district may be in demand in future as source of feldspar.

LOCOMOTIVES

Alloy Steels for. Alloy Steels for Locomotive Construction, W. A. Johnson. Instn. Mech. Engrs.—Proc. (Lond.), no. 5, Dec. 1929, pp. 1087-1097, 1 fig. Alloy steels are particularly susceptible to heat treatment and wide range of properties is possible with given composition; drilling of forgings offers advantages; savings in weight are possible by more extensive adoption of steel of high tensile strength; it is shown that in case of locomotive considered, this amounts to 4 tons approximately, or 7 per cent of static weight of engine, and effect on dynamic hammer blow is shown to be more pronounced.

Electric. Electric Locomotives for Main Line Traction, G. Bianchi. Int. Ry. Congress Assn.—Bul. (English Edition, Brussels), vol. 12, no. 5, May 1930, pp. 1410-1421. Classification of electric locomotives; types of transmission from motor to wheels; arrangement of trucks and bodies; wheel arrangements; lubrication; current collecting devices; lightning arresters; circuit breakers; transformers; traction motors; matters relating especially to locomotives for use in mountainous country; multiple-unit rail motors.

Switching and Transfer Locomotives, P. A. McGee. Ry. Elec. Engr., vol. 21, no. 5, May 1930, pp. 141-143, 4 figs. Illinois Central adopts locomotives with special weight transfer compensating features; nature of switching and transfer service; side elevation of locomotive showing structural details and principal dimensions; weight transfer compensation; locomotive characteristics; principal characteristics of locomotive units are given.

Manufacture, Heat Treatment in. The Heat Treatment of Locomotive Parts, W. A. Stanier. Instn. Mech. Engrs.—Proc. (Lond.), no. 5, Dec. 1929, pp. 1069-1073, 4 figs. At Swindon it is now practice to treat all steel stampings and forgings so that structure of each part is in best condition to resist strains and stresses to which it will be subjected in service; plant consists of vertical furnace with chamber 16 ft. 3 in. long and 2 ft. 2 in. diam., gas-fired; in addition there is horizontal three-chamber furnace; micro-photographs are shown illustrating structure of axle steel in various conditions.

New Types. Locomotives of New Types; in Particular Turbine Locomotives and Internal Combustion Motor Locomotives, P. Koller. Int. Ry. Congress Assn.—Bul. (English Edition, Brussels), vol. 12, no. 5, May 1930, pp. 1383-1390. Report deals with construction, efficiency, use and repair of new types of locomotives, with particular reference to turbine and internal combustion.

Three-Cylinder. Examples of Recent Three-Cylinder Locomotives of Various Types. Ry. Mech. Engr., vol. 104, no. 5, May 1930, p. 261. Specifications concerning general dimensions, weights, and proportions of 16 various railroads.

LUBRICANTS

Progress in. Heavy Oils and Lubricants, W. Lee. Instn. of Petroleum Technologists—Jl. (Lond.), vol. 16, no. 81, Apr. 1930, pp. 266-280 and 2 supp. pp. Review of progress during 1928-1929; no new process introduced for production of heavy distillates or treatment to make them available as lubricant; increased use of Edeleanu liquid sulphur-dioxide process, applied to production of lubricants; production of heavy lubricants by polymerization; recovery of used oils; oxidation resistance; correlation between laboratory carbon tests and engine conditions; transformer oil tests. Bibliography.

LUBRICATING OIL

Automotive. The Significant Properties of Automotive Lubricants, H. C. Mougey. Am. Soc. Testing Matls.—Advance Paper for mtg., Mar. 19, 1930, 10 pp., 1 fig. Methods of determining properties of automotive lubricants are discussed; principal significant properties in order of their importance are: viscosity, stability, oiliness (under certain conditions).

LUBRICATION

Centralized System. Centralized Lubricating System Developed by Farfall. Automotive Industries, vol. 62, no. 19, May 10, 1930, pp. 734-735, 3 figs. Centralized high-pressure lubricating system, designed for all types of machinery and also applicable to automotive vehicles, made by Farfall Co. of Detroit; metering-type unit operates under pressure up to 2,000 lbs.; cross-section of automobile type of lubricator; model 300 pump assembly in section.

M

MACHINE TOOLS

Hydraulic Feeds. The Hydraulic Operation of Machine Tools. Engineer (Lond.), vol. 149, no. 3877, May 2, 1930, pp. 491-492. Editorial remarks on advantages of hydraulic transmission; that its possibilities are being realized by makers of machine tools was evident to all who inspected machinery exhibited at Leipzig Fair.

METALS

Calorizing. Heat Enduring Metals for Furnace Construction, B. J. Sayles. Fuels and Furnaces, vol. 8, no. 5, May 1930, pp. 699-701. Article deals mainly with calorizing process in which aluminum is driven into surface layer of another metal, usually mild steel, to form surface iron-aluminum alloy; this alloy is immune to oxidation up to maximum metal temperatures of 1,650 deg. fahr.

Cold Rolling. Cold Roll Forming of Metals, D. A. Johnston. Metal Stampings, vol. 3, no. 5, May 1930, pp. 429-434, 6 figs. Design of rolls with reference to least distortion of metal, hardening and grinding, life and replacement, etc.

Cutting. Surface Conditions with Machining Operations, Especially with Turning (Das Oberflaechenaussehen bei der spanabhebenden Bearbeitung insbesondere beim Drehen), F. Rapatz. Archiv. fuer das Eisenhuettenwesen (Duesseldorf), vol. 3, no. 11, May 1930, pp. 717-720, 17 figs. partly on supp. plates. Influence of cutting speed, strength, structure, wedge angle, etc., is discussed; reference is made to so-called Whitaker ring.

Testing. Recent Progress in Tests for Automotive Materials, H. F. Moore. Am. Soc. Testing Matls.—Advance Paper for mtg., Mar. 19, 1930, 10 pp., 2 figs. Viewpoint which author presents is that of testing engineer in university laboratory; tests for elastic strength; and creep strength; fracture; impact tests; tenderness of metals; understressing tests; ductility and non-destructive tests; corrosion and strength.

Specimens for Torsion Tests of Metals, R. L. Templin and R. L. Moore. Am. Soc. Testing Matls.—Advance Paper No. 50, for mtg. June 23-27, 1930, 10 pp., 6 figs. Tests to determine influence of form and size of specimen upon results obtained in torsion tests; merits of hollow cylindrical specimens, having different ratios of diameter to wall thickness and length to diameter as well as those of hollow section were investigated; comparative results from hollow and solid specimens show little variation in values of modulus of elasticity in shear; data are given on influence of specimen proportions upon values of shearing yield point obtained from autographic diagrams.

Theory of. Recent Advances in the Theory of Metals, R. H. Fowler. Engineering (Lond.), vol. 129, no. 3356, May 9, 1930, pp. 595-597. Author concerns himself mainly with particular applications and results of quantum mechanics, without which no real progress could be made in theory of metals. Review of Kelvin lecture before Instn. Elec. Engrs., May 1, 1930.

MINES AND MINING

Electric Power—British Columbia. Electricity in Mining, F. W. MacNeil. Elec. News (Toronto), vol. 39, no. 8, Apr. 15, 1930, pp. 93-95, 3 figs. Province of British Columbia, producing 23½ per cent of Dominion's mineral wealth, uses considerable electric power in its many famous mines; short note on power supply to principal mines are given.

N

NATURAL GAS INDUSTRY

Canada. Utilization of Gas From Turner Valley, J. Bilterijst. Can. Engr. (Toronto), vol. 58, no. 18, May 16, 1930, pp. 543-549, 1 fig. Geological features pointing to existence of large potential oil and gas resources in foothills of Rockies in Alberta; gas now wasted must be conserved; feasibility of transmission to Ontario asserted; nature of reservoir; drilling methods; marketable volume of gas. (To be continued.)

O

OIL ENGINES

Automotive. Ignition by Compression or Spark for Automotive Heavy Oil Engine (Selbstzuendung oder Fremdzuendung im Fahrzeugschweroelmotor), A. E. Thiemann. Automobil-Rundschau (Berlin), vol. 32, no. 9, May 1, 1930, pp. 183-186, 4 figs. Comparison of various designs using compression ignition and electric ignition; sketches show details of Hesselman and Leroy engines; injection and combustion phenomena are discussed.

OIL FIELDS

Alberta. Utilization of Gas From Turner Valley, J. Bilterijst. Can. Engr. (Toronto), vol. 58, no. 18, May 16, 1930, pp. 543-549, 1 fig. Geological features pointing to existence of large potential oil and gas resources in foothills of Rockies in

Alberta; gas now wasted must be conserved; feasibility of transmission to Ontario asserted; nature of reservoir; drilling methods; marketable volume of gas. (To be continued.)

CANADA. Oil and Gas Developments in Western Canada During 1929, G. S. Hume. Instn. of Petroleum Technologists—Jl., (Lond.), vol. 16, no. 81, Apr. 1930, pp. 350-353. Summary of oil-well and gas-well drilling activity; completions and flow rates.

OIL FUEL

CHOICE OF. Choice of Liquid Fuels (Die Auswahl der fluessigen Brennstoffe), E. W. Steinitz. Papier-Fabrikant (Berlin), vol. 28, no. 10, Mar. 9, 1930, pp. 154-158, 4 figs. Calorific value and specific gravity are unsuitable as criteria for evaluation of liquid fuels; volatility as shown by distillation curve is of greater value for this purpose; various types of motor fuels and Diesel oils, their distillation curves, anti-knocking properties, and comparative prices are briefly discussed.

P

PHOTO-ELASTICITY

PHENOMENA INVOLVED IN. Phenomena Involved in Photo-elasticity, R. W. Baud. Elec. Jl., vol. 27, no. 5, May 1930, pp. 303-305, 8 figs. Note on natural and polarized light; optical behaviour of isotropic and anisotropic material; formation of isoclinics; formation of colour fringes are given.

PHOTO-ELECTRIC CELLS

SPECIAL APPLICATIONS. Photo-Cells for Special Applications, H. C. Rentschler. Electronics, vol. 1, no. 1, Apr. 1930, pp. 29-30. Short note on performance of photo-electric cells and three principal uses: (1) applications where device must faithfully follow exact variation in light intensity; (2) such applications as simply require trigger action; (3) to integrate light intensity over given time.

PIERS, MASONRY

CALCULATION OF. Calculation of Masonry Piers Under Eccentric Loading (Beitrag zur Berechnung von exzentrisch beanspruchten Mauerpfeilern), H. Gottfeldt. Bauingenieur (Berlin), vol. 11, no. 3, Jan. 17, 1930, pp. 48-49, 5 figs. Author establishes expressions for relation between maximum extreme fibre compressive stress in pier after failure in tension zone due to eccentric loading and tensile and compressive extreme fibre stresses before failure; stability of masonry pier is dependent not only on magnitude of tensile stress but on ratio of this stress to compressive.

PILE DRIVING

EXPERIENCES WITH. Experiences with the Driving of Reinforced-Concrete Piles (Erfahrungen beim Einrammen von Eisenbetonpfaehlen). Zement (Charlottenburg), vol. 19, no. 9, Feb. 27, 1930, pp. 201-203. 3 figs. Method of testing supporting power of unknown ground by driving only one test pile cannot be recommended; stresses in ground, which arise when piles are driven close together, must be taken into consideration; ground must be tested much deeper than necessary foundation depth in order to determine smallest possible distance between piles without overloading; it is advised to drive piles again after several several weeks when all stresses are neutralized.

PIPE, CONCRETE

MANUFACTURE. Developments in the Manufacture and Use of Concrete Pipe, M. W. Loving. Am. Concrete Inst.—Jl., vol. 1, no. 7, May 1930, pp. 732-747, 8 figs. Evolution and modern methods of manufacture of plain and reinforced concrete pipe; use of concrete pipe in culverts, irrigation, water supply and force mains; results of condition survey of 191 reinforced concrete pipe sewers in 43 cities and large industrial plants in United States.

POWER GENERATION

DEVELOPMENTS IN. Power Production—Past, Present and Future, F. C. Lee. Instn. Mech. Engrs.,—Proc. (Lond.), no. 5, Dec. 1929, pp. 1045-1054. After brief review of historical development of prime movers, following questions are discussed: how it came about that before end of seventeenth century so little development was possible, and that from dawn of eighteenth century to present time such extraordinary progress has been made; what are possible limits of efficiency of present methods and whether there are sources of energy that have not yet been developed.

PULVERIZED COAL

FIRING WITH. Pulverized-Coal Firing (Kohlenstaubfeuerung), A. Krenn. Montanistiche Rundschau (Berlin), vol. 22, nos. 5, 6, 7, and 8, Mar. 1, 1930, pp. 97-112, Mar. 16, pp. 125-132, Apr. 1, pp. 149-156, and Apr. 16, pp. 181-188, 25 figs. Systematic presentation of present status of pulverized-coal firing; physicochemical and thermodynamic principles; technical details; types of pulverized-coal boilers, and equipment. Bibliography.

PUMPS

CENTRIFUGAL, ELECTRICALLY DRIVEN. Induction Motors for the Dirve of Vertical Pumps. AEG Progress (Berlin), vol. 6, no. 3, Mar. 1930, pp. 94-97, 8 figs. Great flexibility of electric motor and especially its application as vertical motor has in recent years definitely promoted development of vertical-pattern centrifugal pump; typical pump installations are illustrated and described.

GAS-DISPLACEMENT. Two-Stroke Cycle Gas-Displacement Pump. Water and Water Eng. (Lond.), vol. 32, no. 377, May 20, 1930, pp. 218-220, 4 figs. Description of Christie large volume, low-head pump; pump consists of vertical stand pipe mounted on tee piece, one end of which leads to suction box fitted with sixteen 5-in. suction valves, submerged in tank; the other communicating with 60 ft. play pipe terminating in boiler; pump is capable of suction lift of 8 or 10 ft.; thermal efficiency of 14 per cent has been attained.

SUBMERGED-MOTOR. Evolution of Submerged Motor Pumps (Die Entwicklung der Tauchpumpen), H. Sauveur. V.D.I. Zeit. (Berlin), vol. 74, no. 17, Apr. 26, 1930, pp. 530-532, 9 figs. Features of early and later types, with special reference to Garvenswerke, Arutuenoff; Siemens-Schuckertwerke, Reed Cooper, and other makes.

R

RAIL MOTOR CARS

DATA ON. On the Question of Rail Motor Cars (Subject XX for Discussion at the Eleventh Session of the International Railway Congress Association), Z. Zavadjil. Int. Railway Congress Ass.—Bul. (English Edition, Brussels), vol. 12, no. 2, Feb. 1930, pp. 443-490, 12 figs. Report covers data concerning cars of all countries of Europe, except France; types and principal data of rail motor-cars in service; table giving weights and power of rail motor-cars; organization of service, method of use; economic results of operation of rail motor-cars.

RAILROAD TIES

CONCRETE. Experiments with Reinforced-Concrete Twin Ties (Versuche mit Eisenbeton-Zwillingsschwellen), R. Otzen. Zement (Charlottenburg), vol. 19, nos. 8 and 9, Feb. 20, 1930, pp. 174-177 and Feb. 27, pp. 196-199, 12 figs. Different kinds of reinforced-concrete ties were tested in laboratory for their behaviour when exposed to different continuous and intermittent pressures; impressions, elastic and permanent, were measured; twin-tie showed 50 per cent less change in form than transverse tie; pressure and deformation of roadbed is very much decreased; data are given for calculation of "form-factor" and best tie dimensions.

PRESERVATION. Getting More Service out of Crossties. Ry. Eng. and Maintenance, vol. 26, no. 6, June 1930, pp. 261-263, 1 fig. Ways to improve quality, obtain longer service life and insure permanent supply of timber were studied by producers and consumers at convention of National Association of Railroad Tie Producers held in Memphis, Tenn.

STEEL VS. WOODEN. Steel vs. Wooden Ties (Eisen oder Holzschwelle?), R. Vogel. Stahl und Eisen (Duesseldorf), vol. 50, no. 21, May 22, 1930, pp. 722-729, 7 figs. It is shown that German Government Railroad steel ties are from technical and economic viewpoint not alone on par with wooden ties employed, but in many respects superior.

ROAD MATERIALS

EMULSIONS. Characteristics, Manufacture and Practical Uses of Asphalt Emulsion (Wesen, fabriksmaessige Herstellung und praktische Verwendung von Asphaltemulsionen), Graefe and Fleck. Petroleum (Berlin), vol. 26, no. 12, Mar. 19, 1930, pp. 357-361. Three methods of applying cold asphalts for road surfaces are discussed: (1) surface treatment; (2) penetration process; (3) mixing process.

ROADS

CEMENT-BOUND. Cement-Bound Roads, R. A. B. Smith. Concrete and Constr. Eng. (Lond.), vol. 25, no. 3, Mar. 1930, pp. 184-192, 2 figs. Review of construction practice and costs of cement-bound road surface with special reference to experience of County Mayo, Ireland; half-width and full-width construction; details of centre joint in half-width work.

ROLLS

SHEET-MILL. Tin and Sheet-Mill Rolls, Their Treatment, Performance and Premature Failure in Service, E. R. Mort. Iron and Steel Inst.—Advance Paper, May 1930, 20 pp., 14 figs. Sheet plant to which data relate comprises 16 hot mills of single-stand type; there are no roughing stands, all bars being broken down and finished off on one pair of rolls; generally speaking, harder rolls expand more than mild ones; as body length increases, concavity decreases, converse being case with increase of diameters; pack lengths extend, so should concavity; lighter gauge, less concavity required.

S

SCREWS

MANUFACTURE. Screws Made in Modern Plant, C. B. Phillips. Iron Age, vol. 125, no. 19, May 8, 1930, pp. 1377-1379, 5 figs. Description of manufacturing process and equipment at Rockford, Ill., plant of Elco Tool & Screw Corp., makers of wood screws, machine screws, cap, and lag screws, from small ones up to ½ in. in dia., and such finishes as bare polished, plated with cadmium, copper, brass, nickel or chromium, blued, oxidized, parkerized or raven black.

SEAWALLS

MARSEILLES, FRANCE. "A Chaise" Type of Seawall of Deposited Blocks Provided with Tenons and Mortises (Mur de quai "à chaise" en blocs arrimés munis de tenons et Mortaises), Sainflou. Annales des Ponts et Chaussées (Paris), no. 1, Jan./Feb. 1930, pp. 26-40, 8 figs. Design and construction of new seawall in Port of Marseilles, about 10 m. high and 190 m. long; so-called "à chaise" seawalls have short heel sloping seaward; concrete block dimensions were up to 4.5 by 3 by 2.7 m.

SEWAGE DISPOSAL

CHLORINATION. Efficiency and Cost of Sewage Disinfection, J. W. Ellms and G. T. Pond. Mun. Sanitation, vol. 1, no. 5, May 1930, pp. 266-268, 2 figs. Analyses of raw sewages and effluents; volumes of sewage chlorinated and amount of chlorine applied; effect of disinfection; cost of disinfection of sewage effluents.

UNITED STATES. Recent Trends and Comparative Costs of Sewage Disposal, F. H. Bulot. Water Works and Sewerage, vol. 77, no. 5, May 1930, pp. 155-159. Analysis of 48 sewage treatment plants show increasing use of mechanical equipment; types of treatment; construction and operating cost data; sewage treatment plants constructed during six-year period 1924 to 1930; gas collection; chlorination; sludge disposal; unit costs.

SEWER TUNNELS

OWENSBORO, KY. Driving Sewer Tunnels Through Quicksand under Air, V. J. Brown. Water Works and Sewerage, vol. 77, no. 5, May 1930, pp. 143-146. 8 figs. Detailed description of experience of Owensboro, Ky.; designer took advantage of stiffest material located by borings; mining operations; mining through buried dump; excavation procedure; shaft construction; arrangement of concrete forms; organization of crews.

SHAFTING

VIBRATIONS. Critical Vibrations in Shafting, M. Doucet. Shipbldr. (Lond.), vol. 37, no. 238, Apr. 1930, pp. 465-466, 2 figs. Simple methods for calculating critical speeds in line shafting and in turbine shaft; hypothesis is given that shaft may be divided into sections carrying at each extremity concentrated mass; system of such masses is dynamically equivalent to given system. Translated abstract of paper presented before Association Technique Maritime et Aéronautique.

SHEET METAL

TESTING. Stamping Test for Metal Plates (Les essais d'emboutissage des tôles), R. Cazaud. Aciers Spéciaux, Métaux et Alliages (Paris), vol. 5, no. 53, Jan. 1930, pp. 6-14, 19 figs. Description of test used for controlling annealing, and different types of testing machines employed.

SPRINGS

HELICAL. Further Research on Helical Springs of Round and Square Wire, A. M. Wahl. Am. Soc. Mech. Engrs.—Advance Paper, no. 24, for mtg. June 9 to 12, 1930, 8 pp., 21 figs. Proposed method of calculating stress in helical springs of square or rectangular wire is to use approximate formula, based on St. Venant's results for torsion of rectangular wire, and multiply by correction factor based on spring index; it is suggested that this new formula replaces those commonly given in handbooks, which may lead to considerable error in certain cases. See Engineering Index 1929, p. 1709.

STEAM-ELECTRIC POWER PLANTS

DESIGN. Power Station Betterment. Nat. Elec. Light Assn.—Pub. No. 044, May 1930, 6 pp., 13 figs. Report indicates station betterments possible through modernization by addition of new equipment or remodeling of old; four examples of station betterment by minor capital expenditures are given, intended to show what can be done toward increasing capacity or improving economy with existing apparatus; substantial rebuilding; modernization of boiler house; modification of heat balance; increase in boiler capacity by use of larger stokers and water walls.

ENGLAND. Extensions at Kingston-Upon-Thames. Elecn. (Lond.), vol. 104, no. 2706, Apr 11, 1930, p. 457, 2 figs. Present extension comprises additions to boiler house; foundations, etc.; boiler, turbo-alternator, switchgear, and cables; foundations for boiler, owing to nature of ground, presented some difficulties; boiler plant is of Stirling five-drum type, with patent integral superheater and Green's tri-tube economizer; capable of producing 50,000 lbs. of steam per hour with extremely large overload capacity; turbo alternator of Brush Ljungström type has output of 3,000 kw. at steam pressure of 225 lbs.

SASKATCHEWAN. New Saskatoon Power Station of the Government of Saskatchewan. Power House, vol. 24, no. 2, Feb. 1930, pp. 41-51, 27 figs. Illustrated description of equipment in new public utility power station; boiler plant; feed water system; coal and ash handling equipment; electrical data; list of equipment is given.

STEAM ENGINES

HIGH-PRESSURE. The Steam Engine as the High-Pressure Prime Mover, J. F. Ferguson. Power, vol. 71, no. 19, May 13, 1930, pp. 745-746. For industrial use, author foresees prime movers of reciprocating type, adapted to moderate, high, or extreme initial pressure.

GOVERNORS. Governor Gear for High-Speed Reciprocating Steam Engine. Engineering (Lond.), vol. 129, no. 3355, May 2, 1930, pp. 570-571, 6 figs. Account of construction and operating of governor; operation is such that sheave centre is altered relatively to centre of shaft when variation of load occurs; regulation of both valves simultaneously by governor enables receiver pressure to be maintained practically uniform degree at all loads.

STEAM POWER PLANTS

DESIGN. Power Plant Development, C. F. Hirshfeld. Blast Furnace and Steel Plant, vol. 18, no. 5, May 1930, pp. 812-816, 9 figs. Changes in power-plant design and operation in last few years; graphs show increase in total steam temperatures, in physical size of boiler units, in steaming capacities of boiler units, and in main unit turbine sizes; thermal economy of plants operating on 50-60 per cent annual load factor; output per boiler unit 800,000 lbs. thermal gains by regenerative feed heating; theoretical heat consumption per kw-hr. at different pressures and temperatures; efficiency at various temperatures of heated feedwater and with varying number of extraction points; high-pressure equipment.

HIGH-PRESSURE. Modern Problems of High-Pressure Steam (Neuzeitliche Probleme der Hochdruckdampftechnik), S. Loeffler. Waerme (Berlin), Vol. 53, no. 15, Apr. 12, 1930, pp. 281-284, 10 figs. Sankey diagram and layout of high-pressure steam plant with author's boiler are presented; influence of pump performance on efficiency; heat utilization at different pressures, live steam, and intermediate superheating temperatures; comparison of high-pressure steam plants of this type with and without economizers. This paper, which was contribution to Stodola Festschrift, represents last work of deceased author.

PULVERIZED-COAL-FIRED. Experience Pooled in Pulverized Fuel Burning. Power House, vol. 24, no. 2, Feb. 1930, pp. 55-56. Summary of pulverized-fuel practice has been issued by National Electric Light Association in which personal investigation statements from users and statements from manufacturers are given; coal fineness, sampling methods; boiler operation; burner and furnace operation.

STEAM TURBINES

TESTING. Consumption Tests of Turbines with Reheating of Feedwater; Flow of Hot Water Through Nozzle (Essais de consommation des turbines à réchauffage de l'eau d'alimentation), M. Hentsch. Science et Industrie (Paris), vol. 14, no. 192, Jan. 1930, pp. 4-6, 4 figs. Analysis of measurements and tests with standard nozzle placed in pipe system.

STEEL

CHROMIUM-MANGANESE. *See Chromium-Manganese Steel.*

COPPER. *See Copper Steel.*

HEAT TREATMENT, ELECTRIC. Electric Heating of Metals (Ein Erbtzungsverfahren fuer Metalle auf elektrischem. Wege), F. Staeblein. Stahl u. Eisen (Duesseldorf), vol. 50, no. 9, Feb. 27, 1930, pp. 263-264, 1 fig.; see also translated abstract in Metallurgist (Supp. to Engineer, Lond.), Apr. 25, 1930, p. 61, Electric method of heating metal pieces under water was described by inventor of process, P. Hoho, in Elec. Rev., Feb. 1 and 8, 1929; his description of phenomena and effects produced has been confirmed by trials made at Kaiser Wilhelm Institut fuer Eisenforschung at Duesseldorf and also by author; diagram is shown illustrating application of method to hardening of head of steel rail.

STEEL CASTINGS

TEMPERATURE EFFECT. The Effect of Low Temperatures Upon the Impact Resistance of Steel Castings, R. W. Moffatt. Can. Jl. of Research (Ottawa), vol. 2, no. 5, May 1930, pp. 327-340, 26 figs. partly on supp. plates. Investigation deals with steel castings and forgings; low, medium, and high carbon-steel castings and alloys of vanadium, nickel, and vanadium-nickel steel castings were examined; temperatures varied from room temperatures to temperatures well below zero deg. fahr.; impact resistance of metals decreased for temperatures below freezing point; by proper heat treatment of steel castings impact resistance at 40 deg. may be brought over 300 per cent higher than that of untreated metal at that temperature.

STREAM POLLUTION

CANADA. Pollution of Canadian Inland Waters. Can. Engr. (Lond.), vol. 58, no. 21, May 27, 1930, pp. 615-618. Report covering activities of public-health engineering division of department of Pensions and Health with regard to supervision of quality of drinking water for vessels navigating inland waters, during 1929; water supplies on trains.

T

TANKS, CONCRETE

DESIGN. Reinforced Concrete Tanks, W. S. Gray. Concrete and Constr. Eng. (Lond.), vol. 25, no. 4, Apr. 1930, pp. 257-264, 11 figs. Elementary theory of design with examples; stability of tanks in wet ground; circular tanks in wet ground; moments in uniformly loaded circular slabs fixed at circumference; stresses in narrow rectangular tanks in good ground.

TEXTILE MACHINERY

GEARING. Improving Gear Performance on Textile Machinery, P. S. Huntley. Textile World, vol. 77, no. 18, May 3, 1930, pp. 96-97, 4 figs. Discussion of good gear performance which requires exact alignment of studs or shafts that carry gears, true running of gear on stud or shaft, correct meshing of gears, and intelligent oiling; gears with cast teeth; types of oilers.

TEXTILE MILLS

ELECTRIC MOTORS FOR. Style of Enclosure for Textile Motors. AEG Progress (Berlin), vol. 6, no. 3, Mar. 1930, pp. 52-54, 8 figs. In textile industry large quantities of dust and fluff in atmosphere render service conditions extremely unfavourable; various method of protecting motors are described and illustrated.

WASTE-HEAT UTILIZATION. Heating Water for Process Work in Textile Mills, C. L. Hubbard. Textile World, vol. 77, no. 14, Apr. 5, 1930, pp. 2024-2027 and 2075, 13 figs. Discussion of economy of using exhaust steam for heating waters in textile mills; description of various types of heaters for heating large quantities of water and proper equipment layout to insure best results; explanation of methods; whereby waste heat of Diesel engines may be utilized for heating water for textile processes.

Waste Heat Economy in Textile Mills. AEG Progress (Berlin), vol. 6, no. 3, Mar. 1930, pp. 49-51, 5 figs. General notes on study of process and consequent development of equipment by AEG advantageous for steam consumption, for producing moist atmosphere, for heating and for drying plants of weaving, bleaching, printing, dyeing, and dressing mills.

TIN DEPOSITS

NOVA SCOTIA. Tin Lodes in Nova Scotia, E. H. Davidson. Min. Mag. (Lond.), vol. 42, no. 1, Jan. 1930, pp. 20-23, 4 figs. Notes on geology of Gold River area, Lunenberg County, Nova Scotia, where both tin and gold deposits are found; molybdenite deposit is mentioned.

TOLERANCES

HOLE CENTRES. Limiting Dimensions on Centres of Components and Gauges, L. E. Bunnett. Machy. (Lond.), vol. 36, no. 914, Apr. 17, 1930, pp. 87-88, 2 figs. On dimensions of hole centres number of points arise which call for careful consideration and calculation before deciding upon tolerances; by examination of actual example author shows that clearance holes may be too small if certain limits are used and further that gauging may be made practically impossible.

TRANSFORMER OIL TESTING

BUILT IN CASE. Transformer Oil Tester Built in Case. Elec. World, vol. 95, no. 19, May 10, 1930, p. 938, 1 fig. Glass utensils used for testing may not be perfectly clean; small amount of water in relatively inconsiderable quantity of tested oil is liable to introduce an out-of-proportion large per cent error; uncertainties may be avoided with arrangement described in March 27 issue of Elektrotechnische Zeit. according to which small, simple and inexpensive set of electrodes is built directly into each transformer as permanent part thereof.

TUNNELS

CROSS-SECTION RECORDING. Direct Recording of Cross Section of Civil Engineering Works. Engineer (Lond.), vol. 149, no. 3879, May 16, 1930, p. 555, 2 figs. Instrument, which was used with marked success in taking of cross-sections in which 15-mi. rock tunnel of Lochaber water power scheme, consists of rigid framework pivoted on plane table in which ball bearing is fixed; device enables very accurate diagrams to be made.

V

VALVES AND VALVE GEARS

HYDRAULIC. 42-Inch Internal Differential Needle Valves for Yakima River Crossing Wasteway. U.S. Bur. Reclamation—Specifications No. 511, 1930, 10 pp., numerous figs. on 15 supp. sheets. Description of valves connected to steel-lined vertical shaft from concrete-lined tunnel under Yakima River, used to discharge, into Yakima River, excess water that may enter canal; valve will be operated by electric motor operated from storage battery, and controlled by means of float switches; valves will be operated under head of 383 ft.

VOLTAGE REGULATORS

PROTECTION. Overvoltage Protection of Induction Regulators, E. R. Wolfert. Elec. Jl., vol. 27, no. 5, May 1930, pp. 284-286, 3 figs. Lightning arresters should be used to protect induction regulators against surges from lightning, switching, or interruption of exciting current; notes on factory tests; effect of interrupting exciting current; protection against surges.

W

WATER CHLORINATION

CONTROL. Operating Experiences with a New Automatic Residual Chlorine Recorder and Controller, J. W. Cutler and F. W. Green. Am. Water Works Ass.—Jl., vol. 22, no. 6, June 1930, pp. 755-766, 7 figs. Description of new Wallace and Tiernan photoelectric cell unit for automatic control of chlorination; report on satisfactory experience with this unit installed at Little Falls, N.J., plant of Passaic Consolidated Water Co.

WATER METERS

TESTING. Water-Meter Testing Periods, G. Read. Can. Engr. (Toronto), vol. 58, no. 18, May 6, 1930, pp. 549-550. Meter and Service Superintendent, Los Angeles Dept. of Water and Power, reports on registration tests of 900 meters, in continuous service from one to ten years, which were taken out at random and tested at shop on same rates of delivery as were used when they were new. Paper read before Calif. Section of Am. Water Works Assn., Indexed in Engineering Index, 1929, p. 1930, from Hydraulic Eng., Dec. 1929, and Water Works Eng., Dec. 4, 1929.

WATER PIPE LINES

BRIDGES. Concrete Arch Bridge Carries Pipe Lines, F. M. Preston. Can. Engr. (Toronto), vol. 58, no. 21, May 27, 1930, pp. 605-606, 5 figs. Main features of three-hinge arch of reinforced concrete, constructed to carry water pipe line across estuary near Victoria, B.C.; crossing is 177 ft. in span and includes arch span of 66 ft.

STEEL. A Summarization of Experience and Current Practice in Certain Phases of Steel Plate Pipe Line Construction, G. H. Fenkell, W. E. Foss, G. W. Fuller, J. A. Jensen, J. F. Lahoon, E. E. Lanpher, A. V. Ruggles, J. F. Skinner. Am. Water Works Assn.—Jl., vol. 22, no. 5, May 1930, pp. 579-596. Summary of practical experience with reference to quality of steel, mill inspection of both sides of plate, special quality of metal, thickness of plate, cleaning of pipe, coating, corrosion experience, temperature strain, life of steel pipe.

WATER SOFTENING

MARION, OHIO. Operating Experiences with a New Water Softening Plant at Marion, Ohio, M. E. Flentje and C. Whysall. Am. Water Works Assn.—Jl., vol. 22, no. 6, June 1930, pp. 778-785, 2 figs. Plant described is unusual because of extreme hardness of water being treated; use of all-steel construction above ground; application of double carbonation to produce effluent of low alkalinity. Indexed in Engineering Index 1929, p. 1936, from Hydraulic Eng., Sept. 1929.

WATER TREATMENT

COAGULATION. Coagulation. Water Works and Sewerage, vol. 77, no. 5, May 1930, pp. 147-151, 6 figs. Structure of gelatinous precipitates difficult to determine; formation of calcium-carbonate precipitate on surface of limewater; precipitation of hydrous aluminum oxide; negative ions precipitated with hydrous aluminum oxide; coagulants in removing objectionable substances from water.

WATER WORKS

WINDSOR, ONT. Report on Windsor Water Works System, R. L. Dobbin. Can. Engr. (Lond.), vol. 58, no. 21, May 27, 1930, pp. 607-611. Report dealing with questions affecting distribution system consisting of 97 mi. of mains 4 to 24 in. in diam.; longevity of system; system of arriving at rates for metered and unmetered water.

WATER WORKS MANAGEMENT

EFFICIENCY IN. Elements of Efficiency in Water Works Operation, A. Kanneberg. Am. Water Works Assn.—Jl., vol. 22, no. 3, May 1930, pp. 630-645. Application of various principles of efficiency to problems of water works management; variations of motive power; rules and regulations; free water service; rates; retirement reserves and funds offsetting same; selling water service outside city's corporate limits; main extension policies; equipment.

WELDS

TESTING. Fatigue Tests of Fillet Welds, R. E. Petersen and C. H. Jennings. Am. Soc. Testing Matls.—Advance Paper No. 40, for mtg. June 23-27, 1930, 10 pp., 8 figs. Test data covering effects of machining, spacing and size of weld; tests were all made on rotating cantilever specimens 1 in. in diam.; it was found that fatigue strength of fillet weld could not be increased appreciably by machining radius at base of weld; spacing was found to reduce fatigue strength considerably.

WIRE ROPE

PRE-STRESSING. Manufacturing High-Modulus Footbridge Ropes for Fort Lee Hudson River Bridge, C. C. Sunderland. Eng. News Rec., vol. 104, no. 18, May, 1930, pp. 714-718, 8 figs. Modulus of elasticity of 6 x 37 rope increased from 12,000,000 to 18,000,000 pounds per sq. in. by pre-stressing to 125 per cent of working stress; process applied also to strands for main cables of Grand'Mere and St. Johns Bridges; equipment layout for pre-stressing wire ropes in lengths up to 3,750 ft.; stress-strain diagram of rope before and after multiple stressing; effect of multiple stressing on experimental 1½ in. strand.

WOOD

WATER PENETRATION. The Penetration of Water Vapour Into Wood, L. M. Pidgeon and O. Maass. Can. Jl. of Research (Ottawa), vol. 2, no. 5, May 1930, pp. 318-326, 3 figs. Rate of diffusion of water vapour through wood has been studied through comparison of time taken for samples of various thickness to become saturated; comparative numerical values have been obtained of rate of diffusion of water vapour through spruce and pine in various directions through heartwood and sapwood, and through samples of different lengths.

Engineering Index

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A

AERIAL PHOTOGRAPHY

Geological Surveys. Prospecting by Air, M. S. Kennedy. West. Flying, vol. 7, no. 6, June 1930, pp. 57-59, 4 figs. Notes on application of aerial mapping; cost per sq. mi. was found to average $10: outline of developing and printing procedure and equipment.

Mapping. Making Aerial Mapping Pay, H. A. Erickson. Aviation, vol. 28, no. 23, June 7, 1930, pp. 1125-1127, 3 figs. Description of experiences and procedure in making survey of 2,200 sq. miles in four counties adjacent to Salinas; job was completed in 10 weeks; two K-5 aerial cameras were used; flying strips were 75 miles long; notes on cost of materials.

Use of. Utilization of Aerial Photography (L'Exploitation de la photographie aérienne), L. Poncelet. Conquête de l'Air (Paris), vol. 26, no. 5, May 1930, p. 387-394, 13 figs. Notes on fundamental optics and description of apparatus for transforming aerial photographs, and of cartographic machines built by Aérotopographe G.m.b.H., C. Zeiss, Hugershoff, H. Wild, and Nistri.

AERIAL TRANSPORTATION

Australia. The Perth-Adelaide Air Service, E. J. Hart. Aircraft (Melbourne), vol. 8, no. 7, Mar. 31, 1930, pp. 266-278, 15 figs. Description of operation and facilities of 1,453 mi. of air service; notes on schedules, passenger booking, and main arrangements; airports; geography.

France. Aeronautical Policy of France; Near Future of Civil Aviation (La Politique aéronautique de la France—Le proche avenir de l'aviation civile, M. Laurent-Eynac. Aérophile (Paris), vol. 38, no. 7-8, Apr. 15, 1930, pp. 97 and 99-102, 3 figs. Discussion of profitability of air lines; maps show routes of French lines to Asia, Africa and Latin America.

Future of. The Future of Air Transportation, T. G. Lanphier. Mech. Eng., vol. 52, no. 6, June 1930, p. 596. Important thing at present is to recognize limitations of air transportation and to stay within those limits, while at same time striving continuously to overcome obstacles which prevent air travel from safest, most reliable, most comfortable, and quickest and most convenient method of transportation.

Government Regulation. The Law and the Operator, H. Mirkil. Aviation, vol. 28, no. 24, June 14, 1930, pp. 1175-1176. Discussion of liabilities imposed by law on carriers of passengers for hire; operators of passenger-carrying aircraft will more and more come to be regarded as common carriers under law.

Radio Communication. Radiophone Communication on Air Passenger and Main Routes. Radio Eng., vol. 10, no. 6, June 1930, pp. 51-52. Short description of Boeing block-signal system of San Francisco-Chicago and Seattle-Los Angeles air-mail express passenger routes; equipment, which is described is effective at altitudes as high as 14,000 ft. and at ranges as distant as 200 miles.

Two-Way Communication in Air Transport Service, H. Hoover, Jr. Aero Digest, vol. 16, no. 5, May 1930, pp. 57, 260 and 262, 1 fig. Principles of operation are outlined; schematic diagram of airway showing communication networks between aircraft, airports, and weather observers. (Concluded.)

Voice or Code in Aircraft Radio, W. G. Logue. Aviation, vol. 28, no. 25, June 21, 1930, pp. 1213-1216. Advantages of telegraph apparatus are pointed out; performance and operation of telephone and telegraph equipment are discussed; radio telephone apparatus in plane now costs more than three times as much as two way telegraph apparatus capable of working same or greater distances, and radio telephone ground transmitters now cost from one-third to one-fourth more than ground telegraph equipment; data on weight are given.

AERONAUTICAL EDUCATION

Ground Schools. American Ground Schools, M. F. Eddy. West. Flying, vol. 7, no. 6, June 1930, pp. 50-53, and 130, 3 figs. Discussion of ground school organization and operation; notes on instructors and students; class schedules.

AERONAUTICS

Economics. Economics and the Aircraft Industry, H. P. Pattison, Jr. Aviation, vol. 28, no. 22, May 31, 1930, pp. 1088-1092. Review of events and papers presented before American Society of Mechanical Engineers, Aeronautic Division, at Dayton, Ohio; discussion of design, engines, production and aerodynamics.

AIR CONDITIONING

Research. The Possibilities of Conditioning Air for Comfort, L. L. Lewis. Ice and Refrig., vol. 78, no. 6, June 1930, pp. 490-492, 6 figs. See also Refrigeration, vol. 47, no. 6, June 1930, pp. 46 and 48. Results of research of American Society of Heating and Ventilating Engineers; use of air conditioning in theatres, department stores, and hotels; waste heat of thermodynamic cycle; classification of heat; first attempt at air conditioning. Paper read before Am. Inst. of Refrig.

AIR MAIL SERVICE

Ship-to-Shore. Ship to Shore Air Mail Service, C. H. Gale. Aviation, vol. 28, no. 22, May 31, 1930, pp. 1084-1087, 4 figs. Account of early experiments and present-day operation by French Line and North German Lloyd; rates for mail are given.

AIRPLANE DESIGN

Performance Calculation. The Climb of the Commercial Airplane, J. G. Lee. Airway Age, vol. 11, no. 5, May 1930, pp. 646-649, 5 figs. Analysis of factors affecting rate and angle of climb weight, power, wing area, span, and parasite resistance; graphs show power curves for typical cabin monoplane; comparative rates of climb and comparative angles of climb for typical cabin and light planes; fundamental difference between light plane and cabin plane.

AIRPLANE ENGINES

Diesel. Research of the National Advisory Committee for Aeronautics on Aircraft Diesel Engines, C. Kemper. Am. Soc. Mech. Engrs.—Advance Paper for mtg., June 12 to 14, 1930, 7 pp. Résumé of progress in investigation of fundamental factors controlling injection and combustion: drop size, rate of injection, spray dispersion and distribution, temperature, and air density and turbulence. Bibliography.

Design. Airplane Engine Development and Operating Reliability, R. Chilton. Soc. Automotive Engrs.—Jl., vol. 26, no. 6, June 1930, pp. 771-781, 3 figs. Practically all parts failures in engines are from fatigue originating at small local defects in material or from resonant vibrations which carry stresses beyond safe fatigue limit of material; notes on performance and supercharging; means of measuring torsional vibration; valve springs and valves.

Spark-Ignition Used in Fuel-Spray Aero Engine Recently Demonstrated. Diesel Power, vol. 8, no. 6, June 1930, pp. 306-307, 3 figs. Discussion of hammer-spray injection; principles of Diesel spark-injected aircraft engines; advantages and disadvantages of fuel-injection spark-ignition type of engine.

Maintenance and Repair. Maintenance of Aircraft Engines and Accessories, H. C. Downey. Airway Age, vol. 11, no. 5, May 1930, pp. 654-656, 5 figs. Outline of methods and problems in overhaul at Panama Air Depot, France Field, Canal Zone; notes on wear of principal parts and on method of boring Curtiss bearings; data for setting valves on D-12 engines. (To be concluded.)

Manufacture. Making Rolls-Royce Aero Engines. Machy. (N.Y.), vol. 36, no. 923, June 19, 1930, pp. 353-357, 37 figs. Manufacturing operations at airplane-engine plant of Rolls-Royce, Ltd., Derby, England.

Parts. Stringent Requirements for Aircraft Engine Parts, W. F. Wise. Soc. Automotive Engrs.—Jl., vol. 26, no. 6, June 1930, pp. 782-784, and 795. Review of requirements which make manufacture of aircraft engine parts more costly than that of automobile engine parts; notes on guarding against localized stresses; non-ferrous metals and alloys; checking heat treatment.

Supercharging. The Supercharging and Compounding of Aero Engines, H. R. Ricardo. Engineering (Lond.), vol. 129, no. 3360, June 6, 1930, pp. 738-739. Editorial review of Wilbur lecture read before Royal Aeronautical Society; to obtain substantial increase of power at ground level by means of supercharging, poppet type of exhaust valve must be abandoned; in its stead author suggests use of single-sleeve valve; compounding on these lines should result in material improvement in economy as well as in reduction in weight.

Geared Centrifugal Superchargers for Airplane Engines, S. A. Moss. Aviation Eng., vol. 3, no. 5, May 1930, pp. 10-14, 5 figs. Article previously indexed from Am. Soc. Mech. Engrs.—Advance Paper, for mtg. May 19-22, 1930.

Testing. Engine Testing Laboratory, C. M. Young. Aviation Eng., vol. 3, no. 5, May 1930, pp. 7-9, 3 figs. Description of equipment and procedure used by Dept. of Commerce, Aeronautics Branch, for type testing aircraft engines; specifications of engine requirements call for 50-hr. endurance tests.

Throttling. Aircraft Engine Wear Elimination by Throttling (Motorschonung durch Drosseln), Schatzke. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 21, no. 7, Apr. 14, 1930, pp. 164-175, 21 figs.; see brief translated abstract in Automotive Abstracts, vol. 8, no. 6, June 20, 1930, p. 104. Throttling has strong effect on engine life and decrease of strains in engines has definite effect; author recognizes costs involved in research method, and suggests temporary method which amounts to using of similar aircraft engines now in operation under constant conditions for each engine; varying conditions assigned to each plane will show effect upon engine wear of each condition.

AIRPLANE INDUSTRY

Canada. Surveying the Aircraft Industry of Canada in 1930. Can. Machy. (Toronto), vol. 41, no. 13, June 26, 1930, pp. 111-114, 3 figs. Brief summaries of facts regarding each of plants in Canada now producing airplanes and engines, and indication of rapid growth of this industry.

AIRPLANE MANUFACTURE

Welding. Two Fundamentals of Aircraft Welding, K. Perkins. Acetylene Jl., vol. 32, no. 1, July 1930, p. 22. Abstract of paper read before Int. Acetylene Assn. previously indexed from Flying, Jan. 1930.

AIRPLANE MATERIALS

A.S.T.M. Papers. Aviation Materials—Reviewed in Broad Symposium. Iron Age, vol. 126, no. 1, July 3, 1930, pp. 19-22 and 60. Brief review of papers presented at convention of American Society for Testing Materials at Atlantic City chiefly on metals in aircraft construction; notes on scope of aircraft industry.

Tubing. Identification of Aircraft Tubing by Rockwell Test, H. Knerr. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 342, June 1930, 8 pp., 6 figs. Description of experiments with machine developed for production testing of aircraft tubing; notes on physical properties of carbon and chrome-molybdenum steel.

AIRPLANE PROPELLERS

Vibrations. Contribution to the Theory of Propeller Vibrations, F. Liebers. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 568, June 1930, 23 pp., 5 figs. Calculation of torsional frequencies of revolving bars with allowance for air forces; bending frequencies of revolving straight and tapered bars; Rayleigh's principle of variation; error estimation and accuracy of results; application of theory to screw propellers for airplanes. Translated from Zeit. fuer Technische Physik, vol. 10, 1929.

AIRPLANES

Radio Apparatus. Transmission Characteristic of Airplane Horizontal Trailing Antennas (Ueber die Sendecharakteristik von Flugzeugschleppantennen), G. Sudeck. Zeit. fuer Hochfrequenztechnik (Berlin), vol. 35, no. 3, Mar. 1930, pp. 89-98, 9 figs. Theoretical fundamentals and equations for transmitting characteristics; experimental investigations; comparison of test results witb theory and previous investigations. Bibliography.

STABILITY. Moments of Gyration and Flying Stability (Moments de giration et stabilité de route), A. Lapresle. Aérophile (Paris), vol. 38, nos. 5-6 and 7-8, Mar. 15, 1930, pp. 85-88, and Apr. 15, pp. 115-117, 12 figs. Effect of flat turns on spinning illustrated by graphs. (Concluded.)

AIRPORTS

BEACONS. The Winnipeg Airway Beacon. Engineering (Lond.), vol. 129, no. 3359, May 30, 1930, p. 701. In connection with night flying operations, what is believed to be largest air beacon in British Empire and third largest in world, was augurated on Mar. 3 last; it is erected on roof of large new department store of Hudson Bay Co. at Winnipeg; light provided is about 200 ft. from ground, and main structure of beacon is surmounted by 24-in. Novalux directional beacon; light is provided by special 1,000-watt lamp operating on 115 volts, and giving 1,712,000 beam candle power.

A Turned-Reed Course Indicator for the Four- and Twelve-Course Aircraft Radio Range, F. W. Dunmore. Inst. Radio Engrs.—Proc., vol. 18, no. 6, June 1930, pp. 963-982, 15 figs. For 12-course radio range system, in which three modulation frequencies are used, type of reed indicator has been developed to indicate when aircraft is on any one of 12 courses, and if off, approximately how many degrees and whether to right or left.

CONSTRUCTION. Airport Development and the Highway Engineer, P. A. Fellows. Roads and Streets, vol. 70, no. 7, July 1930, pp. 241-244. Abstract of paper read before Engineers' Club of Philadelphia, previously indexed from Pub. Works, Apr. 1930.

COSTS. Unit Prices from Current Construction Bids. Eng. News-Rec., vol. 104, no. 20, May 15, 1930, pp. 829-830, 3 figs. New York airport bids on nine structural items; timber supports for cotton bales, New Orleans; concrete paving in Maryland; enlarging Morena rock fill dam and spillway for San Diego, details of spillway gates.

MONTREAL. The Airport at St. Hubert, Montreal, Quebec. Engineering (Lond.), vol. 129, no. 3363, June 27, 1930, pp. 842-844, 1 fig. Layout as planned, consists of three runways radiating from central point at angles of 120 deg. to suit all directions of wind; runways are 150 ft. in width, and from 1,800 to 2,000 ft. in length; particulars of mooring mast; movable platform landing stage is provided on passenger platform, connecting over guard rail with airship's gangway.

RUNWAYS SURFACING. Oil Separators Runways at Valley Stream, W. S. Bartlett. Airports, vol. 4, no. 6, June 1930, pp. 23-25, 3 figs. Discussion of construction methods and materials used by Stone & Webster Engineering Corp., in surfacing Curtis-Wright airport at Valley Stream; data on oil application and drainage.

AIRWAYS

TRANSOCEANIC. The Seadrome on Ocean Airways, E. R. Armstrong. Engrs. and Eng., vol. 47, no. 3, Mar. 1930, pp. 49-53, 7 figs. Article previously indexed from Airways, Jan. 1930.

ALLOY STEEL

MECHANICAL PROPERTIES. The Relative Merits of Some Different Alloy Steels with Respect to Certain Mechanical Properties, B. Stoughton and W. E. Harvey. Am. Soc. Testing Matls.—Advance Paper, no. 35, June 23-27, 1930, 16 pp. Taking as basis about 50 binary or ternary alloy steels whose chemical analysis and mechanical properties have been published, 1,800 numerical calculations were made grading steels in order of their relative standing according to numerical value of product of some function of their strength multiplied by function of their ductility or according to values of strength multiplied by function of their ductility or according to values of strength multiplied by Izod impact value.

ALUMINUM

SOLDERING. Soldering Aluminum, P. N. Emigh. Power Plant Eng., vol. 34, no. 11, June 1, 1930, pp. 642-643, 4 figs. Practical discussion of special flux, correct solder, and methods employed.

WELDING. Fusion Welding of Aluminum. Am. Mach., vol. 72, no. 22, May 29, 1930, p. 885, 5 figs. Sketches explain characteristics of oxyacetylene flames; table gives approximate size of tips and relative gas pressures used in welding aluminum of different thicknesses; use and composition of fluxes and rods is described.

AUTOMOBILE INDUSTRY

STANDARDIZATION, CANADA. The Necessity of Standardization in Canada, H. D. Allee. Soc. Automotive Engrs.—Jl., vol. 26, no. 6, June 1930, pp. 791-793 and (discussion) 793-795. Forms of standardization that are applicable to Canadian automotive industry and by which manufacturers can profit are pointed out; effect of export trade and tariff, service parts for overseas, relative size of market in Canada and United States.

B

AUTOMOTIVE ENGINES

DESIGN. Requirements of Airplanes and Automobiles (Der Leistungsbedarf des Flugszeuges und des Kraftwagens: ein Lehrreicher Vergleich), O. Schwager. Deutsche Motor Zeit. (Dresden), vol. 7, no. 6, June 1930, pp. 294-298. Discussion of characteristic differences in power application in automobiles and airplanes; notes on means of controlling power output and their different roles in airplane and automobile-engine design.

BALLOONS, CAPTIVE

OBSERVATION, INSTRUCTION IN. Ground Instruction in Observation for Captive Balloon Observers (L'instruction d'observation donnée en salle aux Elèves-Observateurs en ballon captif), Neant. Revue des Forces Aériennes (Paris), no. 10, May 1930, pp. 524-552, 8 figs. Outline of ground instruction subjects and methods for training military observers; description of exercises in perspective drawing, mapping, and relief plan work.

DESIGN AND PERFORMANCE. Notes on Captive Balloons for Observation (Note sur les ballons captifs d'observation), P. Jouglard. Revue des Forces Aériennes (Paris), no. 9, Apr. 1930, pp. 455-461, 2 figs. Discussion of design and performance requirements of captive balloons; table gives sketches and data for principal types.

BELTS AND BELTING

HORSEPOWER. Belt Horsepower Charts. Product Eng., vol. 1, no. 5, May 1930, pp. 249-250, 2 figs. Chart shows graphically various quantities in belt or chain transmission.

BLAST FURNACE PRACTICE

FUEL ECONOMY. Heat Value, Flow of Heat and Gas as Physical Bases of Metallurgical Processes (Waermewertigkeit, Waerme- und Gasfluss, etc.), H. Bansen. Stahl und Eisen (Duesseldorf), vol. 50, no. 24, June 12, 1930, pp. 841-842, 2 figs. Discussion of paper previously indexed from May 15 issue of this journal.

INDIA. Charcoal Blast-Furnace Practice in Mysore, B. Viswanath. Min. and Met., vol. 11, no. 283, July 1930, pp. 332-335. Notes on plant at Bhadravati, 2,000 ft. above sea level in Shimoga district of Mysore, British India; ore from Kemmangundi hill is mixture of limonite and hematite, with low silica; limestone from quarries near Gangur, 8 mi. distant; analyses of raw materials; furnace dimensions; operating data; average daily production is about 65 tons pig iron.

BOILER FIRING

COMPARISONS. Modern Stokers Compared with Pulverized-Coal Firing (Der neuzeitliche Stoker und sein Vergleich mit der Kohlenstaubfeuerung), J. W. Armour. Archiv. fuer Waermewirtschaft (Berlin), vol. 11, no. 6, June 1930, pp. 201-202, 3 figs. German abstract of paper read before Second International Conference on Bituminous Coal, 1928, indexed in Engineering Index, 1929, p. 261, from Combustion, May 1929, and Steam Coal Buyer, June 1929.

BOILER OPERATION

LOAD FLUCTUATIONS. Causes and Effects of Load Fluctuations in Boiler Operation (Ursachen und Folgen der Belastungsschwankungen im Kesselbetrieb), E. Praetorius. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 10 and 11, May 31, 1930, pp. 143-146 and June 15, pp. 160-161, 17 figs. May 31: Notes on pressure fluctuations. June 15: Preventive measures; equalization of fluctuations. (Concluded.)

BOILER PLATES

CRACKING. Fractures in Boiler Metal, A. E. White and R. Schneidewind. Am. Soc. of Mech. Engrs.—Advance Paper, for mtg. June 9-12, 1930, 19 pp., 63 figs. Examinations, which were to large extent metallographic in nature, have led to some generalizations and classification of cracks and fractures as related to causes of failures; types of failure and their metallographic characteristics; material presented consists of short review of literature on boiler-metal failures, detailed description of fractures in boiler metal due to known causes, and description of actual failures in service.

BOILERS

FEEDWATER TREATMENT. *See Feedwater Treatment.*

HIGH PRESSURE. The Design and Results of a 600 lb. per Sq. In. Boiler Installation, W. Nithsdale. Mech. World (Manchester), vol. 87, nos. 2260 and 2261, Apr. 25, 1930, pp. 395-396, and May 2, pp. 407-409, 5 figs. Abstracts of paper read before Instn. Mech. Engrs., previously indexed from Engineering (Lond.), Mar. 28, 1930. (To be continued.)

HIGH PRESSURE (LOEFFLER). Problems Involved in Operation with Super-Pressure Steam, St. Loeffler. Mech. Eng., vol. 52, no. 6, June 1930, pp. 601-604, 10 figs. Particulars of new studies on steam-pumping boilers without economizers as designed particularly for marine installations. Translated from author's contribution to commemorative volume prepared for A. Stodola's 70th birthday.

HUMMING AND SMOKING. Elimination of Boiler Humming and Smoking (Beseitigung von Kesselbrummen und Rauchen), W. Weck. Zeit. des Bayerischen Vereins (Munich), vol. 34, no. 10, May 31, 1930, pp. 149-151. Scientific measures for overcoming humming and smoking have been developed and successfully applied; details of Weck air regulator supplemented by flaps and walls for improving air distribution.

LOAD FLUCTUATIONS. Causes and Effects of Load Fluctuations in Boiler Operation (Ursachen und Folgen der Belastungsschwankungen im Kesselbetrieb), E. Praetorius. Zeit der Bayerischen Revisions Vereins (Munich), vol. 34, nos. 7 and 9, Apr. 15. 1930. pp. 91-93, and May 15, pp. 126-128, 10 figs. Among causes of fluctuation are day and night changes, seasonal changes, influence of weather, turning off and on of steam-consuming equipment; disadvantages of load fluctuation are enumerated; preventive measures include elastic firing, heat, storage, etc. (To be continued.)

OIL BURNING. Comparative Performance of a Large Boiler Using Oil and Natural-Gas Fuels, F. G. Philo. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. June 9-12, 1930, 11 pp., 31 figs. Boiler tested was Babcock and Wilcox cross-drum, straight-tube type with interdeck superheater; furnace was completely inclosed by Bailey type water-cooled walls; Babcock and Wilcox air heater was of tubular construction; Peabody combination oil and gas burners were used; highest rate of output at which boiler was tested was 450,751 lbs. of steam per hour, which represented operation of 3,416-hp. boiler at 413.2 per cent of rating.

PULVERIZED COAL FIRED, DRAFT CONTROL. Tests on Pulverized-Coal Boiler with Draft Shut-off (Versuche an einer Kohlenstaubfeuerung mit Zugsperre), K. Jaroschek. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 6, June 1930, pp. 214-217, 5 figs. Results of comparative tests on vertical-tube boiler of 830 sq. m. heating surface and suction draft installation, to determine advantages of built-in draft shut-off.

TESTING. Tests of the Resistance to Repeated Pressure of Forged, Riveted, and Welded Boiler Shells, H. F. Moore. Am. Soc. Mech. Engrs.—Advance Paper, no. 15, for mtg. June 9-12, 1930, 6 pp., 7 figs. Comparative tests on standard A.S.M.E. riveted drum, manganese-steel riveted drum, forged seamless-steel shell, two-forge-and-hammer-welded shells, and eight fusion-welded (metallic-arc) shells, well above allowable working pressure; under repeated stress properly made welded joints are stronger than plates themselves when weakened by stress raisers such as small holes or surface defects; data on strength of drum heads.

WATER TUBE, JAPAN. Development of Water Tube Boilers in Japan, M. Kamo. Far East. Rev. (Shanghai), vol. 26, no. 5, May 1930, pp. 225-230, 5 figs. Types of boilers used in Japan on marine vessels and for stationary plants with special reference to Takuma boiler.

WOOD WASTE FIRED. Boiler Settings for Burning Refuse Wood, C. S. Gladden. Am. Soc. of Mech. Engrs.—Advance Paper for mtg., June 9-12, 1930, 13 pp., 14 figs. Some recent developments in design of boiler furnaces for burning green or wet refuse wood; experiences influencing development of furnaces for burning dry refuse wood; factor influencing design of wood-burning furnaces.

BOLTS AND NUTS

MANUFACTURE. Bolts, Nuts and Rivets from Pacific Coast Steel, C. A. Handschin. West. Machy. World, vol. 21, no. 5, May 1930, pp. 173-178, 13 figs. Description of manufacturing process, equipment and operations at San Francisco plant of Pacific Coast Steel Corp.; production capacity is 1,500 tons per month of bolts, nuts, rivets, cap and set screws, railroad track bolts and spikes, and special forgings; bolt and nut department requires 2,500 tons raw material monthly.

Manufacture and Heat Treatment of Screws and Bolts, C. B. Phillips. Wire and Wire Products, vol. 6, no. 5, June 1930, pp. 227-229 and 233-235, 4 figs. Methods and special machines used to produce output automatically and of high quality.

BRIDGE CONSTRUCTION

COSTS. Unit Prices from Current Construction Bids. Eng. News Rec., vol. 104, no. 24, June 12, 1930, pp. 997-998, 1 fig. Unit bids on high-level concrete highway viaduct on Jersey meadow; ties for New York subways and approaches and superstructure for McKees Rocks bridge, Pittsburgh, awarded in three contracts totaling $4,868.233.

BRIDGES, CONCRETE TRESTLE

AUSTRALIA. Road Bridge Over Loddon River at Eddington, Victoria, M. G. Dempster. Commonwealth Engr. (Melbourne), vol. 17, no. 9, Apr. 1930, pp. 337-340, 4 figs. Report on construction of reinforced-concrete trestle bridge 680 ft. long.

BRIDGES, CONCRETE ARCH

GERMANY. The High Bridge Over the Ammer River at Echelsbach (Upper Bavaria), Longest Span Reinforced Concrete Bridge of Germany (Die Hochbruecke ueber die Ammer bei Echelsbach (Oberbayern), die weitestgespannte Eisenbetonbriecke Deutschlands), R. Gerhart. Beton u. Eisen (Berlin), vol. 29, no. 6, Mar. 1930, pp. 89-97, 20 figs. Design and construction of bridge having single arch 130 m. long; outline of Melan-Spangenberg system of bridge; design and construction; report on tests of bridge elements.

BUILDING MATERIALS

HEAT INSULATION. Investigation of the Heat Insulation Properties of Building Construction, H. Krueger and A. Eriksson. Heat., Piping and Air Conditioning, vol. 2, no. 7, July 1930, pp. 563-565, 1 fig. Conductivity values for concrete and frame construction, brick walls, and windows as determined by recent investigations are given; investigations also included two tests on cork.

BUILDINGS STEEL-CONCRETE

FAILURE. Derrick Causes Structural Collapse. Am. Contractor, vol. 51, no. 23, June 7, 1930, p. 15, 1 fig. Note covers subject of item previously indexed from Eng. News-Rec., May 29, 1930.

C

CAISSONS

CONCRETE. Precast Concrete Caissons for Piers and Docks Floated into Place, P. W. Leisner. Concrete, vol. 36, no. 5, May 1930, pp. 30-32, 5 figs. Methods of placing 400 large caissons, covering about 4½ linear miles in harbour structures of port of Gdynia, Poland; largest caissons were 105 ft. long, 23 ft. wide and 35 ft. deep, divided into nine cells by vertical cross walls; width of bottom, or base, was 30 ft.; weight was about 1,200 long tons; most of caissons were made standard length of 60 ft., divided into five cells by vertical cross walls.

CARBON DIOXIDE

REFRIGERATING SYSTEMS. Cooling with Carbon Dioxide, A. N. Changler. Heat., Piping and Air Conditioning, vol. 2, no. 7, July 1930, pp. 572-574, 5 figs. Discussion of equipment layout of carbon-dioxide systems for air conditioning theatres, department stores, or office buildings; carbon-dioxide condensers; carbon-dioxide receiver and pipe connections; layout of carbon-dioxide system arranged for single-effect operation; water-cooling apparatus.

REFRIGERANT. Developments in the Production of Solid Carbon Dioxide, R. Lloyd. Cold Storage (Lond.), vol. 33, no. 387, June 19, 1930, pp. 166-167. Discussion of physical properties and sources of carbon dioxide.

CAST IRON

HEAT TREATMENT. Heat Treatment of Cylinder and Alloy Irons, F. J. Walls and A. Hartwell, Jr. Fuels and Furnaces, vol. 8, no. 7, July 1930, pp. 969-971, 7 figs. Discussion of relief of stresses and physical changes in cylinder irons with various heat treatments; some effects of heat treatment on chromium-molybdenum and chromium-nickel-manganese cast irons. Abstract of paper presented before Am. Foundrymen's Assn.

CEMENT CRACKING

INVESTIGATION OF. Occurrence of Radial Cracks in Cement Pats Scored in Air After Previous Storage in Water (Das Auftreten von Kantenrissen an Zementkuchen, etc.), H. Burchartz. Zement (Berlin), vol. 19, no. 12, Mar. 20, 1930, pp. 265-266; see also brief translated abstract in Bldg. Sci. Abstracts (Lond.), vol. 3, no. 4, Apr. 1930, pp. 127-128. Investigation of radial shrinkage cracks appearing in cement pats prepared for cold-water soundness test after they have been removed from water, which are occasionally mistaken for indications of unsoundness; pats with thick edges had more cracks than standard pats, and drier paste discs more than specimens gauged with standard amount of water.

CEMENT INDUSTRY

BRAZIL. Development of the Cement Industry in Brazil (Entwicklungsaussichten der Zementindustrie in Brasilien). Zement (Berlin), vol. 19, no. 12, Mar. 20, 1930, p. 295. Brief review of industry; two new factories are planned.

CEMENT PLANT

CALIFORNIA. California's Largest Cement Mill Kept Up-to-date. Rock Products, vol. 23, no. 13, June 21, 1930, pp. 41-48, 20 figs. Plant of Santa Cruz Portland Cement Co., Davenport, Calif., is described; no. 7 Symons stone crusher has capacity of 170 tons; Hardinge Mills are fed by 18-in. belt conveyor.

CEMENT, PORTLAND

FINENESS. Influence of the Fineness of Portland Cement on its Properties, P. Filossofow. Pit and Quarry, vol. 20, no. 6, June 18, 1930, pp. 46-48, 6 figs. Translated from article indexed in Engineering Index 1929, from Tonindustrie Zeitung, Sept. 9, 1929.

CEMENT SETTING

FAILURES, CAUSE OF. Mixing Water as the Cause of Faulty Setting (Anmachewasser als Ursache einer Abbindestoerung), Haegermann. Zement (Berlin), vol. 19, no. 12, Mar. 20, 1930, pp. 264-265; see also brief translated abstract in Bldg. Sci. Abstracts (Lond.). vol. 3, no. 4, Apr. 1930, p. 123. Failures of batch of concrete to harden satisfactorily was traced to use of purified effluent of artificial fertilizer factory as mixing water; water contained nitrogen pentoxide which varied considerably in amount from day to day; it was found on investigation that contamination with nitrogen pentoxide up to 0.75 per cent produced no harmful results, but that larger quantities seriously retarded setting.

CHIMNEYS

DUST NUISANCE. Problems Relating to the Prevention of Nuisance from Fumes and Dust from Power Stations, M. W. Travers. Inst. of Fuel—Jl. (Lond.), vol. 3, no. 11, Apr. 1930, pp. 292-299 and (discussion) 300-302, 3 figs. Methods of preventing evolution of oxides of sulphur and dust from power-plant chimneys; results of investigations upon individuals for sulphur-dioxide detection.

CHROMIUM PLATING

VALUE OF. The Value of Deposited Chromium as a Corrosion Preventative, L. Wright. Chem. and Industry (Lond.), vol. 49, no. 23, June 6, 1930, p. 473. Main developments in chromium plating during last four years have been realization of limitations of deposited chromium and exploration of its uses as engineering asset dependent upon its physical properties rather than its chemical.

CITY PLANNING

ZONING. Zoning Legislation in the United States, N. L. Knauss. U.S. Bur. Standards —Division of Bldg. and Housing, Apr. 1930, 51 pp. Review of zoning development in past 30 years; standard state zoning enabling acts; tabulation of zoning legislation by states and years.

COAL

BRIQUETTING. Coal Briquetting without Binder (Zur Frage der Brikettierung von Steinkohlenstaub ohne Bindemittel), R. Uloth and W. Swietoslawski. Zeit. des Oberschlesischen Bergu. Huettenmaennischen Vereins zu Katowice (Katowice), vol. 69, no. 5, May 1930, pp. 244-254, 6 figs. Discussion of possibility of coal briquetting without binder; author contends that laboratory method developed by Swietoslawski and assistants is unsuitable in practice but method developed by M. Dunkel may be used; W. Swietoslawski answers, defending his work. Bibliography.

HANDLING. *See Steam Power Plants.*

PREPARATION. Fitting Preparation to Meet Market Demands, J. B. Morrow. Coal Age, vol. 35, no. 6, June 1930, pp. 362-364, and 367, 1 fig. Visual inspection on 2½ x 4 in. or 1 x 2½ in. sizes is not sufficiently dependable or accurate enough for control purposes; only real determinant for extraneous matter is float-and-sink test in heavy characteristics of coal; percentage of refuse; quality and use of final product; capacity of plant; climatic conditions; available mill site; there are many places where air methods are applicable and economical, but wet process offers lower ash and greater uniformity in market product. Abstract of paper presented before Rocky Mountain Coal Min. Inst.

COAL CARBONIZATION, LOW TEMPERATURE

GREAT BRITAIN. The Economics and Commercial Development of Low Temperature Carbonization in Great Britain, C. H. Lander. Colliery Guardian (Lond.), vol. 140, no. 3626, June 27, 1930, pp. 2402-2403. Factors influencing commercial success of different processes discussed are: type of coal available, and its cost; type of products for which there is local market, and prices obtainable; type of plant that will yield suitable products from available coal and in most remunerative proportions; costs of erecting and working plant. From paper before World Power Conference, Berlin.

COAL DISTILLATION

PROGRESS IN. Progress in Coal Utilization (Ueber Fortschritte auf dem Gebeite der Kohlenverwertung), H. Pichler. V.D.I. Zeit .(Berlin), vol. 74, no. 22, May 31, 1930, pp. 720-722, 1 fig. General review of modern processes for chemical refinement of coal with special reference to coal liquefaction, hydrogenation, etc.

COAL MINES AND MINING

ENGINEERING. Engineering Objectives in Planning and Development of Wildwood Mines, J. H. Fletcher. Coal Age, vol. 35, no. 5, May 1930, pp. 268-270. Notes on engineering work done preparatory to design of completely mechanized mine to recover 40,000,000 tons of coal in Thick Freeport seam in tract in Allegheny County, 15 mi. north of Pittsburgh.

MECHANIZATION. Report of Investigation of the Underground Conveying and Loading of Coal by Mechanical Means, R. Clive. Instn. of Min. Engrs.—Trans. (Lond.), vol. 78, part 5, Apr. 1930, pp. 305-338 and (discussion) 339-399, 21 figs. Report was prepared by special committee of Midland Inst. of Min. Engrs., collaborating with other organizations; discussion was at meetings of various institutes; matter was indexed in Engineering Index, 1929, p. 452, from many sources; also in 1930 from Iron and Coal Trades Rev., Feb. 28, and Mar. 7, 1930.

COAL RESOURCES

AUSTRALIA. A Report on the Coal Resources of the Commonwealth of Australia. Standards Assn. of Australia—Power Survey Report (Sydney), no. PS. 3, Dec. 1929, 169 pp., 60 figs. Report covers character of deposits in various parts of Australia; geographical distribution, chemical analysis of various kinds; output, markets and chief uses.

COLD STORAGE PLANTS

DESIGN. An Analysis of Terminal Cold Storage Design, M. Hyde. Cold Storage (Lond.), vol. 33, no. 387, June 19, 1930, pp. 179-181, 6 figs. Structural requirements of new Jacksonville, Fla., project; use of artificial atmospheres; present-day construction; foundations; wall construction. (To be continued.)

HALIFAX. Canadian Cold Storage Plant Uses Quick Freezing, A. E. Macdonald. Heat. Piping and Air Conditioning, vol. 2, no. 7, July 1930, pp. 593-596, 8 figs. Illustrated description of plant and equipment at Halifax Ocean Terminals, operated by Nova Scotia Public Cold Storage Terminals, Limited; 50 tons of ice daily; power plant equipment; fish processing procedure.

CONCRETE AGGREGATES

CONCRETE AGGREGATES. The "Missing Link" in Concrete Aggregate, L. C. Gilbert and H. F. Kriege. Rock Products, vol. 23, no. 13, June 21, 1930, pp. 55-58, 4 figs. Failure to regard aggregate in its entirety, as concrete-making ingredient, is responsible for much of difference of opinion that exists regarding concrete-making properties of various kinds of aggregate; aggregate between ¼-in. and 10-mesh sizes is responsible for as much variation in concrete strengths as are variations in types of aggregates.

ADMIXTURES. Use of Concrete in Hydraulic Structures. Elec. West, vol. 64, no. 6, May 15, 1930, pp. 372-389, 29 figs. Report of subcommittee on use of concrete in hydraulic structures of Pacific Coast Electrical Assn.; description of various forms of diatomaceous earth and volcanic ash, and their effect on workability, chemical reaction, strength and permeability; experiences of three California companies in constructing of concrete bench flumes in various localities and under different circumstances; transportation facilities, aggregate plants, concrete plants, forms, reinforcing and methods of placing concrete.

CONCRETE COLOURING

RECOMMENDATIONS FOR. The Colouration of Concrete, R. Wilson. Contract Rec. (Toronto), vol. 44, no. 23, June 4, 1930, pp. 691-693. Associate chemist of research laboratory of Portland Cement Association gives recommendations for producing tinted effects; colouring with pigments; cause of non-permanency of colour; penetration processes; paints. Report of Am. Concrete Institute's Committee No. 703.

CONCRETE, HAYDITE

TESTS OF. Tests of Plain and Reinforced Haydite Concrete, F. E. Richart and V. P. Jensen. Am. Soc. for Testing Matls.—Advance Paper, no. 68, for mtg. June 23-27, 1930, 20 pp., 2 figs. Structural properties of poured Haydite concrete, such as is being used in building construction; mixtures include concretes made with fine and coarse Haydite aggregates, natural sand and coarse Haydite, and, for comparison, sand and gravel or broken limestone; studies were made of properties of aggregates, workability, yield, unit weight, compressive strength and modulus of elasticity of concrete, and resistance to bond and diagonal tension in beams.

CONCRETE SPECIFICATIONS

SIMPLIFIED. Simplified Specifications for Quality Controlled Structural Concrete. Concrete, vol. 36, no. 5, May 1930, pp. 23-24. Short form of quality-control specifications for structural concrete, suitable for inclusion as part of general specification at point where concrete work is covered.

CONVEYORS

BELT. Care and and Operation of Conveyor Belts and Equipment, J. W. Schaffner. Power Transmission, vol. 36, no. 5, May 1930, p. 28. Discussion of causes of poor belt elevator service; elimination of danger of static electricity. (Continuation of serial.)

CENTRALIZED CONTROL. Intricate Conveyor System has Centralized Controls, C. K. Prevear. Iron Trade Rev., vol. 86, no. 23, June 5, 1930, pp. 75-79, 10 figs. Description of conveyors and handling devices used in warehouse of merchandising department of Western Electric Co., Kearny, N.J.; live roller curve, sorting mechanisms, alligator switches, lowerators; cross-section showing elevations of two warehouse buildings. Paper presented at A.S.M.E. Materials Handling meeting in Chicago, Mar. 5-7.

FORGE SHOPS. *See Forge Shops.*

D

DIESEL ENGINES

AUTOMOTIVE. Diesel Engine for Motor Vehicles and Its Economy (Der Dieselmotor fuer Kraftfahrzeuge und seine Wirtschaftlichkeit), Wawrziniok. Automobiltechnische Zeit. (Berlin), vo. 33, no. 17, June 20, 1930, pp. 416-420, 4 figs. General discussion of factors controlling economy; combustion chamber design and injection principle; tables give fuel specification and data on design and performance of Diesel and carburetor engines; operating economy of M.A.N. Diesel and M.A N. gasoline truck is compared.

The Diesel Engine as Applied to Road Transport, W. H. Goddard. World Power (Lond.), vol. 13, no. 77, May 1930. pp. 439-444, 8 figs. It is evident that Diesel engine is destined, in near future, to occupy very important place not only in Great Britain but in most parts of civilized world; full description of technical details of Diesel engine and its performance as compared with that of gasoline engine.

Trend in Design of Diesel Engines, O. Nonnenbruch. Oil and Gas Jl., vol. 29, no. 3, June 5, 1930, pp. T-122 A. Brief article, with special reference to engines for petroleum pipe line main pumping stations; manufacturers seem to lean towards weight of about 3 to 3½ lbs. per cu. in. cylinder displacement.

FUEL INJECTION. Some Effects of Air and Fuel Oil Temperatures on Spray Penetration and Dispersion, A. G. Gelalles. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 338, May 1930, 11 pp., 6 figs. Spray records and curves plotted from records show that changed properties of air and fuel under high temperatures decreased penetration and increased dispersion of oil sprays. Bibliography.

Factors in Nozzle Design in the Light of Recent Oil-Spray Research, P. H. Schweitzer. Am. Soc. for Mech. Engrs.—Advance Paper, for mtg. June 12-14, 1930, 6 pp., 12 figs. Discussion of Diesel spray-nozzle constructions with special reference to following: metering, timing, injecting, and spraying.

HIGH SPEED. Injection Systems for High-Speed Diesel Engines, L. Hausfelder. Diesel Power, vol. 8, no. 6, June 1930, pp. 311-313, 2 figs. Illustrated description of design features of constant-stroke fuel pumps; port-controlled pumps. (Continuation of serial.)

SUPERCHARGING. The Compounding and Supercharging of Diesel Engines, M. Gautier. Shipbldr. (Lond.), vol. 37, no. 238, Apr. 1930, pp. 432-433. Paper presented before Association Technique Maritime et Aéronautique, indexed in Engineering Index 1929, p. 568, from Bul. Technique du Bureau Veritas, July and Aug. 1929.

MAINTENANCE AND REPAIR. Diesel Engine Upkeep. Power Plant Eng., vol. 34, no. 12, June 15, 1930, pp. 699-701, 5 figs. Piston upkeep is dependent upon operating conditions of other engine parts; high temperatures complicate problem; repair and upkeep methods; withdrawal and replacement. (Continuation of serial.)

SUPERCHARGING. Supercharging Diesel Engines (La suralimentation des moteurs Diesel), A. Rateau. Génie Civil (Paris), vol. 96, no. 7, Feb. 15, 1930, pp. 160-165, 7 figs.; see also translated abstract in Power Engr. (Lond.), vol. 25, no. 290, May 1930, p. 203. Prefatory note, explaining importance of author's work on supercharging of airplane and Diesel engines is followed by reprint of article contributed to Revue Générale des Sciences shortly before author's death; he considers that it is possible to maintain supercharging pressure equal to 2¼ times mean back pressure at exhaust in four-stroke Diesel on normal load.

VIBRATIONS. Torsional Vibrations and Critical Speeds in Diesel Generators. V. L. Maleev. Power, vol. 71, no. 22, June 3, 1930, pp. 861-864, 2 figs. Practical outline of method of figuring critical speeds produced by torsional vibration of crankshafts of Diesel engines direct-connected to a.c. generators; how design of Diesel, particularly of its flywheel, is influenced by requirements of parallel operation.

DIESEL LOCOMOTIVES

COMPRESSED AIR TRANSMISSION. The Diesel Compressed-Air Locomotive, J. Geiger. Eng. Progress (Berlin), vol. 11, no. 5, May1930. pp. 117-120, 5 figs. Description of design and performance of Diesel-compressed-air locomotive, built for German Railroad Company by M.A.N., Augsburg Works, and Maschinenfabrik Esslingen; at speed of 60 km. 37 mi.) per hr., Diesel-compressed-air locomotive consumed 12 per cent less fuel per ton and mile than Diesel-electric locomotive under same conditions; vertical 6-cylinder M.A.N. Diesel engine with airless injection is direct-connected to two-cylinder air compressor of single-stage double-acting type; sketch showing section through air compressor.

E

ELECTRIC CABLES

IONIZATION. Ionization Studies in Paper-Insulated Cables, C. L. Dawes and P. H. Humphries. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 766-775, 12 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

ELECTRIC CIRCUIT BREAKERS

EXPANSION. Expansion Breaker (Der Expansionsschalter), F. Kesselring. Elektrotechnische Zeit. (Berlin), vol. 51, no. 14, Apr. 3, 1930, pp. 499-508, 31 figs. Principle of breaker is derived from fundamentals of liquid breaker; thermodynamic and electric processes during passage of current through zero are studied and design is outlined; comparison between expansion and compressed air breakers.

ELECTRIC CIRCUITS

ANALYSIS. Operating Diagrams for Symmetrical Networks (Betriebsdiagramme fuer Symmetrische Kettenleiter), T. Watanabe. Elektrische Nachrichten Technik (Berlin), vol. 7, no. 4, 1930, pp. 153-166, 25 figs. Theoretical mathematical high-frequency electric circuit analysis.

ELECTRIC CONDUCTORS

MEASUREMENTS. Study of Alternating Current Energy and Voltage in Case of Conductors of Oblong Cross Section (Untersuchungen ueber Wechselstromleistung und- spannung bei Leiterstuecken von ausgedehenten Querschnitt), W. Wangen. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 17, Apr. 27, 1930, pp. 381-389, 6 figs. It is shown that in case of two conductors of oblong cross-section, coefficients of self and mutual impendance exist and that voltages of each conductor measured with voltage measuring wires can be presented as linear, homogeneous function of total of currents by means of this coefficient; exemplification.

ELECTRIC FURNACES

HEAT TREATING. Electrical Equipment for Heat Treating, C. L. Fisher. Heat Treating and Forging, vol. 16, no. 6, June 1930, pp. 775-777, 6 figs. Description of different types of furnaces and methods of automatically controlling them.

ELECTRIC GENERATORS

VENTILATION. Ventilation of Revolving-Field Salient-Pole Alternators, C. J. Fechheimer. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 548-575, 51 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

ELECTRIC HEATING

EXHIBITION, LEIPZIG. Electric Heating at the Leipzig Fair—1930 (Elektrowaerme auf der Leipziger Messe 1930), Moertzsch. Elektrizitaetswirtschaft (Berlin), vo. 29, no. 504, Mar. 1930, pp. 135-141, 14 figs. Practically all large concerns have taken up manufacturing of heating equipment; tendency towards adaptation and fulfilment of practical wishes of housewives was visible in this year's exhibits; industrial heating and special furnaces.

INDUSTRIAL. Industrial Electric Heating. World Power (Lond.), vol. 13, no. 78, June 1930, pp. 550-551. Consideration of indirect heating by resistances; discussion of working costs; efficiency of oven space.

ELECTRIC INSULATING MATERIALS

PUNCTURE. Three Regions of Dielectric Breakdown, P. H. Moon and A. S. Norcross. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 755-765, 10 figs. Paper previously indexed from Am. Inst. Elec. Engrs.—Jl., Feb. 1930.

ELECTRIC LINES, HIGH TENSION

FAULT LOCATION. Fault-Location Measuring Equipment for High-Tension Transmission Lines (Das Fehlerortmessgeraet fuer Hochspannungsfreileitungen), H. Poleck. Siemens-Zeit. (Berlin), vol. 10, no. 3, Mar. 1930, pp. 153-162, 8 figs. Description of equipment with outside source of measuring frequency, which answers practical requirements, and usefulness of which has been proven in practical tests on high-voltage networks.

ELECTRIC MACHINERY

INDUCED VOLTAGES. Induced Voltage of Electrical Machines, L. V. Bewley. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 456-466, 5 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

SYNCHRONOUS. Transient Torque-Angle Characteristics of Synchronous Machines, W. V. Lyon and H. E. Edgerton. Am. Inst. Elec. Engrs. Trans., vol. 49, no. 2, Apr. 1930, pp. 686-699, 12 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

Three-Phase Short Circuit Synchronous Machines, R. E. Doherty and C. A. Nickle. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 700-714, 16 figs. Paper previously indexed from Advance Paper. for mtg. Jan. 27-31, 1930.

THEORY. Generalized Theory of Electrical Machinery, G. Kron. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 666-685, 31 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

ELECTRIC MOTORS

STARTING. Starting Performance of Salient-Pole Synchronous Motors, T. M. Linville. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, pp. 531-546, 20 figs. Paper previously indexed from Am. Inst. Elec. Engrs.—Jl., Feb. 1930.

ELECTRIC POWER SUPPLY

CHICAGO. System Connections and Inter-Connections Chicago District, G. M. Armbrust and T. G. LeClair. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 582-596, 13 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

DETROIT. The Fundamental Plan of Power Supply of the Detroit Edison Company, S. M. Dean. Am. Inst. Elec. Engrs.—Trans., vol. 49, no 2, Apr. 1930, pp. 597-604, 4 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

PHILADELPHIA. Fundamental Plan of Power Supply in the Philadelphia Area, R. Bailey. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 605-620, 6 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

ELECTRIC SWITCHGEAR

METAL-CLAD. The Metal-Clad Switchgear at State Line Station, A. M. Rossman. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 397-403, 8 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

ELECTRIC SYMBOLS

STANDARDIZATION. Symbols and Designations for Testing and Calculation in Electricity-Supply Practice (Begriffe und Bezeichnungen fuer Untersuchungen und Berechnungen auf dem Gebeit der Elektrizitaetswirtschaft), W. Windel. Electrotechnische Zeit. (Berlin), vol. 51, no. 21, May 22, 1930, pp. 738-741. Proposed standardization of terms and symbols in field of electric supply practice are listed.

ELECTRIC TRANSFORMERS

AUTO. Inversion Currents and Voltages in Auto-Transformers, A. Boyajian. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 810-822, 12 figs. Paper previously indexed from Am. Inst. Elec. Engrs.—Jl., Feb. 1930.

LOADING. Loading Transformers by Temperature, V. M. Montsinger. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 776-792, 21 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

LOSSES. No-Load Current of Network Transformers (Der Leerlaufstrom der Netztransformatoren), J. Wahlig. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 505, Apr. 1, 1930, pp. 168-170, 2 figs. Analysis of no-load and magnetizing current under various load conditions, and their relation to no-load losses; voltage wave oscillogram of 10-kva. transformer.

OPERATION. Operating Transformers by Temperature, W. M. Dann. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 793-797. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

POLE. Pole Transformers (Oszloptranszformatorallomasok), L. Jozsef. Elektrotechnik (Budapest), vol. 23, no. 3/4, Feb. 15, 1930, pp. 23-30, 13 figs. Explanation of complaints against transformer stations; favourable results of service with separately mounted high-tension fuses and transformers erected with oil switches; new design of disconnectable high-tension fuses with wire protection by celluloid tube.

ELECTRIC WELDING

ARC PROCESS. Industrial Progress, H. M. French. Min. and Met., vol. 11, no. 283, July 1930, pp. 352-354, 5 figs. Metallic arc, carbon arc, atomic hydrogen arc, and shielded-arc methods are brifly described; major applications of each are noted.

Cathode Energy of the Iron Arc, G. E. Doan. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 723-734, 2 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

RESISTANCE. Resistance Welding, B. T. Mottinger. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 524-530, 11 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

Electric Resistance Welding (A villamos ellenallashegesztes es a toemeggyartas), B. Jozsef. Elektrotechnika (Budapest), vol. 23, no. 7/8, Apr. 15, 1930, pp. 70-74, 10 figs. Development of electric resistance welding; new designs of electric welding machines operating with pilgrim-step; advantages of use of such machines in mass manufacturing.

ELEVATORS

CAPACITY. The Traffic Capacity of Elevators, G. F. Draffin. Instn. Engrs. Australia—Jl. (Sydney), vol. 2, no. 5, May 1930, pp. 164-169, 4 figs. Effect of elevators of large building on both its initial cost and its rental value is such as to warrant more careful choice of elevator ratings than is usual; method of analysis is given to enable this choice to be satisfactorily made and example is worked out; while curves and tables of design data are given, it is pointed out that accuracy of results will depend very largely on experience of designer; this experience can only be gained by continual recording and systematic tabulation of data from existing installations.

ENGINEERING

BUSINESS RELATIONS. American Business—And the Engineer, R. P. Shorts. Mich. Engr., vol. 48, no. 1, Mar. 1930, pp. 20-26. Interdependency of industries; problem of capital and labour; importance of industrial research and contribution of engineers.

RESEARCH. Engineering Research, A. D. Bailey. Combustion, vol. 1, no. 11, May 1930, pp. 24-29, 8 figs. Extent and rapidity of industrial progress depends upon efficiency and scope of research activities; emphasis is placed upon better organization of widespread work that is being done by principal engineering and trade associations, private corporations and other agencies; discussion of research activities by federal organization.

SCIENCE RELATIONSHIP. The Relationship Between Science and Engineering, G. Dunn. Mech. Eng., vol. 52, no. 6, June 1930, p. 595. Engineering is profession, born about 1750, child of industrial era; of many kinds of art, engineer deals only with those that are useful; sciences of mathematics, mechanics, physics, and chemistry have their art of engineering, which is art of economic application of these sciences to purpose of man. From address before Alumni of Columbia University, Feb. 12, 1930.

ENGINEERING EDUCATION

UNIVERSITY. Our Universities. Engineer (Lond.), vol. 149, no. 3878, May 9, 1930, p. 522. Editorial comment on education problems contained in report of University Grants Committee; it is stated that universities should not, as they now do, refuse promotion to men of recognized teaching ability because they have not won international reputations by books and articles in learned periodicals.

ENGINEERS

GOVERNMENT ACTIVITIES. Engineering and the Art of Government, L. W. Wallace. Mich. Engr., vol. 48, no. 1, Mar. 1930, pp. 51-59. Part engineering is playing in activities of government is shown by review of organized engineering services in various executive departments of United States and extent of function of each.

The Engineer in Government, F. C. Emerson. Mich. Engr., vol. 48, no. 1, Mar. 1930, pp. 27-35. Reasons from experience of author as engineer and State governor, in support of proposition that training, experience and necessary qualifications of successful engineers, fit him in many ways for fine service in field of government; fundamental qualities essential for good public official.

REGISTRATION. The Registration of Engineers. Engineer (Lond.), vol. 149, no. 3881, May 30, 1930, pp. 605-606. Editorial comment on symposium of papers read before Société des Ingénieurs Civils de France; it seemed to be agreed that universities should still be allowed to confer their own degrees and diplomas and those awards should qualify possessors to call themselves engineers; desire to control use of title, engineer, is largely sentimental; man who has devoted many years to his education and training does not like to be classed with engine driver and mechanic; he feels that some means of distinguishing between the highly trained and untrained should exist.

The Registration of Engineers in Canada. Engineering (Lond.), vol. 129, no. 3361, June 13, 1930, p. 768. Registration institutions for engineers exist in all provinces except Saskatchewan, while in five of them registration or membership of these bodies is compulsory; in British Columbia, where procedure followed for this purpose may be taken as typical of rest, Association of Professional Engineers was established in 1920.

Remuneration. Who should Pay the Engineer? J. P. Ferris. Mech. Eng., vol. 52, no. 6, June 1930, pp. 615-617. Manufacturing public is accustomed to obtaining valuable engineering services without cost; author believes that important step lies in building up by industry of consulting engineering profession; manufacturers should include as much as possible of cost of engineering services rendered in their quotations; proposed change should benefit every one except manufacturer who has been asking for excessive engineering service without placing orders in sufficient volume to pay for it.

EVAPORATION

Formulae. Vapour Pressure and Heat Vaporization, P. G. Nutting. Indus. and Eng. Chem., vol. 22, no. 7, July 1930, p. 771. Development for formulae for determination of relation between heat of vaporization and temperature.

EVAPORATORS

Marine. A New Type of Marine Evaporator. Engineer (Lond.). vol. 149, no. 3882, June 6, 1930, p. 641, 1 fig. New type with revolving disc-shaped elements is manufactured under Englisch-Clarke, Chapman patents by Clarke, Chapman and Co.; in ordinary type common fault is separating out of salt from sea water which adheres to outer surfaces of tubes and interferes with heat transmission; this defect is claimed to be entirely overcome in new type of evaporator as salt is deposited in relatively loose incrustation which is easily removed from revolving elements by stationary scrapers.

EXCAVATING MACHINERY

Power Requirements. Choosing Power for Crane and Shovel, W. G. Wall. Motive Power, vol. 1, no. 1, Feb. 1930, pp. 15-16, 3 figs. Discussion of power selection for excavating and hoisting machinery; torque curves showing relation between Diesel and gasoline engine characteristics.

EXPLOSIVES

Colloidal Powders. Laws of Combustion of Colloidal Powders (sur la loi de combustion des poudres colloïdales), H. Muraour and G. Aunis. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 8. Feb. 24, 1930, pp. 485-488, 1 fig.; see also brief translated abstract in Chem. and Industry (Lond.), vol. 49, no. 20, May 16, 1930, p. 442. From results of experiments carried out with powder free from solvent and containing 13 per cent nitrogen in bomb of 150 c.c. capacity, giving rise to pressures of 54 to 4,310 kg. per sq. cm. is calculated.

EXTENSOMETERS

Development of. Development of a Method of Measuring Concentrated Stresses, J. F. Quereau. Mech. Eng., vol. 52, no. 6, June 1930, pp. 611-613, 4 figs. Results of investigation conducted for purpose of developing high-sensivity lateral extensometer for use in measuring concentrated stresses such as are encountered at edges of holes, notches, and fillets.

F

FEEDWATER ANALYSIS

Method of. Operation and Control of Boiler Feed Water Purification Systems, S. T. Powell. Am. Gas. Assn.—Proc., 1929, pp. 1088-1094, 6 figs. Method of analyses applicable to feedwater; routine tests for control of boiler feedwater and concentrated boiler waters; determination of alkali carbonate and hydroxide in presence of one another; determination of phosphate.

New Meter. A New Water Purity Meter. Mar. Engr. and Motorship Bldr. (Lond.), vol. 53, no. 633, June 1930, pp. 212-213, 3 figs. Evershed and Vignoles Ltd., produce electric indicating and recording pattern dionic salinometer operated from ship's mains for use with water-tube boilers; indicator consists of especially constructed indicating ohmmeter in metal case.

FEEDWATER TREATMENT

Boiler Developments. Modern Boiler Developments and Feed Water Treatment, W. S. Coates. Chem. and Industry (Lond.), vol. 49, no. 20, May 16, 1930, pp. 230T-232T, 2 figs. Notes on boiler-water conditioning. (Continuation of serial.)

Modern Boiler Developments and Feed Water Treatment, W. S. Coates. Chem. and Industry (Lond.), vol. 49, no. 21, May 23, 1930, pp. 242T-244T. Instability of sodium carbonate in boiler water; trisodium phosphate; experiences with phosphate conditioning. (Concluded.)

Conditioning. Water Conditioning and Power Plant Chemistry. Elec. West, vol. 64, no. 6, May 15, 1930, pp. 455-459. Prime Movers Committee Report containing statement of requirements for current boiler-water conditioning; description of more recent short methods of analysis for routine control; carry-over of impurities from boilers; system of water conditioning in use at Seal Beach station of Los Angeles Gas and Electric Corp.

High Pressure System. Development of a High Pressure System for Boiler Water Conditioning, A. H. Markson. Combustion, vol. 1, no. 11, May 1930, pp. 45-46. Discussion by R. E. Hall of paper presented before Am. Soc. Mech. Engrs., previously indexed from Apr. 1930 issue of same journal.

Methods. Boiler Feedwater Purification Methods, H. A. Kuljian. Power Plant Eng., vol. 34, no. 11, June 1, 1930, pp. 614-616, 3 figs. Continuous and intermittent precipitation water softeners and zeolite softeners; types, methods of control, and operation. (Continuation of serial.)

Softening. Salt Content in Feedwater (Salzgehalt im Speisewasser), R. Klein. Waerme (Berlin), vol. 53, no. 21, May 24, 1930, pp. 377-382. Influence of salt content on brine deposit on boiler; softening of carbonate- and sulphate-rich raw water according to four different processes; brine and heat losses occurring herewith are studied and examples cited.

Salt Content in Feedwater (Salzgehalt im Speisewasser), R. Klein. Waerme (Berlin), vol. 53, no. 22, May 31, 1930, p. 398-402, 10 figs. Determination of amount of brine; losses due to salt removal from feedwater; reduction of salt content. (Concluded.)

FLOORS, STEEL

Welding. Welded Steel Floor Construction, L. H. Miller. Iron and Steel of Canada (Gardenvale, Que.), vol. 13, no. 5, May 1930, pp. 99-101 and 121, 2 figs. Abstract of paper previously indexed from Am. Welding Soc.—Jl., May 1930.

FLOW METERS

Slide Rules. Slide Rule Simplifies Orifice-Flow Calculations, H. G. Hyland. Power, vol. 71, no. 25, June 24, 1930, pp. 997-999, 4 figs. To facilitate calculations of orific diameters and in design of scale where extreme accuracy is not required, flow-meter slide rule has been designed which takes care of practically all of variables entering into calculations; operating instructions.

FLOW OF AIR

Orifices. The Flow of Air Through Circular Orifices with Rounded Approach Discharging into the Atmosphere, J. A. Polson, J. G. Lowther, and B. J. Wilson. Univ. of Ill.—Eng. Experiment Station—Bul., no. 207, vol. 27, no. 39, May 27, 1930, 52 pp., 12 figs. Study of flow of air through orifices by precision method, to determine coefficients to be applied to Fliegner's formula; ordinary atmospheric air was compressed and stored in weighing tank with no attempt to remove moisture or control humidity; with rounded approach, diameters of smallest orifice sections varied from ¼ in to 1 in.; weight of air discharged agrees very closely with Fliegner's formula. Bibliography.

FLOW OF FLUIDS

Measurement. Rules for Volume Measurements with Uncalibrated Nozzles and Measuring Diaphragms at Less than Sound Velocity (Regeln fuer die Mengenmessung mit ungeeichten Duesen und Messraendern bei Unterschallgeschwindigkeit). Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 6, June 1930, pp. 220-223, 10 figs. It is claimed that volume of flow can be measured with German standard nozzles and diaphragms without calibration; these two measuring instruments and their operation are discussed.

Pipes. Formula for Loss of Head in Cylindrical Pipe (Note sur la formule de la perte de charge dans les tuyaux cylindriques), A. Schlag. Revue Universelle des Mines de la Métallurgie des Travaux Publics (Paris), vol. 73, no. 6, Mar. 15, 1930, pp. 163-166, 3 figs. Factors which influence resistance to flow; formula for calculation of losses and how it is applied.

FLOW OF WATER

Theoretical Discussion. Flow of Water Made Clearer (Ein Beitrag zur Klaerung der Wasserbewegung), A. Reuther. Gesundheits Ingenieur (Munich), vol. 53, nos. 11, 12 and 13, Mar. 15, 1930, pp. 164-167, Mar. 22, pp. 180-185 and Mar. 29, pp. 194-202, 42 figs. Theoretical discussion deriving simplified formulae to account for flow of water, liquids and gases as well granular materials; flow of water in natural streams and other open channels; flow of liquids from orifices and over weirs; movement of underground waters.

FORGE SHOP PRACTICE

Description of. Forge and Foregemen (Forgeage des métaux autres que l'acier). Arts et Métiers (Paris), vol. 83, no. 113, Feb. 1930, pp. 53-55, 17 figs. General description of drop-forging practice, design of dies and fixtures; crankshaft forging; axle, hub and wheel dies; notes on non-ferrous forgings; sketch shows layout of forge shops; proerties of die materials.

Die Pressing. Die-Pressed Parts Reduce Production Costs, H. Chase. Am. Machinist, vol. 72, no. 21, May 22, 1930, pp. 835-837, 3 figs. Description of advantages of die-pressing and application to specific cases; die-pressed parts of brass or bronze have tensile strength of 45,000 to 46,000 lbs. per sq. in.; brass castings from 27,000 to 33,000 lbs. per sq. in.: comparison of cost with casting.

FOREMEN

Importance of. Keystone of the Industrial Arch, A. H. Rodrick. Iron Age, vol. 125, no. 26, June 26, 1930, pp. 1877-1878 and 1930-1941. Increased recognition of importance of foreman; major activities controlled by foremen; functions and responsibilities of foremen.

Training. Foreman Training that Works, R. G. Adair. Factory and Indus. Mgmt., vol. 80, no. 1, July 1930, pp. 85-86, 88 and 90. Subjects for meetings on prevention of waste of machinery and equipment through improper operations, inadequate maintenance and makeshift repairs, misuse of small items and through study of cost sheet.

Foremen Training by the Conference Method, E. B. Luce. Am. Gas Assn.—Proc., 1929, pp. 68-72, 1 fig. Informational, instructional and conference type of educational procedure; variations in conference methods and cautions to be exercised; topic analysis and case analysis methods discussed.

FOUNDATIONS

Vibrations. Present Status of Research in Field of Machinery and Foundation Vibrations (Der heutige Stand der Forschungen auf dem Gebeite der Maschinen und Fundamentschwingungen), Nolle. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 6, June 1930, pp. 207-210, 6 figs. Study is based on works of Blaess, Geiger, Beyer, Ehlers, Hort, Rausch, Noelle, Reuter, Lupberger, Zeuner, and Marguerre, read before Vereingung der Elektrizitaetswerke, Apr. 25, 1929, and of Kayser, published in V.D.I. Zeit., 1929; critical speed and balancing of rotors; formula for oscillation; determination of vibratory properties of different foundations.

FOUNDRIES

Materials Handling. Materials Handling and Storage in Foundry Operations, W. M. Booth. Am. Foundrymen's Assn.—Trans., vol. 1, no. 6, June 1930, pp. 168-185. Three general rules for improving materials handling in foundry are: General use of electricity or mechanical power; routing work through plant in as nearly straight line as possible; waist-high movement of all materials involving lahour.

Material Handling in the Small Foundry. Mech. Handling (Lond.), vol. 17, no. 5, May 1930, pp. 159-160. Advances in non-ferrous foundry practice and subject of material handling in small foundries were main topic of discussion at meeting of Ohio Foundries Association, Inc., held at Dayton, Ohio.

FURNACES, MELTING

Pulverized Coal. Some Features of the Pulverized Coal Fired Air Furnace, E. F. Wilson. Am. Foundrymen's Assn.—Trans. and Bul., vol. 1, no. 5, May 1930, pp. 1-40, 4 figs. Main headings of discussion are: design; materials of construction; methods of furnace construction; calculation of mixtures; features affecting oxidation; furnace operation; test methods to determine heat progress; doping melt; pouring melt; features of combustion; powdered coal combustion; fuels; bath reactions, and modification of air furnaces. Bibliography.

FURNITURE MANUFACTURE

Factory Methods. Modern Chair Factory Methods, F. L. Booth. Wood-Worker, vol. 29, no. 4, June, 1930, pp. 40-41, 5 figs. Consistent progress made by B. L. Marble Chair Co., Bedford, Ohio, due to policy of using only up-to-date equipment and methods; brief description of plant and equipment is given.

G

GALVANIZING

Dross Reduction. Temperature of Galvanizing Bath Affects Dross Production, W. G. Imhoff. Iron Trade Rev., vol. 86, no. 25, June 19, 1930, pp. 65-66, 3 figs. Discussion of differences in dross under various operating conditions and temperatures; microphotographs show dross differences due to carbon content; notes on operating temperature and kettle life.

Specifications. Report of Sectional Committee on Zinc Coating of Iron and Steel. Am. Soc. Testing Matls.—Advance Paper, no. 31, for mtg. June 23-27, 1930, 14 pp. Report of technical committee on specifications for zinc coating on structural steel shapes, plates and bars and their products; proposed standard specifications for zinc (hot galvanized) coatings on structural steel shapes, plates and bars and their products.

GAS MANUFACTURE

Fundamental Problems. Production Conference Studies Fundamental Problems. Am. Gas Jl., vol. 132, no. 6, June 1930, pp. 59-62 and 67-71. Brief abstracts of papers before American Gas Association: Carbureting water gas with "bunker C" oil, J. V. Richards; Actifier air disposal in boilers and gas producers, M. T. Herreid; Reforming petroleum still gas, R. G. Rincliffe; Tests of cooking coals, A. D. Davis, and A. C. Fieldner; Cost of reforming of refinery still gases, C. A. Schlegel; Coke as domestic heating fuel, P. Nickolls; Economic interrelationship of petroleum and gas industries, H. J. Nichols, Jr.; Mixing and distributing butane-air gas at North Manchester, Ind., L. C. Heavner, etc.

GAS PLANTS, BUTANE-AIR

Indiana. Operating Results of Butane-Air Gas Plant in Small Indiana Town, L. C. Heavner. Natl. Petroleum News, vol. 22, no. 23, June 4, 1930, pp. 81-82 and 84-86, 3 figs. Description of installation of new types of plant at North Manchester, Indiana, small town that had never been supplied with gas; project was experimental, to obtain operating and cost data to determine whether company was warranted in applying for franchises and installing similar plants in smaller towns of its territory, not now served with gas; detailed figures are given. Read before Am. Gas Assn.

GASOLINE

SULPHUR CONTENT. Ghost of Sulphur in Gasoline Costs Americans 50 Millions a Year, G. Egloff, C. D. Lowry, Jr., and P. Truesdell. Nat. Petroleum News, vol. 22, nos. 24 and 25, June 11, 1930, pp. 41 and 43, and June 18, pp. 69 and 71-72. June 11: Argument for raising sulphur limitation in motor gasoline specifications; high cost of treating gasoline, to keep within 0.10 per cent limit, comes out of pockets of American motorists; no evidence published, except few laboratory tests, to prove danger of high sulphur gasolines. June 18: It is stated that gasolines with up to 0.7 per cent sulphur have been marketed without complaint; various opinions are quoted; data on corrosion.

GASOLINE FILLING STATIONS

NEW PUMP. Expands Gasoline Pump Output from 10 to 500 Units a Day, F. L. Prentiss. Iron Age, vol. 125, no. 25, June 19, 1930, pp. 1805-1809, 5 figs. Description of manufacturing process and equipment at plant of Ferro Machine and Foundry Co., Cleveland; pump is of rotary type and is driven through flexible coupling and stuffing box located within bracket; specified pumpage of 15 gals. per min.

GASOLINE TANKS

LOSSES. Filling and Storage Losses From Pressure Containers, H. C. Boardman. Water Tower, vol. 16, no. 8, Apr. 1930, pp. 4-6, 4 figs. Theoretical discussion leading to following statements about pressure storage: filling losses for given vapour pressure are greatest first time pressure container is filled; if pressure container could be operated under partial vacuum its effectiveness in preventing evaporation losses would be greatly increased.

GEARS AND GEARING

JOHNSTONE TAYLOR. Gearing, Johnstone Taylor. Mech. World (Manchester), vol. 87, no. 2265, May 30, 1930, pp. 512-514, 8 figs. Supports for double helical gears; arrangement of turbine gears; elements of design of spiral level gears. (Continuation of serial.)

LUBRICATION. Lubrication of Gears, H. S. Trecartin. Power Transmission, vol. 36, no. 5, May 1930, pp. 23-24, 2 figs. Rubbing action between gear teeth is cause of friction; gear life directly proportional to quality of lubricant; metallic contact should be eliminated; selecting the lubricant.

MANUFACTURE. Manufacture of Herringbone Bevel Gears (Die Herstellung von Kegelraedern mit Pfeilversahnung,) M. Coenen. Automobil-Rundschau (Berlin), vol. 32, no. 11, June 1, 1930, pp. 222-224, 11 figs. Outline of advantages of herringbone bevel gears in manufacture and operation; small gears run almost noiseless at 15,000 r.p.m.; sketches illustrate working principle of automatic cutter built by J. E. Reinecker A.-G., Chemnitz-Gahlenz.

MANUFACTURE, ENGLAND. The Works of Messrs. David Brown and Sons (Huddersfield), Limited. Engineering (Lond.), vol. 129, nos. 3355 and 3359, May 2, 1930, pp. 559-561, and May 30, pp. 693-696, 29 figs. on p. 574, and supp. plates. Works have grown from small establishment, supplying cast gear wheels, to buildings covering 12 acres and employing 1,500 hands; all classes of gear manufacture were undertaken prior to 1914 but following development of D.B.S. worm gear, important expansion took place in development of this type of gearing; and works were largely concentrated on this product; general arrangement of shops; methods and equipment employed in manufacture.

NON-METALLIC. Micarta Non-Metallic Gears in the Steel Mill Industry, T. C. Roantree. Assn. of Iron and Steel Elec. Engrs.—Proc. for Yrs. 1928-1929, pp. 407-409. Indexed in Engineering Index 1928, p. 865, from Iron and Steel Engr., Oct. 1928.

NON-UNIFORM ROTATION. Eccentrically Driven Gear Arrangement (Das exzentrisch angetriebene Raeddrknie), K. Hoecken. V.D.I. Zeit. (Berlin), vol. 74, no. 16, Apr. 19, 1930, pp. 509-512, 4 figs. Theoretical investigation of mechanism for non-uniform rotation with reverse movement; formulae for dimensioning various gears; movement and velocities illustrated by graphs and diagrams.

PLANETARY. Planetary Trains with Two Internal Gears, W. Richarss. Machy. (Lond.), vol. 36, no. 922, June 12, 1930, pp. 331-334, 5 figs. Description of various designs with two internal gears; planetary reduction gear having fixed and driven internal gears with train arm as driver; planetary reduction gear in which train arm is eccentric and driver and driven rotate in same directions; planetary reduction gear in which train arm is eccentric and driver and driven rotate in opposite directions: data reduction ratios are given in tables.

SPUR. Theoretical Considerations in the Design of Spur Gear Teeth, F. A. Mickle. Product Eng., vol. 1, no. 7, July 1930, pp. 314-316, 2 figs. Calculations which indicate that fundamental principle laid down in Lewis formula is correct.

GEOLOGY

ARIZONA. The Pre-Cambrian Greenstone Complex of the Jerome Quadrangle, C. Lausen. Jl. of Geology, vol. 38, no. 2, Feb.-Mar. 1930, pp. 174-183, 2 figs. In Jerome quadrangle are series of greenstones varying in composition from andesites to rhyolites, principally former, which are pre-cambrian in age; these greenstones have been included with Yavapai schist series, but detailed mapping shows them to rest uncomformably on upturned and eroded edges of schist; structural features of this complex and contact action of pre-cambrian granitic masses are described; copper deposits are mentioned, but not discussed. Bibliography.

CALIFORNIA. Recent Sands of California, R. D. Reed. Jl. of Geology, vol. 28, no. 3, Apr.-May 1930, pp. 220-245, 15 figs. Study of recent sands collected from California deserts, beaches, and stream channels reveals widespread occurrence of feature that is interpreted as immaturity; attention is called to possible importance of this factor in interpretation of certain cretaceous and tertiary sedimentary formations. Bibliography.

VALUE TO INDUSTRY. The Value of Geology to Industry, L. Reinecke. S. African Min. and Eng. Jl. (Johannesburg), vol. 41, no. 2009, Mar. 29. 1930, pp. 109-111. Review of main lines along which science of geology has been applied to economic problems; survey of structural materials; geology and civil engineering; ore deposition and ore finding; limitations of geophysical prospecting; more funds for geological survey urged. Presidential address before Geol. Soc. of S. Africa.

GLASS

MANUFACTURE. Modern Plant Glass Manufacture (Neuzeitliche Spiegelglasherstellung), L. von Reis. V.D.I. Zeit. (Berlin), vol. 74, no. 26, June 28, 1930, pp. 899-905, 27 figs. Statistical data on consumption of plate glass in Europe and America; comparative study of European and American manufacturing methods with special reference to Bicheroux process and methods developed by Libbey-Owens Sheet-Glass Co., Henry Ford Motor Co., Pittsburgh Plate Glass Co., and General Motors Co.

SILICA. The Rate of Crystal Growth in Technical Soda-Lime-Silica Glasses, A. Dietzel. Glass Industry, vol. 11, nos. 5 and 6, May 1930, pp. 106-113, and June, pp. 132-137, 37 figs. Translated from Sprechsaal, 1929, indexed in Engineering Index 1929, p. 888. (To be continued.)

THERMAL EXPANSION. Measuring Expansion of Several Glasses with Help of a Recording Apparatus (Ueber Ausdehnungsmessungen an einigen Glaesern mit Hilfe einer selbstregistrierenden Apparatur), W. M. Cohn. Sprechsaal (Coburg), vol. 63, no. 16, Apr. 17, 1930, pp. 287-289, 5 figs. Apparatus will photographically record expansion of glass with temperature; limiting temperature of operation is 900 deg.; it was used to determine average linear coefficient of expansion, transformation temperatures, and softening points of 8 typical glasses of wide variation in chemical composition; heating rate was 2 to 3 deg. per min. (To be continued.)

GREENHOUSES

HEATING. Economic Utilization of Condensation Heat of Electric Power Plants in Large Greenhouses (Wirtschaftliche Ausnutzung der Kondensationswaerme eletrischer Kraftwerke in grossen Gewaechschausanlagen) Grossbruchhaus. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 508, May 2, 1930, pp. 243-247, 6 figs. Present status of waste-heat utilization in power plants; heating of greenhouses with condensation heat; construction of greenhouse; examples of design of large installation for heating of greenhouse of 700,000 sq. m. surface with waste heat of 50,000-kw. steam turbine; numerical data.

GRINDING MACHINES

HEALD. Eccentric Feed Mechanism for Internal Grinder, L. L. Roberts. Machy. (N.Y.), vol. 36, no. 10, June 1930, pp. 761-762, 2 figs. Description and sketches of eccentric feed mechanism operated by differential gearing for Heald cylinder grinder.

ROLL. Roll Grinding Precision. Abrasive Industry, vol. 11, no. 6, June 1930, pp. 29-31, 4 figs. Description of new machines of Churchill Machine Tool Co., Ltd., Manchester; cambering mechanism for concave, convex cambers, and transverse mechanism hydraulically operated; separate motors for wheel, workhead, and traverse; smaller model to grind rolls up to 40 in. in diameter, and larger models for 60 and 72 in.

SURFACE. Surface Grinding Machine Design Reveals Production Grinding Development, F. B. Jacobs. Abrasive Industry, vol. 11, no. 6, June 1930, pp. 22-25, 8 figs. Description of steps in development of surface grinding; sketches show features of several designs; travelling grinding-wheel head; principle of guide-bar grinding; oscillating wheel head and stationary platen; rotary platen surface grinding machine.

GRINDING WHEELS

PRODUCTION CONTROL. The Right Handling Equipment, Central Dispatching, Bonus for Truckers and Cost Curves Crashed, B. A. Hildebrant. Factory and Indus. Mgmt., vol. 79, no. 6, June, 1930, pp. 1343-1345, 5 figs. Method used by Morton Co., Worcester, Mass., in manufacture of grinding wheels for materials handling, dispatching, and production control.

GUNNERY

AIRCRAFT. Shooting from Airplanes at Aerial Objective (Le tir en avion sur objectif aérien), Devèze. Revue des Forces Aériennes (Paris), no. 10, May 1930, pp. 594-604, 5 figs. Description of large (8 m. x 50 m.) cotton targets which are towed in vertical or horizontal position by airplanes; notes on value for ballistic studies.

GYPSUM PLASTER

RESEARCH. Anhydrite Plasters and Cements, A. E. Flynn. Can. Min. and Met. Bul. (Montreal), no. 218, June 1930, pp. 810-833, 1 fig. Results of researches at Nova Scotia Technical College; technology of gypsum plasters; scope of investigations; experimental methods; other materials used; test of anhydrite from different deposits; amount of catalyzer necessary; method of adding catalyzer; fineness of grinding; ageing; effects of foreign material; artificial anhydrite; chemically pure calcium sulphate; calcined anhydrite; porosity; cellular insulating plaster; hydration tests; weight of set plaster. Read before Min. Soc. of Nova Scotia.

H

HIGH SPEED STEEL

PROPERTIES OF. Mechanical Properties of High-Speed Steel at Elevated Temperatures, A. R. Page. Metallurgia (Lond.), vol. 1, no. 6. Apr. 1930, pp. 239-241, 9 figs. Report of research to determine properties; all tests were carried out under definite standard set of conditions; while results obtained are not absolute, it is claimed that they are comparative and give idea of variation in properties when material is heated.

HIGHWAY ACCIDENT PREVENTION

HIGHWAY ACCIDENT PREVENTION. The Human Side of Traffic Accidents. Nat. Safety Council—Trans., vol. 3, of mtg. Sept. 30 to Oct. 4, 1929, pp. 82-101. Papers presented before Public Safety Division by J. S. Kemper, C. M. Anderson, J. D. Robertson, and C. A. Whitmer.

Public Safety Division. Nat. Safety Council—Trans., vol. 3, of mtg. Sept. 30-Oct. 4, 1929, pp. 3-22. Papers presented before Public Safety Division, by P. Hoffman, L. I. Dublin, H. A. Locke, and F. E. Shortemeier.

HIGHWAY SYSTEMS

PERU. Central Southern Trunk Highway (La troncal del Medio-Sur), J. A. de Izcue. Informaciones y Memorias de la Sociedad de Ingenieros del Peru (Lima), vol. 32, no. 2, Feb. 1930, pp. 61-72, 1 fig. Notes on main highway designed to give outlet to coast from departments of Ayacucho, Apruimac and Cuzco, entire system comprises 821 km. of which 375 km. practically completed; zone of more than 40,000 sq. km. will be served.

How We Should Meet the Problem of Building Our Roads (Como debemos afrontar le ejecucion de nuestros caminos), C. Romero Sotomayor. Informaciones y Memorias de la Sociedad de Ingenieros del Peru (Lima), vol. 31, no. 10, Oct. 1929, pp. 627-647, 3 figs. Broad discussion of problems of road construction in different regions of Peru.

HYDRAULIC MACHINERY

DESIGN. Hydraulics in Design, J. P. Ferris. Machine Design, vol. 2, no. 3, Mar. 1930, pp. 27-34, 10 figs. Description of development and various applications of hydraulic principle in machine design; characteristics of nine basic systems of hydraulic power transmission are given in tabular form and illustrated by sketches.

Hydraulics in Design, J. P. Ferris. Machine Design, vol. 2. nos. 5 and 6, May 1930, pp. 35-39 and 53, June, pp. 26-28 and 53, 15 figs. May: Machines utilizing action; volumetric motor-multiple and pump-multiple plungers; diagram of hydraulic drive for tire conveyor honing machine with hydraulic reciprocation of hones; welding machine and shaper-planer with hydraulic table drive. June: Automatic drilling machine with hydraulic feed and hydraulic indexing of table; machine for assembling bushings; boring; facing machine equipped with three hydraulic feeding motions. (Continuation of serial.)

NOTES ON. Notes on Hydraulic Power Systems and Piping, E. W. Sylvester. Heat. Piping and Air Conditioning, vol. 2, no. 7, July 1930, pp. 579-582, 5 figs. Design, installation, and operation of hydraulic power systems which apply in general to applications of hydraulic power.

HYDRAULIC TURBINES

DESIGN. Graph for Quick Determination of Principal Dimensions of Hydraulic Turbines (Graphique pour la détermination rapide des dimensions principales des roues de turbines hydrauliques), M. Mathieu. Arts et Métiers (Paris), no. 116, May 1930, pp. 200-202, 1 fig. Graph and explanatory note are given.

JAPAN. Water Turbine Development in Japan, M. Tazawa. Far East. Rev. (Shanghai), vol. 26, no. 4, Apr. 1930, pp. 167-173 and 175, 19 figs. Invention and development of water turbine; advent of hydro-electric plant; early hydro-electric prime mover and American manufactured turbines; importation of European wheels during early period and growth of home supply in Japan; why American turbines were displaced by European rivals; domination of imported turbines and its effect on Japan's industry; revival of demand for American turbines, and premature collapse of import projects; post-war conditions. (To be continued.)

Water Turbine Development in Japan, M. Tazawa. Far East. Rev. (Shanghai), vol. 26, no. 5, May 1930, pp. 232-237, 9 figs. Distribution of hydro-electric plants in Japan and their generating capacity; foreign makes dominate large capacity turbine market; competition among foreign suppliers; setback to foreign turbine makers and comeback of Japanese manufacturer; changes of turbine types and effect of American wheels on Japanese design; how hydro firms select their turbines; and competition among international makers; research work by Japanese turbine makers, and progress in their manufacturing methods. (Continuation of serial.)

Manufacture. Contributions to Hydraulic Power Development by Pennsylvania Manufacturers: S. Morgan Smith Co., B. E. Smith. Pa. Elec. Assn.—Proc., Sept. 1929, pp. 71-76, 9 figs. During 1928, year marked by many important activities in field of hydraulic power developments, S. Morgan Smith Co. was awarded number of large contracts for turbines; total output involved in these contracts, including orders placed with Canadian associates, S. Morgan Smith-Inglis Co., amounts to more than 1,000,000 hp.; features of equipment are described.

HYDRODYNAMICS

Hydrodynamics. On the Resistance of Water to a Rapidly Moving Sphere, M. Masima and S. Sasaki. Tokyo Imperial Univ.—Faculty of Eng.—Jl. (Tokyo), vol. 18, no. 10, Mar. 1930, pp. 247-256, 4 figs. Report on measuring velocities of bullets fired down vertically into wooden tank filed with water. (In English.)

HYDRO-ELECTRIC POWER PLANTS

Control. Automatic Hydraulic Regulatory and Safety Devices. Elec. West. vol. 64, no. 6, May 15, 1930, pp. 331-337, 7 figs. Hydraulic Power Committee Report on devices in use in hydro-electric developments as separate or distinct units in contrast to those which are found in automatic or semi-automatic plants and are more or less intimately associated with automatic equipment for operation of plant.

Germany. Power Utilization of Flow at Hengstey Lake (Die ausnutzung der Laufwasserkraefte am Hengsteysee), O. Spetzler. V.D.I. Zeit. (Berlin), vol. 74, no. 23, June 7. 1930, pp. 761-766, 9 figs. Description of two low-head hydro-electric power plants, constructed by Ruhrverband Essen at Hengstey and Stiftsmuehle: Hengstey plant, equipped with three Kaplan vertical axis turbines, produces 4,200 hp. at head of 4.85 m.; Stiftsmuehle plant, which is also equipped with three Kaplan turbines vertical axis develop 37.20 hp. at head of 3.3 m.; details of plant equipment.

Maintenance and Repair. Maintenance of Hydraulic Works. Elec. West, vol. 64, no. 6, May 15, 1930, pp. 359-361, 1 fig. Report of subcommittee on maintenance of hydraulic works of Pacific Coast Electrical Assn.; standard of maintenance; maintenance of efficiency and capacity; maintenance programme; replacement of units; new designs.

Operation. Hydraulic Plant Operating Problems. Elec. West, vol. 64, no. 6, May 15, 1930, pp. 370-372. Report of subcommittee on hydraulic plant operating problems of Pacific Coast Electrical Assn.; comments by superintendents, foremen and operators on following subjects: storage reservoirs, water conduits, long distant water level gauges, penstocks, turbines, draft tubes, impulse water wheels; recommendations for improvements in design, manufacture and construction to help prevent occurrence of operating troubles.

HYDRO-ELECTRIC POWER DEVELOPMENTS

Scotland. The Lochaber Water-Power Scheme and Its Geological Aspect, B. A. Peach. Instn. of Min. Engrs.—Trans. (Newcastle-Upon-Tyne), vol. 79, part 1, Mar. 1930, pp. 43-44. Discussion of paper previously indexed from various sources.

I

INDUSTRIAL TRUCKS

Electric. Combination of Different Types of Materials Handling Equipment, C. B. Crockett. Iron Age, vol. 125, no. 25, June 19, 1930, pp. 1810-1813, 6 figs. Outline of advantages obtained by use of electric trucks for handling materials at plant of Link-Belt Co., Chicago; data on reduction of labour costs in cupola charging.

INTERNAL COMBUSTION ENGINES

Corrosion Prevention. Fuel Economy in Internal-Combustion Engines Through Prevention of Water Scale and Corrosion in Cooling-Water Chambers (Wege zur Brennstoffersparnis bei Explosionsmotoren durch Wasserstein und Rostverhuetung in den Kuehlwasserraeumen), H. Balcke. Brennstoff und Waermewirtschaft (Halle), vol. 12, no. 9/10, May 1930, pp. 113-123, 7 figs. Account of experimental investigations; character of scale and rust, and their deleterious effect and means of combatting them; description of GAV process developed by M. Groeck, which makes use of reagent which dissolves scale and removes rust without damaging action of acid.

Fuels. Fuels for Internal-Combustion Engines, H. E. Degler. Motive Power, vol. 1, nos. 1, 2 and 3, Feb. 1930, pp. 9-12 and 44, Mar., pp. 15-17 and 42, and Apr., pp. 15-17, 11 figs. Feb.: Classification, fuel-aix mixtures, pressures, fuel consumption of solid and gaseous fuels; data on gaseous fuels. Mar.: Uses and limitations of liquid fuels and their classification; factor in carburetor and manifold design; table illustrating typical analyses of liquid fuels. Apr.: Conclusions concerning proper selection of liquid fuels; typical performance curves of Diesel engine operating on fuel oil.

Lubrication. Efficient Lubrication Depends Upon Correcting Mechanical Deficiencies, O. Adams. Motive Power, vol. 1, nos. 2 and 3, Mar. 1930, pp. 26-28 and 46-47, and Apr., pp. 28-32, 17 figs. Mar.: Success of engine of present-day design is dependent upon intelligent application of certain protecting devices, methods of operation and lubrication; engine problems analyzed; engine reconditioning; advantages of ground cylinder; smooth finish and oil film. Apr.: Importance of proper piston-ring design for effective internal-combustion-engine lubrication; double seal rings now used; analysis of piston-ring leakage; construction of ring; oil pumping.

Marine, Carburetors. Downdraft Carburetion, E. H. Shepard. Motive Power, vol. 1, no. 2, Mar. 1930. pp. 21-22 and 44, 6 figs. Paper presented before Soc. Automotive Engrs. previously indexed from Feb. 1930, issue of their Journal.

IRON AND STEEL PLANTS

Waste Heat Utilization. The Utilization of Waste Heat in the Steel Industry, C. W. E. Clarke. Fuels and Furnaces, vol. 8, no. 6, June 1930, pp. 827-830. Discussion of practical possibilities for utilization of waste heat in steel plant; sources of waste heat; qualities of various gases; use of blast furnace gas in conjunction with pulverized coal; various heat requirements. Abstract of paper read before Am. Iron and Steel Inst., previously indexed from Advance Paper, for mtg. May 9.

IRRIGATION

Seepage. Pumping Seepage Water From Wells for Irrigation, E. H. Neal. Eng. News-Rec., vol. 104, no. 25, June 19, 1930, p. 1020. Abstract of report read at annual meeting of American Society of Agricultural Engineers, describing experimental installation of four wells, in Boise River valley, in southwestern Idaho, to relieve water-logged land and furnish supplemental irrigation supply.

IRRIGATION UTILITIES

Usefulness of. Commercial Irrigation Companies W. A. Hutchins. U.S. Dept. of Agriculture—Tech. Bul., no. 177, Mar. 1930, 40 pp. Conclusions as to present usefulness of commercial companies as means of irrigation development, as permanent irrigation-utility investment, and as means of best serving interests of water users; classification of commercial companies; contribution of commercial enterprises to irrigation development; why commercial company investments have been generally unprofitable; internal features of irrigation utilities. Bibliography.

J

JAPANNING

Developments in. Developments in the Use of Ovens for Baked Finishes, W. J. Miskella. Fuels and Furnaces, vol. 8, no. 6, June 1930, pp. 821-822, 1 fig. Discussion of recent developments in baked japanning field; new synthetic undercoats for application under lacquer finishes; baking process, wherein two coats of japan are applied with one bake.

L

LEAD DEPOSITS

Missouri. An Alnoite Pipe, its Contact Phenomena, and Ore Deposition Near Avon, Missouri, J. T. Singewald, Jr., and C. Milton. Jl. of Geology, vol. 38, no. 1, Jan.-Feb. 1930, pp. 54-66, 6 figs. Pipe of augite-free alnoite has intruded Bonneterre dolomite with explosive violence and assimilation of much dolomite; solutions entered fractures in dolomite at periphery of pipe and deposited same ore and gangue minerals that occur in southeastern Missouri disseminated lead deposits; there is no evidence to indicate that igneous pipe had any relation to this mineralization other than that its locus provided channels of circulation for mineralizing solutions. Bibliography.

LOCOMOTIVES

Design. Railway Motive Power, a Few Points on the Present Trend of Design, W. E. Barnes. Can. Ry. and Mar. World (Toronto), no. 388, June 1930, pp. 352-354. Discussion of problems encountered by locomotive designer; design features of various locomotive parts are considered.

Fuel Economy. Fuel Association Work Commended by Railroad Officers. Ry. Mech. Engr., vol. 104, no. 6, June 1930, pp. 325-329, 2 figs. Chicago convention told that savings through fuel economy are largely offset by increased taxes; committee reports concerning new locomotive economy devices, and Diesel locomotives.

LUBRICANTS

Graphite. Graphite Greases (Grasas grafitadas), C. F. Hickethier. Ingenieria (Buenos Aires), vol. 34, no. 5, May 1930, pp. 178-180, Graphite is most important solid lubricant; it is used in natural state and in combination with oils or lubricating greases; analyses of typical natural graphites, and of Acheson artificial amorphous graphite; graphite grease specifications.

Oils and Greases. Lubricating Oils, Greases, and Cutting Oils, J. S. Gander. Mech. World (Manchester), vol. 87, no. 2264, p. 473. Essential properties of lubricating oils are: body to prevent metallic surfaces from coming into contact; should be as fluid as possible and have minimum coefficient of friction; freedom from corrosive acids; contain no materials liable to produce oxidation or gumming; must not be easily thinned by heat or thickened by cold. (Continuation of serial.)

M

MACHINE SHOP PRACTICE

Details of. Are Precision Machines Sound Investments? H. A. Laystrom. Machy. (N.Y.), vol. 36, no. 10, June 1930, pp. 808-808A. Detailed analysis of number of jobs handled in shop of Quality Hardware & Machine Corp., Chicago, Ill., demonstrates advantages of precision machines.

MACHINE TOOLS

Electric Drive. Recent Developments in Electric Drives of Machine Tools on the Continent. Machy. (Lond.), vol. 36, no. 925, July 3, 1930, pp. 444-447, 5 figs. Control system for large lathe; electric drive for portal milling machine; electrical control arrangements for heavy boring and turning mill; turning and grinding machine for large rotors employing 13 motors; electric drive of planers.

MAGNETIC CIRCUITS

Units. Magnetic Circuit Units, A. E. Kennelly. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 486-510, 2 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

MATERIALS HANDLING

Equipment. Bucket Elevators, Bucket Hoists, and Belt Conveyors (Skopelevatorer, Skophissar och remtransportorer), E. Dahlin. Teknisk Tidskrift (Stockholm), vol. 60, no. 20, May 17, 1930, (Mekanik), pp. 61-67, 6 figs. Bucket elevators and conveyors are discussed; applications, efficiency and cost of construction and installation. (To be continued.)

METALLURGICAL ENGINEERING EDUCATION

South Africa. Mining and Metallurgical Education in South Africa, G. H. Stanley, and G. A. Watermeyer. Empire Min. Rev. (Johannesburg), no. 2, Apr. 1930, pp. 67-68. See also abstract in S. African Min. and Eng. Jl., Special No., Apr. 1930, p. 97. Review of development of provision of trained technical staff from within South Africa itself since stabilization of mining industry by Cecil Rhodes in 1888; co-operative efforts in 1902; at University of Witwatersrand, emphasis is laid on practical works. Abstract of paper read before Empire Min. and Met. Congress.

METALS

Corrosion. Corrosion and Stress. Metallurgist (Supp. to Engineer, Lond.), June 1930, pp. 82-93. Emphasis is laid on importance of fact that stress is important factor in regard to corrosion; perhaps most striking evidence in that direction is associated with what has come to be known as corrosion fatigue following upon original discovery made by Haigh and subsequently very fully worked out by McAdam, that fatigue resistance of great majority of metals and alloys becomes very seriously reduced if surface of test piece is exposed to such mildly corrosive conditions as are produced by gentle stream of tap water.

Fatigue. Fatigue and Fatigue Testing. Metallurgist (Supp. to Engineer, Lond.), May 1930, pp. 75-76. Review of discussion on impact testing by A. Thum and S. Berg, previously indexed from V.D.I. Zeit., Feb. 15, 1930, under classification of Impact Testing, Notched Bar; question of fatigue under impact is regarded in Germany as very real one; danger of blows is believed to be increased when they occur at high frequency as is case with fast-running machines, and it is supposed that they may lead to serious shortening of life of machine. (Continuation of serial.)

MINE HOISTS

Failures. Notes on a Winding Accident at Mainsforth Colliery, Co. Durham, December 31st, 1928, C. Howson. Instn. of Min. Engrs. Trans. (Lond.), vol. 79, part 1, Mar. 1930, pp. 2-8 and (discussion) 8-10, 7 figs. Full text of paper previously indexed from Colliery Guardian, Feb. 28, 1930, and Iron and Coal Trades Rev., Feb. 28, 1930.

MINE LIGHTING

Mine Lighting. Efficiency and Rapidity of Mine Working in Relation to Lighting Intensity (Guete und Schnelligkeit der Bergeauslesung in Abhaengigkeit von der Beleuchtungsstaerke), C. Koerfer. Glueckauf (Essen), vol. 66, no. 15, Apr. 12, 1930, pp. 508-511, 7 figs. Results of tests carried out by Society for Inspection of Rubr Mines, to study influence of lighting on safety and bealth of miners as well as on efficiency of mining operations.

MINERAL DEPOSITS

IDAHO. Geology and Ore Deposits of the Seafoam, Alder Creek, Little Smoky, and Willow Creek Mining Districts, Custer and Camas Counties, Idaho, C. P. Ross. Univ. of Idaho—Bur. of Mines and Geol.—Pampblet, no. 33, Mar. 1930, 26 pp., 9 figs. on supp. plates. Seafoam, in nortbwestern Custer county; silver, gold and lead; sbear zones and replacements in dolomitic limestone; Alder Creek, west of Mackay; contact metamorpbic; copper, with some gold and silver; Little Smoky and Willow Creek, in Camas county, on border of Blaine; shear zones, large replacements; lead, zinc, silver and gold; general geology; principal deposits and mines of each district; production data.

Geology and Ore Deposits of the Clark Fork District, Idaho, A. L. Anderson. Idaho Bur. of Mines and Geol.—Bul., no. 12, Mar. 1930, 128 pp. and index, 26 figs. on supp. plates and 3 maps. Report on area along Clark Fork of Columbia river in northern Idaho, 35 mi. north of Coeur d'Alene district; general geology; deposits are mainly replacement veins resembling those of Coeur d'Alene district and also some veins filling fissures; silver and lead are chief values, with small amounts of zinc; copper occurs in distinct veins; gold veins also occur, distinct from both of others; descriptions of deposits, and of principal mines and prospects.

MINERAL RESOURCES

RHODESIA. Tbe Southern Rbodesian Prospecting Concession. S. African Min. and Eng. Jl. (Johannesburg), vol. 41, no. 2016, May 17, 1930, pp. 311-312, 1 map. Map shows area reserved from pegging and to be granted for exclusive prospecting purposes upon suitable terms to company to be registered for purpose; 9,000 sq. mi., bounded on nortb by 20tb parallel of soutb latitude, as far as longitude 31 deg. east; geological features; granite gneiss country has possibilities both with regard to gold and base metals; Umkondo beds bave already been worked for copper in Bikita district.

MINES AND MINING

EQUIPMENT. The Purchases of Mechanical Equipment for Mines, D. S. Hines. Can. Min. and Met. Bul.—Jl., no. 218, June 1930, pp. 764-774. Discussion of problems and difficulties encountered in purchasing procedure; requisition; inquiry; order; price; terms, sales tax; shipment or delivery; insurance; inspection; customs; general remarks. Read before Min. Soc. of Nova Scotia.

EQUIPMENT SALVAGING. Systematic Control of Materials in Underground Mines (Die planmaessige Erfassung der Betriebsstoffwirtschaft untertage), A Kuenze. Glueckauf (Essen), vol. 66, no. 15, Apr. 12, 1930, pp. 497-508. Economy of salvaging materials and equipment is set forth; stationary iron and steel equipment; scrap material; mine timbering; organization of salvaging scbeme; functions of stores department.

FIRST AID. First Aid Organization on tbe Witwatersrand Gold Mines, H. T. H. Butt. S. African Min. and Eng. Jl. (Johannesburg), Special No., Apr. 1930, pp. 71-72. See also abstract in Empire Min. Rev., no. 2, Apr. 1930, pp. 45-46. Organization on military lines; initial treatment on spot; collection of casualties at ambulance depot; sending down line to dressing station, or to hospital if serious; pivot of underground first aid is boss-boy, mostly recruited from Portuguese natives; above him are medical officer and ambulance officer, both full time officials, and underground and shaft ambulance officers, plus volunteers. Abstract of paper read before Empire Min. and Met. Congress.

ONTARIO. Mining in Ontario, T. W. Gibson. Empire Min. Rev. (Johannesburg), no. 2, Apr. 1930, p. 18. See also brief abstract in S. African Min. and Eng. Jl., Special No., Apr. 1930, p. 105. Chief gold areas are Porcupine and Kirkland Lake, located in 1929 and 1911; notes on principal producers and outputs; use of airplane, outboard motor, geophysical methods and radio in mining exploration; reported new gold belt, from Red Lake east to Fort Hope; increased activity in Sudbury copper nickel region. Abstract of paper read before Empire Min. and Met. Congress.

MINING ENGINEERING EDUCATION

COLORADO. Tbe Experimental Mine, J. B. Read, and J. Underhill. Colorado School of Mines—Quarterly, vol. 25, no. 2, Apr. 1930, 20 pp., 22 figs. Edgar mine at Idabo Springs, Colorado, is maintained by Colorado School of Mines for undergraduate work in mining which cannot be taught in classroom or in regular college laboratories; mine is property of North American Mining Company, whicb has leased all upper workings of mine, for long period, to Colorado School of Mines for essentially its sole use; equipment; use of mine by other colleges and by industries.

SOUTH AFRICA. Mining and Metallurgical Education in South Africa, G. H. Stanley, and G. A. Watermeyer. Empire Min. Rev. (Johannesburg), no. 2, Apr. 1930, pp. 67-68. See also abstract in S. African Min. and Eng. Jl., Special No., Apr. 1930, p. 97. Review of development of provision of trained technical staff from witbin Soutb Africa itself since stabilization of mining industry by Cecil Rbodes in 1888; co-operative efforts in 1902, at University of Witwatersrand, empbasis is laid on practical works. Abstract of paper read before Empire Min. and Met. Congress.

MINING INDUSTRY

CANADA. Review of the Mining of Canada, C. Camsell. Empire Min. Rev. (Johannesburg), no. 2, Apr. 1930, pp. 17-18. See also brief abstract in S. African Min. and Eng. Jl., Special No. Apr. 1930, pp. 105-106. Every province in Dominion, except Prince Edward Island, contributes to mineral output; total value increased from $164,420,877 in 1900 to $273,446,864 in 1928; increase in chemical manufacturing plants; Canada ranks third in world production of gold and of silver, and fourth in lead and copper; controls nickel market and supplies 90 per cent of world requirements. Abstract of paper read before Empire Min. and Met. Congress.

MINING LAWS AND LEGISLATION

SOUTH AFRICA. Mines and Works Regulations Revised. S. African Min. and Eng. Jl. (Johannesburg), vol. 41, nos. 2011 and 2013, Apr. 12, 1930, pp. 179-181 and 183, Apr. 26, pp. 223-225. Apr. 12: Specification of Scbeduled Persons to whom issue of certificates of competency may be issued; hoisting practice; signalling; travelling ways, ventilation; dust-allaying; drilling and blasting safeguards; control of gold. Apr. 26: Electrical regulations; exemptions; boilers; responsibility; accidents; blasting certificates.

MOTORBOAT ENGINES

LYCOMING. Lycoming Enters Marine Field with 40 hp. Engine. Automotive Industries, vol. 62, no. 25, June 21, 1930, pp. 950-951. Description of Model UA, 4-cylinder marine engine witb reverse gear and front-mounted generating and starting unit.

MOTOR TRUCK TRANSPORTATION

GREAT BRITAIN. Supplying 300 Shops. Motor Transport (Lond.), vol. 50, no. 1317, June 9, 1930, pp. 682-684. Outline of activities of traffic department of Birmingbam Co-operative Society; organization; drivers: notes on class of work undertaken; safety maintenance and service; blank forms illustrate record system.

N

NATURAL GASOLINE INDUSTRY

REVIEW OF. Great Outlet for Stabilized Naturals and More Storage Capacity Needed, W. K. Warren. Nat. Petroleum News, vol. 22, no. 22, May 28, 1930, pp. 88, 93 and 97, 3 figs. Review of industry since 1916; relations between producers and refiners who may use more or less natural gasoline for blending; price concessions to ensure constant use; inconspicuous storage as remedy for movement of distress gasoline; prediction that Mid-Continent natural gasoline industry will market stabilized product. Read before Natural Gasoline Assn. of America.

NATURAL GASOLINE SPECIFICATIONS

REFINER'S VIEWPOINT. Natural Gasoline Specifications From the Refiner's Viewpoint, M. H. Nolan. Nat. Petroleum News, vol. 22, no. 22, May 28, 1930, pp. 47-48. Paper is based on opinions expressed in interviews with several representative members of Natural Gasoline Assn.; average refiner is averse to giving up gravity and recovery as specifications if they could be included witb points on Engler curve; factors are enumerated that would render natural gasoline of greater utility to refiner for blending purposes.

NATURAL GASOLINE TRANSPORTATION

EVAPORATION LOSSES. Equip Tank Cars for Gauging Witbout Removing Dome to Lessen Outage, E. Kaye. Nat. Petroleum News, vol. 22, no. 22, May 28, 1930, pp. 85-87. Outage is not only transportation loss, but also includes plant losses, loading losses, and unloading losses; total of losses is estimated at 6 per cent of gasoline transported in tank cars, or about $7,000,000 yearly; discussion of losses and of methods of diminishing losses, with special reference to gauging devices. Read before Natural Gasoline Assn. of America.

NOISE

MEASURING INSTRUMENTS. Tbe Analysis and Measurement of Noise Emitted by Machinery, B. A. G. Churcher and A. J. King. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 402, June 1930, pp. 780-787. Discussion of paper previously indexed from Jan. 1930 issue of same journal.

O

OIL FIELDS

WATERS. The Water Problem in Oil and Gas Fields, W. P. Campbell. Eng. Jl., vol. 13, no. 6, June 1930, pp. 364-369, 9 figs. Water problem creates difficulties in well drilling, in production, and in proper abandoning of unproductive wells; discussion of oil sands; definitions of top, middle or intermediate, lenticular, edge, and bottom waters, all of which are capable of making trouble; water sand records; sampling of water in sands; water analysis; grapbic classification of water; cementing of wells to shut off water.

OIL WELL DRILLING

CALIFORNIA. Uniform Penetration in Orderly Development of Oil Zones, C. C. Thoms. California Oil Fields, vol. 14, no. 9, Mar. 1929, pp. 5-20, 3 supp. plates. Partial analysis of development of one structure, Ventura Avenue dome of Ventura anticline, submitted with hope that facts brougbt out and conclusions drawn may induce discussion and study as to best practical method of oil field development; history of development; gas-bearing sands; saturation; water conditions; enumeration of conclusions as to best metbod of drilling and producing.

P

PAVEMENTS, CONCRETE

CONSTRUCTION CONTROL. Control of Materials and Mixtures for Concrete for Pavements, R. W. Crum. Highway Researcb Board—Proc., of mtg. Dec. 12-13, 1929, pp. 276-318 and (discussion) 318-330, 26 figs. Description of methods used by Iowa Higbway Commission to produce concrete for pavements high in strength, uniform in quality, and is of definite, predetermined composition; determination of specific gravity of aggregate particles and moisture in aggregates; measurement of aggregates; inspection of weigbing devices; measurement of water; field tests; time of opening pavement; effect of proportions; crushing strengths from moulded specimens and drilled cores; relation between transverse and crushing strength.

PETROLEUM INDUSTRY

UNITED STATES. Stabilization of American Oil Industry, J. E. Jones. Pan-Am. Geologist, vol. 53, no. 3, Apr. 1930, pp. 183-196, 1 fig. Analysis and discussion of situation with respect to crude oil supply and demand in United States; tabular statistical data, Jan. 1916 to Dec. 1929; fundamental factors, or bases, of determining supply and demand are domestic production, imports, exports, and stocks; domestic over-production is regarded as myth, except for short periods and locally; over supply exists primarily because of imports; remedy is suggested.

PETROLEUM PRODUCTS

OXIDATION. Catalytic Oxidation of Paraffin and Mineral Oil (Ueber die katalytische Oxydation von Paraffin und Mineraloel), E. Zerner. Chemiker Zeitung (Koethen), vol. 54, nos. 27 and 29, Apr. 2, 1930, pp. 257-259 and Apr. 9, pp. 279-281. Apr. 2: Oxidation of paraffin; reaction products and yields. Apr. 9: Oxidation of mineral oils; oxidation in alkaline medium; conclusions.

PIPE LINES

PROTECTIVE COATINGS. Procedure in Making Surveys of Soils, D. E. Dickey and H. Hayes. Oil and Gas Jl., vol. 29, no. 3, June 5, 1930, p. T-75, 2 figs. Brief review of literature on research on pipe line corrosion; outline of practice of oil company in California in soil survey and final selection of coatings for portions of line requiring protection. Bibliography.

WELDING. Electric Arc Welding of Pipe Lines, C. M. Taylor. Oil and Gas Jl., vol. 29, no. 3, June 5, 1930, pp. T-76 and T-79, 1 fig. Brief review of development since introduction of electric arc welding in pipe line industry about two years ago; explanation of approved practice; bell and spigot joints; firing line and bell bole units; river crossings.

PLATINUM MINES AND MINING

SOUTH AFRICA. Potgietersrust Platinums, Ltd. Notes on the Metbod employed in Mining tbe Zwartfontein Central Ore Body, K. Richardson. S. African Min. and Eng. Jl. (Johannesburg), Special no., Apr. 1930, pp. 89 and 91. See also brief abstract in Empire Min. Rev., no. 2, Apr. 1930, pp. 62-63. Prospecting disclosed shoot of good values in pyroxenites 300 ft. long by 90 ft. across at widest point; shaft showed persistence in deptb; 1,000 tons per ft. of deptb developed between surface and 100 ft. level in tbree shoots; mine costs 115.3 d. per ton. Brief abstract of paper read before Empire Min. and Met. Congress.

PIPE LINES

WOODEN. Pipe Perfect After 73 Years' Use. Oil and Gas Jl., vol. 29, no. 3, June 5, 1930, p. T-76, 1 fig. Brief article describes metbod of constructing gas pipe line in Marietta, Ohio, in 1856 and 1857; white pine logs turned to 6 in. outside diameter and bored to 2 in. inside diameter; bell end bored to 4 in. diameter about 4 in. in and other end turned to fit bell; tarred inside and out; joints made by dipping end in hot tar and driving into belled end, on wbicb iron band bad been shrunk.

PORCELAIN EXHIBITIONS

PARIS. Porcelain Exhibition in Paris (Die Porzellan-Ausstellung in Paris). Sprecbsaal (Coburg), vol. 63, no. 7, Feb. 13, 1930, pp. 117-118, 5 figs.; see also translated abstract in Am. Ceramic Soc.—Jl., vol. 13, no. 6, June 1930, p. 406. Exhibition embraces about 2,000 art objects of different epochs beginning from 1675 to 1914, most of which come from museums and private collections.

POTASH MINES AND MINING

SHAFT CEMENTING. Use of Chemical Cementing Process in Rendering Impervious Liquor Dike in Shaft Sinking at the Potash Mines Sachsen-Weimar in Unterbreizbach (Rboen) [Die Anwendung des chemiscben Verfestigungsverfabrens bei der Abdichtung eines Laugendammes und bei Schachtdichtungsarbeiten auf dem Kaliwerk Sachsen- Weimar in Unterbreizbach (Rhoen)], A. Lohmann. Kali (Halle), vol. 24, no. 6, Mar. 15, 1930, pp. 81-85, 6 figs. Ordinary methods of dike construction did not stop seepage but pumping in silicate and aluminate solutions made effective seal.

POWER PLANTS

DESIGN. Modern Power—Basic Principles, Design and Application, F. T. Morse. South Power Jl., vol. 48, no. 6, June 1930, pp. 41-47, 8 figs. Discussion of problems developed in electric power generation and distribution by variable load which is characteristic of all public utility systems; careful explanation of various terms used is given, and methods employed by leading utilities in meeting various problems are discussed.

STEAM AND DIESEL COMBINED. Joint Use of Diesel and Steam Engine to Balance Heat and Power, E. J. Kates. Am. Soc. Mech. Engr.—Advance Paper for Nat. Oil and Gas Power mtg., June 12-14, 1930, 14 pp., 6 figs. Purpose is to increase efficiency of steam utilization; simplified examples are used to show effect of Diesel power on overall thermal economy and upon overall costs; conclusions of two specific studies of heat and power supply involving joint use of Diesel and steam engines, and brief description of two actual applications.

PRESSURE VESSELS

WELDING. The Strength and Design of Fusion Welds for Unfired Pressure Vessels, L. W. Schuster. Mech. World (Manchester), vol. 87, nos. 2264, 2267 and 2268, May 23, 1930. pp. 484-487, June 13, pp. 551-553, and June 20, pp. 585-588, 12 figs. Abstract of paper presented before Instn. Mech. Engrs., previously indexed from Engineering, Mar. 14, 21, and 28, 1930.

PUMPS, CENTRIFUGAL

HIGH CAPACITY. Development of Storage Pumps (Der Entwicklungsstand der Speicherpumpen), W. Hahn. V.D.I. Zeit. (Berlin), vol. 74, no. 25, June 21, 1930, pp. 881-886, 15 figs. General discussion of functions, design, and installation of large-capacity pumps for pumped storage power plants with special reference to Herdecke hydro-electric plant; tests with models; special features of Herdecke pump; station equipped with two-stage adjustable guide vane centrifugal pump having capacity of 13.16 cu. m. per sec., working against total head of 160 m. with speed of 300 r.p.m.

PYRITES

UTILIZATION OF. The Utilization of Pyrites in Pulp and Acid Manufacture, H. Freeman. Can. Min. and Met. Bul. (Montreal), no. 216, Apr. 1930, pp. 471-476. About $3,000,000 worth of sulphur is consumed annually in Canadian pulp mills and acid plants, all of which is imported from United States; reasons for preferred use of sulphur; considerations in favour of pyrite; installation for burning pyrite concentrate; cleaning and cooling of gases.

R

RADIATORS

HEAT CAPACITY. Practical Determination of Heat Capacity of Radiators (Die praktische Bewertung der Waermeleistung von Heizkoerpern), R. Meisterhans. Gesundheits-Ingenieur, (Munich), vol. 53, no. 11, Mar. 15, 1930, pp. 161-164, 8 figs. Mathematical discussion presenting simplified practical method for determining radiation from radiator with special reference to ribbed radiators.

RADIO AMPLIFIERS

NEUTRALIZED AMPLIFIER CASCADE. Theory of Neutralized Amplifier Cascade (Theorie neutralisierter Verstaerkerketten), R. Fledtkeller. Zeit. fuer Hochfrequenztechnik (Berlin), vol. 35, no. 2, Feb. 1930, pp. 45-55, 7 figs. Anode retroaction can be removed in resistance-coupled amplifier cascade according to neutralization principle when as neutralization impedance series of condenser, inductance and resistance are connected between grids of two consecutive tubes; amplification curve of neutralized cascade is calculated.

RADIO AMPLIFIERS. Presentation of Frequency Relations of Transformer Hook-ups for Audio Frequency Amplification (Ein Beitrag zur Darstellung der Frequenzabhaengigkeit von Transformatorschaltungen fuer Nierderfrequenzverstaerkung), H. Kafka. Zeit. fuer Hochfrequenztechnik (Berlin), vol. 35, no. 2, Feb. 1930, pp. 56-60, 2 figs. Sample method of graphical presentation; Philips transformer connected to A 415 tube is given as example.

RADIO CIRCUITS

ANALYSIS. Phase Relations and Start of Oscillations in Two-Tube System According to Leithaeuser-Heegner Hook-up (Phasenverhaeltnisse und Schwingungseinsatz bei einem Zweiroehrensystem nach Art der Leithaeuser-Heegner-Schaltung), M. von Ardenne and K. Schlesinger. Zeit. fuer Hochfrequenztechnik (Berlin), vol. 35, no. 2, Feb. 1930, pp. 60-67, 11 figs. Simple mathematical form for substitute resistance is developed; from study of vector equation and connection of hook-up with oscillating circuit, conditions for auto-excitation are developed; experiments and test results are described.

RADIO RECEIVING APPARATUS

HETERODYNE RECEPTION. Study of Processes in Heterodyne Reception (Untersuchung der Vorgaenge beim Ueberlagerungsempfang), F. Vilbig. Telegraphen und Fernsprech-technik (Berlin), vol. 19, nos. 4 and 5, Apr. 1930, pp. 109-120, and May 1930, pp. 141-145, 32 figs. Theoretical mathematical analysis of principles in neutrodyne and superheterodyne radio receiving apparatus.

RADIO TELEPHONE

TRANSOCEANIC. Transoceanic Telphone Service—Short-Wave Equipment, A. A. Oswald. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, April 1930, pp. 629-637, 9 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

RADIO WAVES, SHORT

MEASUREMENT. Methods for Frequency Measurement of Short Waves (Einige Methoden zur Frequenzmessung von kurzen Wellen), H. Moegel. Elektrische Nachrichten Technik (Berlin), vol. 7, no. 4, Apr. 1930, pp. 133-140, 11 figs. Measurement with standard circuit and minor galvonometer; improved measuring method; application of quartz resonator for direct frequency control at sender. Bibliography.

RAILROADS

MECHANICAL ENGINEERING. Proceedings of the Session of the American Railway Association—Division 5—Mechanical, for mtg. June 25-28, 1929, published by Association, 30 Vesey Street, New York, 1188 pp., diagrs. and figs., including Appendix covering historical record of standards and recommended practice. Committee reports on draft gear tests of Purdue University; design of shops and terminals; specifications and tests for materials; brake equipment; wheels; lubrication; construction; arbitration; tank cars; loading rules; research; apprentices; electric rolling stock; locmotive design and construction; utilization of locomotives.

FRANCE. Report on State Railways of France for Year 1928 (Résultats Obtenus en 1928 sur le Réseau des Chemins de Fer de l'Etat en France). Revue Générale des Chemins de Fer (Paris), vol. 49, no. 1, Jan. 1930, pp. 33-42. Summary of statistical data, in tabular form, on operation, rolling stock, new construction, revenue and expenditure, etc.

PYRENEES MOUNTAINS. The Problem of Transpyrenean Railroads and the Penetration of European Lines into Spain (La Question des Transpyrénéens et celle de la pénétration de la voie Européenne en Espagne), M. Garau. Revue Générale des Chemins de Fer (Paris), vol. 49, no. 4, Apr. 1930, pp. 301-324, 19 figs. Historical sketch of development of railroad communication across Franco-Spanish border; description of recently completed railroad lines between Bedous and Canfranc and Aix-les-Thermes and Puigcerda; outline of proposed railroad developments between French border and Barcelona.

RESERVOIRS

ECONOMICS. Economics of Reservoirs, P. Hansen. Water Works Eng., vol. 83, no. 12, June 18, 1930, pp. 943-944 and 982, 3 figs. Economics of impounding reservoirs; storage capacity should be provided for periods of from ten to thirty years; filtered water-storage; proper allowance for fire reserve.

ROAD CONSTRUCTION

IRELAND. Concrete and Asphalt Road Surfacing in an Urban Area, R. E. L. Clarke. Instn. Mun. and County Engrs.—Jl., vol. 56, no. 23, May 13, 1930, pp. 1201-1221, 7 figs. Methods of constructing asphalt and concrete roads in Ireland; classes of road foundations; important conditions in laying concrete roads.

ROAD DESIGN

FROST. A Method of Analysis of Data on Frost Occurrence for Use in Highway Design, J. A. Sourwine. Pub. Roads, vol. 11, no. 3, May 1930, pp. 51-60, 8 figs. Paper presents method of determination of probable ground freezing occurrence from past records; critical initial air temperature for ground freezing selected as 23 deg. Fahr.; relation established between minimum temperature in air and soil; frequency of minimum temperatures; duration of cold periods; index map showing most adverse conditions of frost occurrence, considering intensity, frequency, and duration.

ROADS

FROST DAMAGE. Mitigating Frost Action on Road Surfaces. Eng. News-Rec., vol. 104, no. 25, June 19, 1930, pp. 1021-1023, 7 figs. Discussion of causes influencing frost action and means employed to overcome its damaging effects; surface damage from freezing and thawing; frost heavy of surface-treated macadam; granular sub-bases; drains and backfilled trenches; repairing frost heaves. Extract from Am. Road Bldrs. Assn.

LOW COST. Stone Conservation in Low-Cost Roads, W. Huber. Quarry and Surveyors' and Contractors' Jl. (Lond.), no. 400, June 1930, pp. 217-218. Abstract of article previously indexed from Can. Engr., Mar. 4, 1930.

SAND ENCROACHMENT. Construction and Safeguarding of Roads Located Upon Shifting Sands (Construccion y defensa de calzadas trazadas sobre arenas erraticas), V. Alcedan. Informaciones y memorias de la Sociedad de Ingenieros del Peru (Lima), vol. 31, no. 10, pp. 648-658, 9 figs. General considerations; origin of dunes and shifting sands of Peruvian coast; theory of sand movement; natural slope, and changes due to wind and gravity; coast mountain range fixed dunes; wind effects on roads built upon sand; protection of road surface; methods of keeping sand off roads. Read before National Technical Road Conference.

ROCK DRILLING

COLOMBO HARBOUR. Rock Drilling Colombo Harbour. Engineer (Lond), vol. 149, no. 3882, June 6, 1930, p. 640, 1 fig. Rather unusual proposition in way of rock drilling has developed in scheme for deepening harbour at Colombo, Ceylon, which, it is hoped, has been met by equipment by Climax Rock Drill and Engineering Works; for purpose of drilling rock preparatory to blasting, Company has supplied equipment of three drilling units, air compressor, and drill steel sharpening machine.

S

SAND AND GRAVEL PLANTS

ILLINOIS. Revamping a New Gravel Plant for Efficiency and Output. Rock Products, vol. 23, no. 13, June 21, 1930, pp. 49-54, 26 figs. Design, layout, equipment and operation of plant of Material Service Corp., Lockport, Ill.

OHIO. Unique Sand and Gravel Dredging Operation. Rock Products, vol. 23, no. 12, June 7, 1930, pp. 73-74, 3 figs. Plant of Muskingum River Gravel Co., Zanesville, Ohio, equipped with 120-hp. 8½ x 10½-in., 500-r.p.m. Fairbanks-Morse Diesel engine through Cutler-Hammer magnetic clutch; Falk flexible coupling is used at Symons crusher so that it may easily be disconnected when desired, but arrangement is such that 100 per cent crushed gravel may be produced when desired.

SHEET STEEL

HEAT TREATMENT. Normalizing Steel Sheets in the Continuous Furnace, R. Whitfield. Fuels and Furnaces, vol. 8, no. 6, June 1930, pp. 801-804. Discussion of use of continuous normalizing furnace for heat treatment of steel sheets to impart physical properties required in sheet to be used in subsequent deep drawing operations. Abstract of paper read before Brit. Iron and Steel Inst., May 1-2, 1930, previously indexed from various sources.

SHIP DESIGN

STABILITY. The Automatic Stabilization of Ships. Engineer (Lond.), vol. 149, no. 3882, June 6, 1930, pp. 625-628, 9 figs. Examples of application of Schlick stabilizer; system was unsatisfactory, not because of miscalculation, but because of fixed weight at fixed distance as means of supplying required precessional moment was wrong in principle; development of idea was taken up by Sperry Gyroscope Co. who did not, however, endeavour to perfect Schlick principle but instead struck out on line of its own characterized by new method of controlling precession. (Continuation of serial.)

SILVER MINES AND MINING

ONTARIO. Gowganda Silver Area, A. D. Campbell. Can. Min. and Met. Bul. (Montreal), no. 216, Apr. 1930, pp. 453-480, 8 figs. Gowganda silver area is about 55 mi. northwest from Cobalt; mines have produced since 1909; discussion of how ore shoots occur, in comparatively small areas of extensive calcite veins in Nipissing diabase; some silver has been found in Huronian and Keewatin rocks above diabase sill, and more may be found; notes on milling of silver ores at plant of Castle-Trethewey Mines.

SMOKE ABATEMENT

DISCUSSION. A Catalyst, A. E. Winter. Coal and Coal Trade Jl., vol. 61, no. 22, May 29, 1930, p. 347. Correspondence item on use of catalyst for increasing sales by treating coal for prevention of soot, smoke, and clinker; discussion of combustion and cause of smoke; possibilities in partial elimination of smoke by catalytic treatment of coal.

EXPERIMENTS. Use of Purified Flue Gases in Carbon-Dioxide Fertilizer (Die Verwendung von gereinigten Rauchgasen zur Kohlensaeuereduengung), F. Riedel. Gesundheits-Ingenieur (Munich), vol. 53, no. 17, Apr. 26, 1930, pp. 257-261, 6 figs. Discussion of beneficial effects of carbon-dioxide fertilizing; results of experiments in large greenhouses and in open fields; bearing of method upon smoke abatement; carbon-dioxide fertilization may eliminate damage caused by smoke and may cause high yields of crops.

SPRINGS

DESIGN. General Considerations in Designing Mechanical Springs, A. M. Wahl. Machine Design, vol. 2, no. 5, May 1930, pp. 26-31, 12 figs. Outline of method for determining working stresses in spring based on tensile and fatigue properties of material; graphs show distribution of stresses over cross section of springs of large index and results of stress test on helical spring: numerical example for valve spring is given. (To be continued.)

FEATURES. Spring vs. Weights, R. G. Standerwick. Gen. Elec. Rev., vol. 33, no. 6, June 1930, pp. 341-344, 5 figs. Author points out limiting features of dead weights and describes how these limits restrict their useful application in many cases; interesting features of springs and some of general laws.

STEAM

HIGH PRESSURE. Steam Conditions and Cycles, J. N. Waite. Elec. Rev. (Lond.), vol. 106, no. 2740, May 30, 1930, pp. 1003-1005. Case for high initial temperatures, high pressures, and resuperheating in electric power stations.

Higher Steam Pressures and Temperatures. Nat. Elec. Light Assn.—Report, no. 053, May 1930, 8 pp., 5 figs. Report discusses thermal economies resulting from use of steam pressures between 500 and 1,500 lbs. and of steam temperatures above 750 deg. fahr.; construction costs and operating results in their relation to steam conditions, and properties of various alloys at high temperatures.

STEAM ACCUMULATORS

RUTHS. Ruths' Storage Equipment for Peak-Load Power Generation in Berlin (Ruthsspeicher fuer Spitzenkrafterzeugung in Berlin), E. Schulz and Gropp. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 505, Apr. 1, 1930, pp. 153-162, 16 figs. Ruths storage equipment of Charlottenburg plant of Berlin municipal electricity works is described; notes on dimensions; possibilities of equipment; method of operation; reliable experience for future developments; costs.

STEAM CHARTS

FOR STEAM CYCLE. The Heat Content-Pressure Diagrams, L. Holdredge. South. Power Jl., vol. 48, no. 6, June 1930, pp. 56-59, 1 fig. Diagram intended to cover complete steam cycle, much broader range than does Mollier diagram, in solution of thermo-dynamic problems; its use offers easy graphical methods of determination.

STEAM CONDENSERS

DESIGN. Condenser Design and Operation, A. J. German. Pac. Mar. Rev., vol. 27, no. 6, June 1930, pp. 232-233. Progress in condenser design during past few years has been directed along following lines; first, better steam distribution over tube nest, thus making larger percentage of tube surface area effective in heat transfer; second, removal of non-condensable gases by better arrangement of baffles and lanes.

SURFACE. Study of Circulating Water Consumption in Surface Condensers (Etude sur la consommation d'eau de circulation dans les condenseurs par surface), A. Risler. Revue d'Electricité et de Mécanique (Paris), no. 10, Mar./Apr. 1930, pp. 38X-X41, 1 fig. Mathematical data, curves, and tables.

STEAM-ELECTRIC POWER PLANTS

BERLIN. West Power Plant of the Berlin Municipal Electricity Works (Das Kraftwerk West der Berliner Staedtische Elektrizitaetswerke Akt. Ges.). M. Rehmer. Elektrotechnische Zeit. (Berlin), vol. 51, nos. 14 and 16, Apr. 3, 1930, pp. 485-498, and Apr. 17, pp. 557-570, 85 figs. Introductory notes to future increase of current consumption and consequent development in design of new West plant; installed capacity is 228,000 kv. in 6 units of 34,000 kw. and 2 house turbines generators of 12,000 kw. each; notes on boiler engine and plant equipment.

CONTROL. Thermal Supervisory Equipment of High-Pressure Steam Installation in Simmering Power Plants of Vienna Municipal Electricity Works (Die waermetechnischen Ueberwachungsanlagen der Hochdruckdampfanlage im Kraftwerk Simmering der Wiener Staedtischen Elektrizitaetswerke), R. Mokesch. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 16, Apr. 20, 1930, pp. 364-369, 9 figs. Measuring and supervisory equipment of boiler and turbine installation of plant containing 2 units of 17,800 kva. and 25,000 kva. respectively and operating at steam pressure of 35 atmos. at 420 deg. cent.

STEAM POWER PLANTS

ASH SEPARATORS. Recovering Unburnt Fuel From Ash Pit Refuse, D. Brownlie. Combustion, vol. 1, no. 11, May 1930, pp. 40-44, 6 figs. Recovery of unburnt fuel from ash-pit refuse has been practiced to considerable extent in Great Britain and in certain European countries; in England, practice seems to have found particular application in connection with gas-plant operation; author describes two of most extensively used processes and presents data relative to economic aspects of typical gas-plant and steam-plant installations.

DESIGN. Steam Generation and Utilization, L. C. Edgar. Assn. of Iron and Steel Elec. Engrs.—Proc. for Yrs. 1928-1929, pp. 697-698. Indexed in Engineering Index 1929, p. 1739, from Iron and Steel Engr., June 1929.

EFFICIENCY. Comparison of Steam Station Performance, A. G. Christie. Power Plant Eng., vol. 34, no. 12, June 15, 1930, pp. 672-675, 4 figs. Presentation of expression for station performance and comparison; discussion of question and problems arising from new method of expressing station performance; "Parsons Line" does not consider capacity factor, which has many advantages; input-output curves for three phases of large coal fired central station are given.

STEAM POWER PLANTS, INDUSTRIAL

PAPER AND PULP MILLS. Heat and Power Problems, R. W. Crute. Paper Mill, vol. 53, no. 22, May 31, 1930, pp. 36-38. Determination of proper pressure to use in steam power plant of paper mill; advantages of high-pressure steam. Paper presented before Am. Pulp and Paper Mill Superintendents Assn.

STEAMSHIPS, TURBINE

BREMEN. Express Liner Bremen (Der Vierschrauben Turbinen-Schnelldampfer Bremen), P. Biedermann, W. Koch and H. Hein. Werft-Reederei-Hafen (Berlin), vol. 11, no. 10, May 28, 1930, pp. 197-216, 22 figs. and numerous figs on 6 supp. plates. Detailed report of shipbuilding aspects of design and equipment by P. Biedermann and H. Hein and of main and auxiliary propelling machinery, by W. Koch, previously indexed from V.D.I. Zeit., May 24, 1930, and other sources.

STREAM POLLUTION

WATER ANALYSIS. Methods of River-Water Analysis (Zur Methodik der Flusswasseruntersuchung), Ilzhoefer. Gesundheits-Ingenieur (Munich), vol. 53, no. 14, Apr. 5, 1930, pp. 209. Report from Department of Hygiene of University of Munich, presenting data on pollution of rivers Isar and Lech by sewage of Munich and Augsburg; details of methods of sampling and of physical, chemical, and bacteriological analyses.

STRUCTURAL STEEL

OXYACETYLENE CUTTING. An Investigation of the Failure of Flame-Cut Wind-Bracing Brackets, W. J. Krefeld. Columbia Univ. Eng. Testing Lab., no. 3, July, 1929, 133 pp., 45 plates; see also abstract in Eng. News-Rec., vol. 104, no. 17, Apr. 24, 1930, pp. 684-685, 4 figs. Study of broken wind-bracing brackets; metallographic examination; effects of formative processes; detection and measurement of strain; strains produced by punching; local heating etc.; impact; hardness; static bend; tension and drop tests; evidence of brittleness in wind-bracing brackets flame-cut after punching; remedies suggested. Bibliography.

T

TELEPHONE LINES

INDUCTIVE INTERFERENCE. Telephone Interference from A-C. Generators, J. J. Smith. Am. Inst. Elec. Engrs.—Trans., vol. 49, no. 2, Apr. 1930, pp. 798-809, 3 figs. Paper previously indexed from Advance Paper, for mtg. Jan. 27-31, 1930.

POLES. Calculation of Wooden Line Poles (Beitraege zur Berechnung hoelzerner Leitungsmasten), K. Winnig. Telegraphen und Fernsprech-Technik (Berlin), vol. 19, no. 5, May 1930, pp. 133-141, 11 figs. Notes on calculation of single pole with bending and combined buckling and bending loads, graphs and curves.

TEXTILE MACHINERY

ELECTRIC DRIVE. The Electrical Drive of Weaving Sheds Equipped with Plain Cotton Looms, R. H. Wilmot. Metropolitan Vickers Gaz. (Manchester), vol. 12, no. 205, Apr. 1930, pp. 85-90, 2 figs. Advantages and disadvantages of various methods of driving weaving sheds; cleanliness of product and atmosphere; description of modern methods of electrical drive of weaving sheds. (To be continued.)

TIMBER SPECIFICATIONS

TIMBER SPECIFICATIONS. Report of Committee K-7 on Timber. Am. Soc. Testing Matls.—Advance Paper, no. 80, for mtg. June 23-27, 1930, 81 pp., 10 figs. Report of Subcommittee on timber preservatives, and on moisture content of timber; proposed revised standard specifications for structural wood joists, planks, beams, stringers and posts; notes on working stresses for structural grades of American lumber standards; proposed tentative specifications for timber piles; revised standard method of test for coke residue of creosote oil; proposed tentative definitions of terms relating to timber preservatives.

TRACTORS

DESIGN. Some Problems Encountered in the Design of Track-Type Tractors, H. S. Eberhard. Motive Power, vol. 1, no. 5, June 1930, pp. 20-22 and 32-33, 5 figs. Design and operating problems; dust exclusion is important factor; tractor operated on 111 per cent slopes; heat treatment; charcoal burning tractor. Abstract of paper presented before Soc. Automotive Engrs.

TRAFFIC CONTROL

PROBLEMS. Traffic Problems. Nat. Safety Council—Trans., vol. 3, of mtg. Sept. 30-Oct. 4, 1929, pp. 57-81. Papers presented before Public Safety Division by H. S. Simpson, R. Kingery, and H. M. Gould.

PHOTOELECTRIC CELLS. Bridge Traffic Controlled by Photo-Electric Cells, B. Cooper. Eng. News Rec., vol. 104, no. 24, June 12, 1930, pp. 974-975, 3 figs. Article previously indexed from Electronics, June, 1930.

TUNGSTEN CARBIDE

CUTTING TOOLS. Users of Tungsten Carbide Report Variety of Experiences, F. C. Spencer. Iron Trade Rev., vol. 86, no. 25, June 19, 1930, pp. 73-75. Advantages and shortcomings are revealed by replies to questionnaire of subcommittee on tungsten-carbide cutting materials of American Society of Mechanical Engineers; suggestions for improvement in machine tool design.

TUNNELS

CONCRETE LINING. Repairs to Concrete Lining of Truckee Canal Tunnels, W. H. Nalder. New Reclamation Era, vol. 21, no. 4, Apr. 1930, pp. 64-65. Description of methods used and cost data.

CONSTRUCTION, PERU. Peruvian Method of Highway and Railroad Tunnel Construction (Metodo Peruano para la Construccion de tuneles para carreteras o ferrocarriles), D. Castagnola. Informaciones y Memorias de la Sociedad de Ingenieros del Peru (Lima), vol. 31, no. 10, Oct. 1929, pp. 613-618, 6 figs. on supp. plates. Construction costs of 19 tunnels by hand drilling were lower than similar jobs with portable gasoline-driven compressors; top heading 1.6 by 1.8 meters; widening to full arch; removal of rock to grade in two benches; average costs 14 to 18 Peruvian pounds per meter of finished tunnel 4 by 5 meters; no cost details. Read before National Technical Road Conference.

SURVEYING. Recording Instruments for Determining Distance between Tunnel Walls with Reference to Clearance Limit (Appareil enregistreur de la distance des parios des souterrains par rapport au gabarit de chargement etc.), Virot. Revue Générale des Chemins de Fer (Paris), vol. 49, no. 3, Mar. 1930, pp. 197-204, 9 figs. Detailed description of Pichon instruments for surveying interior profile of tunnel sections to determine actual clearance at critical points; instrument is mounted on small rail truck carrying gear of recording apparatus; method of use and samples of graphical records obtained.

V

VACUUM TUBES

DIODE. Theory of Diode Tubes and Generation of Electric Oscillations of Ultra-Low Frequency (Theorie der Zweielektrodenroehren und Erzeugung elektrischer Schwingungen von extra niedriger Frequenz), Y. Ito. Zeit. fuer Hochfrequenztechnik (Berlin), vol. 35, no. 2, Feb. 1930, pp. 67-75, 24 figs. Notes on self-excitation, principle of feed-back and its mathematical equation; amplitude of self-excitation oscillations and their stability, performance of tube as generator, simple a.c. hook-ups, frequency of self-excited oscillations, limit of generated frequencies; examples are given.

VIADUCTS

NEW JERSEY. High Viaduct 3 Miles Long Will Complete Gap in Holland Tunnel Road. Eng. News Rec., vol. 104, no. 24, June 12, 1930, pp. 973-974, 2 figs. Outline of plans and structural features of elevated steel structure costing nearly twenty million dollars, including two duplicate fixed-span cantilever bridges with clearance of 135 ft., over Passaic and Hackensack Rivers, each with main span of 550 ft.

VIBRATIONS

DAMPING. Steady Forced Vibration as Influenced by Damping. L. S. Jacobsen. Am. Soc. Mech. Engrs.—Advance Paper no. 12, for mtg. June 9 to 12, 1930, 10 pp. 11 figs. General method of obtaining approximate solutions of steady forced vibration of damped system, of one degree of freedom, for case of sinusoidally varying disturbing forces; approximation consists in expressing all damping terms of original differential equation by single equivalent damping term, proportional to first power of velocity of motion; discussion of experimental results at Stanford University; comparison of Den Hartog's exact theory and the approximate theory.

W

WATER SOFTENING

UNITED STATES. Progress and Trends in Water Softening, C. P. Hoover. Eng. News-Rec., vol. 104, no. 21, May 22, 1930, pp. 843-846, 5 figs. Review of recent progress; greater degree of softening now obtained; excess-lime method followed by carbonation; combination of zeolite and lime-soda softening; chemistry of water softening; pneumatic conveying equipment for handling of chemicals; carbonation plant at Columbus, Ohio; continuous sludge removal equipment at St. Louis, Mo.; lime feeders and slakers at Marion, Ind. See editorial comment, pp. 832.

WATER WORKS

MANAGEMENT. The Round Table. Water Works Eng., vol. 83, no. 12, June 18, 1930, pp. 951-952 and 981. Discussion of following questions: when street grades are changed is cost of lowering water mains, hydrants and services borne by water department (or company) or by city; in case of damage to private property through water leakage who is responsible.

WATER WORKS ENGINEERING

UNITED STATES. Water Purification Dominant Topic. Eng. News Rec., vol. 104, no. 24, June 12, 1930, pp. 980-984, 1 fig. Report on proceedings and short abstracts of many papers before American Water Works Association at St. Louis, on making water better, wells, pumps, pipe, finance, airport supplies, etc.

WELDING

APPLICATIONS. Salvaging Expensive Parts, A. Eyles. Welding Engr., vol. 15, no. 5, May 1930, pp. 45-46, 11 figs. Description of procedure for typical welding repair jobs; use of fluxes in welding and its alloys; welding ruptured copper steam pipe; gas welding cast-iron parts; rivet-heater electrodes built up by welding.

Engineering Index

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A

ABRASIVE MATERIALS

MANUFACTURE. Metal Abrasives, A. B. McDaniel. Metals and Alloys, vol. 1, no. 13, July 1930, p. 614, 1 fig. Review of manufacture, uses and research on grit, shot and sand of iron and steel for abrasive and cleaning purpose data on shot and grit production in United States and on export and import are given.

AERIAL PHOTOGRAPHY

METHODS AND EQUIPMENT. Air Photography, F. C. V. Laws. Roy. Air Force Quarterly (Lond.), vol. 1, no. 3, July 1930, pp. 524-533, 18 figs. partly on supp. plates. Outline of methods and equipment for aerial photography used by Royal Air Force; notes on training of personnel and use of air photographs.

AERIAL TRANSPORTATION

GERMANY. German Commercial Air Transport, M. Wronsky. Inst. of Transport—Jl. (Lond.), vol. 11, no. 7, May 1930, pp. 304-322. General review of present developments and objects of German commercial flying.

GREAT BRITAIN. The Achievements and Possibilities of Air Transport, F. H. Page. Inst. of Transport—Jl., vol. 11, no. 8, June 1930, pp. 371-379. Brief notes on commercial aviation; airplane development, night flying, airship transport, private flying, military aircraft, relationship of aerial to other forms of transportation.

RADIO COMMUNICATION. Two-Way Radio Communication in Air Transport Service, H. Hoover, Jr. Aero Digest, vol. 16, no. 4, Apr. 1930, pp. 62-63 and 278, 5 figs. Brief review of developments; wave bands and antennas are discussed regarding distance; radio telephone equipment now commercially available weighs about 150 lbs., including power supply; power of 50 watts, if fully modulated appears to fulfill all requirements on plane; while 400 watts if fully modulated will cover requirements on ground.

Air Transportation, P. Goldsborough. Am. Soc. Mech. Engrs.—Advance Paper, June 9-12, 1930, 5 pp. Description of importance of radio for safety; review of latest developments in equipment and application.

SOUTH AMERICA. What Can Aviation Do For Central and South America? R. V. Wright. Am. Soc. Mech. Engrs.—Advance Paper for mtg., May 19-22, 1930, 10 pp. Outline of possibilities for airlines in developing resources; relations between United States and Latin America are reviewed, with data on population, transportation facilities and commerce; list of airlines and mileage.

AERONAUTICS

EUROPE. Trend of Aeronautics in Europe, A. H. G. Fokker. Aero Digest, vol. 16, no. 4, Apr. 1930, pp. 67 and 226. Discussion of factors of design and operation affecting economy; comparison of conditions in United States of America and Europe; trend in Europe back to wood and fabric; limit (500 horsepower) has about been reached in efficiency of air-cooled engines.

AIR COMPRESSORS

MAINTENANCE AND REPAIR. Care and Maintenance of 8½-inch C.C. Compressor, C. D. Nicholls. Railroad Herald, vol. 34, no. 6, May 1930, pp. 28-32. Practical discussion of proper methods to be employed in maintenance and repair of locomotive air compressors. Presented before Southeastern Air Brake Club.

AIR CONDITIONING

REFRIGERATION. Cooling and Heating With One Unit, E. Guarini. Ice and Cold Storage (Lond.), vol. 33, no. 386, Mar. 1930, pp. 122-123, 2 figs. Use of electrically driven refrigerating machines in inhabited premises for heating in winter and for cooling in summer; heating effected by use of electric aerotherms; cost of heating and cooling. Abstract of address before Belgian Soc. of Electricians.

AIRPLANE ENGINES

DESIGN. Developments of Aircraft Engines From 1912 to 1930 (Gli sviluppi del motore di aviazione dal 1912 al 1930), G. Lauro. Atti del Sindacato Provinciale Fascista Ingegneri di Milano (Milan), vol. 8, no. 4, Apr. 1930, pp. 135-154, 31 figs. Comparative study of airplane engine of Italian design; critical discussion of mechanical, metallurgical, and thermodynamical aspects; table giving specifications and performance data for Isotta Fraschini engines; notes on possibilities of future developments.

The Development and Progress of the Aero Engine, H. R. Ricardo. Flight (Lond.), vol. 22, no. 23, June 6, 1930, pp. 616-620; see also Aeroplane (Lond.), vol. 38, no. 23, June 4, 1930, pp. 1075-1076, 1078 and 1080, 4 figs. Review of development and outline of possibilities of improved designs; data on fuel consumption and weight; air vs. water-cooling; supercharging; notes on sleeve-valve performance; exhaust at pressure of 300 lbs. per sq. in. can be used in low-pressure cylinder; data on compression ignition. Abstract of Wilbur Wright Memorial Lecture presented before Roy. Aeronautical Soc.

DIESEL. Diesel Engine in Aviation (El Motor Diesel en la Aviacion), C. Ordonyez. Revista de Ingenieria Industrial (Madrid), vol. 1, no. 2, June 1930, pp. 11-19, 14 figs. Aviation pilot discusses development of Maybach, Beardsmore, Sunbeam, Packard, Junkers and Garuffa types; injection, lucrication, starting, and operation.

The Oil Engine in Aeronautics, E. E. Wilson. Am. Soc. Mech. Engrs.—Advance Paper, June 12-14, 1930, 5 pp., 1 fig. Discussion of requirements of aeronautic engines in general, manner in which these requirements have been met, influence of these requirements on application of oil engine to aeronautics and possibilities of future; advantages of oil and gasoline engines are compared; graph shows displacement-weight relations in aircraft engines.

LIQUID-COOLED. Water-Cooled Aero Engines (Six-Years' Progress), A. J. Rowledge. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 34, no. 235, July 1930, pp. 578-590 and (discussion) 590-602, 9 figs. Discussion of design and development of water-cooled engines of various makes; data on Rolls Royce engines; notes on variable pitch propeller and supercharging; in units of more than 500 hp. liquid cooling seems to be superior to air-cooling.

TESTING. All Major Parts Contribute to Failure in A.T.C. Aircraft Engine Tests. Automotive Industries, vol. 63, no. 4, July 26, 1930, pp. 118-121 and 132, 5 figs. Outline of type test procedure and requirements for approved type certificate of Department of Commerce; notes on equipment of aircraft engine testing laboratory of Aeronautics Branch, Department of Commerce, at Arlington, Va.; principal causes for failures are discussed.

AIRPLANE INDUSTRY

DESIGN, ETC. Airplane Design, Manufacture, and Sales—Commercial vs. Military, R. B. Beisel. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. May 19-22, 1930, 5 pp. Commercial industry differs materially from military; paper discusses these differences from general standpoints of design, manufacture, and sale; it would be much more difficult for commercial builder to enter military field than for maker of military airplanes to successfully enter general commercial field.

AIRPLANE MAINTENANCE AND REPAIR

SERVICING. Airplane Servicing From the Operator's Point of View, R. C. Marshall. Am. Soc. Mech. Engrs.—Advance Paper for mtg., May 8, 1930, 9 pp. Description of procedure and methods in overhauling engines and planes used by Thompson Aeronautical Corp., Cleveland, Ohio; notes on machine shop work and equipment; block test data.

AIRPLANE MANUFACTURE

MASS PRODUCTION. Problems of Airplane Quantity Production, R. S. Damon. Am. Soc. Mech. Engrs.—Advance Paper for mtg., May 19-22, 1930, 6 pp. Maximum production to date is 25 machines per week and with total runs, extending over more than one season, not exceeding 700 machines per model; notes on management and production organization to improve efficiency; cost factors are discussed with regard to possible reduction.

AIRPLANE PROPELLERS

LIGHT REFLECTION. Luminous Reflections of Rotating Propellers (Riflessione luminosa delle eliche in rotazione), V. S. Kulebakin. Notiziario Tecnico Di Aeronautica (Rome), vol. 6, no. 3, Mar. 1930, pp. 235-242, 12 figs. Experiments on light-reflecting properties of propellers for elimination of disturbing effects during night landings; dull dark colour gives best results. Translated from Zeit. fuer Flugtechnik und Motorluftschiffarht.

AIRPLANE WINGS

WIND TUNNEL TESTING. Air Forces and Air-Force Moments at Large Angles of Attack and How They Are Affected by the Shape of the Wing, R. Fuchs and W. Schmidt. Nat. Advisory Committee for Aeronautics—Tech. Memorandums, no. 573, July 1930, pp. 1-20, 48 figs. Article previously indexed from Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), Jan. 14, 1930.

AIRPLANES

FRAMEWORK. Building the Framework of the Moth Plane, F. C. Duston. Machy. (N.Y.), vol. 36, no. 12, Aug. 1930, pp. 970-972, 4 figs. Outline of procedure of Moth Aircraft Corp. followed in building wooden framework for wings, fins, ailerons, and similar parts, and application of fabric covering to these elements; notes on doping and painting of fabric.

FUSELAGES. Constructing Fuselages for Airplanes. Machy. (Lond.), vol. 36, no. 922, June 12, 1930, pp. 321-325, 5 figs. Notes on properties and proportions of tubing used; autogenous-welding practice; construction of important details; saving in weight by using alloy steel; strength and toughness; fittings for fuselage.

ICE FORMATION. The Formation of Ice on Aircraft, V. O. Clapp. U. S. Naval Inst.—Proc., vol. 56, no. 330, Aug. 1930, pp. 743-744. Conditions under which ice formations occur; data obtained in sixty altitude flights.

MAINTENANCE AND REPAIR. Equipment for the Aircraft Service Station, E. W. Fair. Aviation, vol. 29, no. 1, July 5, 1930, pp. 20-22, 3 figs. Descriptions of tools and machines necessary for efficient and profitable operation of small or large service; table gives primary small tools used for general maintenance in aircraft service stations shop.

Maintenance at Roosevelt Field, N.Y. Airway Age, vol. 11, no. 7, July 1930, pp. 934-937, 11 figs. Outline of system of records and inspection used by Roosevelt Field Corp. of Minneola, L.I.; blank forms of airplane flight and others are given; data on overhaul periods and expenses.

PILOTS. *See Aviators.*

RADIO APPARATUS. Aircraft Radio Receivers and Broadcast Service, J. C. Hromada. Airway Age, vol. 11, no. 7, July 1930, pp. 922-925, 6 figs. Outline of requirements of aircraft receivers and description of equipment built by Western Electric, Radiomarine Corp. of America and other companies; notes on electric circuits, power supply, etc.

TESTING. Aerodynamic Research Flying, S. Scott-Hall. Roy. Air Force Quarterly (Lond.), vol. 1, no. 2, Apr. 1930, pp. 281-290. Discussion of methods for determination of aerodynamic characteristics of airplane; notes on instruments for measuring air speeds, acceleration and current recorders.

Duration Flights During 1929, H. B. Hendrickson. Aero Digest, vol. 16, no. 4, Apr. 1930, pp. 64-65 and 272, 274, 276 and 278. Description of outstanding events in 1929 and equipment; graph of record refueling flights and graph of solo duration flights.

WELDING. *See Welding.*

AIRPORTS

LIGHTING. Careful Planning Pays in Airport Lighting, F. S. Peterson. Elec. World, vol. 96, no. 6, Aug. 9, 1930, pp. 259-260, 3 figs. Care used in preliminary study and planning; centralized remote control and underground distribution are features of Denver's airport lighting.

MANAGEMENT. Management and Operation of a Large Airport, W. D. Waterman. Am. Soc. Mech. Engrs.—Advance Paper, May 1930, 5 pp. Outline of relations of airport management with transport companies operating large fleets, with air-service operators having fleets of taxi and charter planes, with schools, with dealers and distributors, with manufacturers, with private owners of airplanes, with individual owners of single airplanes or small fleets for business purposes, and with general public; figures are given showing how successful business has been built at Los Angeles Metropolitan Airport.

RUNWAYS. Two-Course Asphalt Surfacing for Airport Runways, N. H. Angell. Eng. News-Rec., vol. 105, no. 6, Aug. 7, 1930, pp. 215-217, 4 figs. Description of two-course asphaltic surfacing, designed to meet unusually rigid specifications for runways of United Airports, recently completed at Burbank, Calif.; surface hardness under temperature changes controlled by mixed-in-place base course and premixed topping; grading of aggregate for plant-mixed course.

AIRSHIPS

HULL STRESS. The Strength of Transverse Frames of Rigid Airships, H. M. Lyon. Roy. Aeronautical Soc.—Jl. (Lond.), no. 234, June 1930, pp. 497-556, 14 figs. Mathematical investigation of methods which may be used to estimate loads in members and deflections at joints of frame under system of external loads in plane of frame, and in case of space frame, of forces perpendicular to plane of symmetry of frame.

R. 101. New British Dirigible R. 101 (Le nouveau dirigeable anglais "R. 101"), G. Delanghe. Le Génie Civil (Paris), vol. 96, no. 26, June 1930, pp. 621-629, 17 figs. Brief review of airship development and types; description of design of 142,000 cu. m. dirigible; sketches show structural details.

AIRWAY LIGHTING

BEACONS. Luminous Signals for Aerial Communications (Senyales luminosas para comunicaciones aereas). Revista Electrotecnica (Buenos Aires), vol. 16, no. 2, Feb. 1930, pp. 78-87, 14 figs. Most important factors in airway light signal systems are greatest possible range, lowest power consumption, and distinguishability from other light beams; mathematical discussion of luminosity; description of equipment; notes on practice on Berlin-Hanover and Berlin-Konigsberg routes.

ALIGNMENT CHARTS

NOMOGRAPHY. A Short Monograph on Nomography, F. M. Wood. Eng. Jl. (Montreal), vol. 13, no. 8, Aug. 1930, pp. 507-518, 1 fig. Systems of two parallel and one curved scale; equations containing four variables; binary scales; cases with more than four variables. (Continuation of serial.)

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

BEARING METALS. *See Bearing Metals.*

CAST IRON. *See Cast Iron.*

ALUMINUM ALLOYS

BRONZE. Aluminum Bronze—A Corrosion Resistant Alloy, R. J. Anderson. Metallurgia (Lond.), vol. 2, no. 8, June 1930, pp. 57-60. Brief review of development of aluminum bronze, known prior to 1860, but formerly too costly for use as engineering material of construction; compositions and mechanical properties; resistance to corrosion by various media; applications under corrosive conditions. Bibliography.

CORROSION. Some Factors Contributing to Corrosion of Aluminum, M. I. Makushenko. Tzvetniye Metalli (Moscow), no. 3, Mar. 1930, pp. 348-365, 37 figs. Report on experimental study made at laboratory of Krassny Viborzhetz plant, in Leningrad, on corrosive effect of river water, acid solutions, cooked rice, etc., upon aluminum ware and samples of aluminum plate. (In Russian.)

TESTING. Flow Tests Under Constant Pressure on Aluminum and Alpax (Essais de coulabilité, sous pression constante, de l'aluminium et de l'alpax), A. Courty. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 15, Apr. 14, 1930, pp. 936-938. Pressure of molten metal is kept constant by flap-valve arrangement in form of thin lead sheet; values obtained by this method check well; refinement with alkali, repeated fusions, duration of heating and overheating have only insignificant influence upon fluidity of alpax, in contrast to their influence upon its mechanical properties.

AUTOMOTIVE FUELS

DETONATION. Atmospheric Conditions and Knock Testing, D. B. Brooks, N. R. White and H. H. Allen. Soc. Automotive Engrs.—Jl., vol. 27, no. 1, July 1930, pp. 56-64 and (discussion) 64-68, 11 figs. Study of effect of barometric pressure, air temperature and humidity on both absolute and relative detonation of fuel; ratings being obtained in terms of benzol and of tetraethyl lead in straight-run Pennsylvania-base gasoline and in terms of isooctane in normal heptane in some cases.

AVIATION

BLIND FLYING. For Flying Equipment. Aircraft (Melbourne), vol. 8, no. 9, June 30, 1930, pp. 374, 376, 378, 380, 382, 384 and 386. On September 24, 1929, demonstrations under Guggenheim Fund's direction proved conclusively that aircraft can take-off and land by instruments alone; advantages of gyroscope; test plane equipped with Radio Frequency Laboratory standard aircraft receiver and vibrating reed indicator; aural type radio beacon, purposes of which was to direct incoming aeroplane to vicinity of field, visual type of localizer beacon to lead pilot to exact point on aerodrome and ground receiving and transmitting set.

INDIA. Calcutta-Singapore Air Route. Roy. Air Force Quarterly (Lond.), vol. 1, no. 3, July 1930, pp. 473-482. Description of survey cruise by two flying boats of supermarine type, each equipped with two Napier Lion engines.

SWEDEN. Civil Aviation in Sweden, H. C. Plummer. Aero Digest, vol. 16, no. 4, Apr. 1930, pp. 54-55, 246 and 250, 4 figs. Description of commercial aviation progress in Sweden; data on rates, equipment, routes and finances of Aktb. Aerotransport, only Swedish aeronautical transportation unit.

AVIATORS

TRAINING. Training Master Pilots, G. Myers. Airway Age, vol. 11, no. 6, June 1930, pp. 798-800. Outline of education methods of Boeing School of Aeronautics; notes on progress checks; instrument flying, types of planes, etc.

B

BEARING METALS

DEVELOPMENTS. Bearing Metals and Bearings, W. M. Corse. Am. Soc. for Steel Treating—Trans., vol. 18, no. 2, Aug. 1930, pp. 179-203.

BEARINGS

ROLLER. Testing of Tapered Roller Bearings (Die Pruefung von Kegelrollenlagern), G. Oehler. Werkstattstechnik (Berlin), vol. 24, no. 9, May 1, 1930, pp. 244-247, 20 figs. Description of new test methods for tapered roller bearings; actual measurements show conformity of various test methods; graphs give data on thickness, blackness, and hardness of outer races.

BELTS AND BELTING

RUBBER. Stretch in Rubber Transmission Belting, C. W. Staacke. Am. Soc. Testing Matls.—Advance Paper, no. 103, for mtg. June 23-27, 1930, 13 pp., 7 figs. Investigations were made to determine proper amount of inelastic stretch to remove from belting during vulcanization process when using given fabric; eight identical samples of 6-in. 4-ply belting were given amounts of stretch varying from zero to 11.6 per cent; in case of this particular construction belt stretched between 7 and 8 per cent during vulcanization will render satisfactory service.

BOILER CORROSION

PREVENTION. Keeping Heating Surfaces Clean for Increasing Efficiency of Boiler Plants (Sauberhaltung der Heizflaechen zur Hebung der Wirtschaftlichkeit von Dampfkesselanlagen), H. Schlicke. Papier-Fabrikant (Berlin), vol. 28, no. 24, June 15, 1930, pp. 402-404. Abstract of paper previously indexed from Waerme, Dec. 21, 1929.

BOILER FURNACES

DESIGN. Modern Boiler Furnace Plant. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 10, Apr. 1930, 16 pp. between pp. 596-623, 20 figs. Review of recent developments in design of plant for combustion and control of fuel in boiler house; diagrammatic view of Babcock and Wilcox ash-handling plant; Howden-Buell burner and distributor; diagrammatic view of Hydrojet system of ash handling.

BOILERS

DESIGN. Increase in Efficiency of Boilers and Its Influence on Parts of Steam (Die Leistungssteigerung von Kesseln und ihr Einfluss auf den Dampfpreis), H. Maas. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 11 and 12, June 15, 1930, pp. 153-154 and June 30, pp. 170-172, 3 figs. Conditions governing increase in efficiency; tests of performance with increasing steam output; economic considerations and advantages; based on practical examples investigation is made as to whether increase in capacity of boiler effects reduction in cost of steam generation.

BOILERS, HIGH PRESSURE

BENSON. The Benson Steam Generators at Gartenfeld, Berlin, C. H. Vickers. Eng. and Boiler House Rev. (Lond.), vol. 44, no. 1, July 1930, pp. 34 and 36, 2 figs. Discussion of Benson generating process; general layout of plant of Siemens-Schuckert.

BOILER MANUFACTURE

WELDING. Reliability of Materials Analysis in Welded Seams of Boiler Parts (Die Zuverlaessigkeit der Feststellungen der Werkstoffeigenschaften in Schwessnaehten der Kesselteile), E. Helfrich. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, no. 11, June 15, 1930, pp. 155-157. It is claimed that properties of weld cannot be determined from weld specimen and therefore determination of properties in specimen is not reliable criterion.

BOILERS

PULVERIZED COAL FIRED. General Operation Experiences with the First "Wood" Steam Generator, E. W. Smythe. Instn. Mech. Engrs.—Proc. (Lond.), no. 1, Jan. 1930, pp. 73-106, 30 figs. Abstract of paper previously indexed from Engineering, Jan. 31, and Engineer, Jan. 31 and Feb. 7, 1930.

Pulverized Coal-Firing Systems Compared, A. E. Grunert. Elec. World, vol. 96, no. 5, Aug. 2, 1930, pp. 208-209. Abstract of article previously indexed from Am. Soc. Mech. Engrs.—Advance Paper for mtg., June 9-12, 1930.

BOILER TUBES

HEAT EXPANSION. Influence of Heat Expansion of Boiler-Tube Nests on Movement of Boiler Drums (Ueber den Einfluss der Waermedehnung von Rohrbuendeln auf die Bewegung von Kesseltrommeln), Ebel. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 437-443, 8 figs. It is experimentally shown that heat expansion of tubes not only fluctuates in direction of gas path, but that it can assume different values in horizontal direction of boiler, that is perpendicular to gas path; causes of this phenomenon are explained.

BRIDGES, CONCRETE

COSTS. Extensive Bridge and Approach Project in Rochester. Eng. News-Rec., vol. 105, no. 2, July 10, 1930, pp. 79-80, 2 figs. Descriptions and unit cost bids on construction of multiple-arch reinforced concrete bridge in Rochester, N.Y., having main span 300 ft. long and 150 ft. wide; main four highway concrete bridges in New Jersey and Kansas.

BRIDGES, HIGHWAY

NEW YORK-NEW JERSEY. Interstate Crossings between New York and New Jersey with Particular Reference to the Hudson River Bridge Between Fort Washington and Fort Lee, O. H. Ammann. New York Railroad Club—Proc., vol. 40, no. 6, May 1930, pp. 9250-9259, 5 figs. Financing and building of interstate crossings by Port Authority; necessity of bridges at links in highway system; two Arthur Kill bridges; Kill Van Kull bridge; Hudson River bridge.

BRIDGES, SUSPENSION

HUDSON RIVER. An Account of the Major Construction Operations on the Hudson River Bridge, M. B. Case. New York Railroad Club—Proc., vol. 40, no. 6, May 1930, pp. 9260-9269, 5 figs. General discussion of methods employed in construction; cable spinning.

BRIQUETTING PRESSES

CAST IRON SCRAP. Briquetting Cast-Iron Springs, F. J. Walls. Am. Mach., vol. 73, no. 6, Aug. 7, 1930, pp. 245-249, 7 figs. Description of design and performance of hydraulic briquetting machine built by Southwark Foundry and Machine Company of Philadelphia, and installed at plant of Wilson Foundry and Machine Company, Pontiac, Mich.; notes on use of briquettes in cupola.

C

CABLEWAYS

DESIGN. Computation of Shape of Aerial Cableways Traversed by Moving Loads (Del calcolo della configurazione delle funi portanti aeree percorse da carichi mobili), G. Piazzo. Ingegnere (Rome), vol. 4, no. 5, May 1930, pp. 312-314, 1 fig. Theoretical mathematical discussion, with numerical examples illustrating use of formulae in case of supports differing in elevation.

CADMIUM PLATING

IMMERSION. The Deposition of Cadmium on Small Iron and Steel Parts by Immersion, C. H. Proctor. Metal Cleaning and Finishing, vol. 2, no. 6, June 1930, pp. 491-493. General outline of procedure for applying cadmium coatings by immersion on small iron and steel parts, including such data as cleaning, acid dipping, cadmium immersion, and drying.

CARBON DIOXIDE

REFRIGERANT. Carbon Dioxide—By-product or Waste Materials, C. L. Jones. Chem. and Met. Eng., vol. 37, no. 7, July 1930, pp. 416-417. Factors affecting by-product carbon-dioxide recovery may be conveniently grouped as technological and economic factors; sound development of solid carbon-dioxide industry will depend to large extent on thoughtful and conservative handling of those supplies of by-product carbon dioxide that can be exploited on firm economic basis, and no others.

CARS, STREET RAILROAD

BERLIN. New Trailers of Berlin Street Railroad (Neue Beiwagen der Berliner Strassenbahn), E. Kindler. Verkehrs Technik (Berlin), no. 20, May 16, 1930, pp. 244-247, 12 figs. Description of new trailers with two and four axles, centre entrance and level floor; sketches show floor plans and constructional details, brake and suspension arrangement.

CAST IRON

ALLOY. High-Quality Cast Iron in Modern Engineering Practice, A. B. Everest. Engineering (Lond.), vol. 130, no. 3365, July 11, 1930, pp. 56-58, 6 figs. Brief survey of use of alloy additions in cast iron, it is seen that wherever high strength and good wearing qualities, together with improved machinability are desired, there are strong grounds for increased application of alloy iron, and use of special elements enables foundryman to give engineer more uniform and more reliable product with improved life and service. Paper read before Rugby Eng. Soc., Jan. 15, 1930.

CELLULOSE SWELLING

PHENOMENA. Swelling Phenomena with Cellulose Esters (Quellungsvorgaenge bei Celluloseestern), A. Eichengruen. Zeit. fuer Angewandte Chemie (Berlin), vol. 43, no. II, Mar. I5, 1930, pp. 236-237; see also brief translated abstract in Textile Inst.—Jl., vol. 21, no. 6, June 1930, p. 325A. Compact forms may be prepared from cellulose derivatives by placing finely powdered material mixed with filling material in hot moulds at 150-180 deg. and subjecting to strong pressure; similar results may be obtained if cellulose derivative is heated under pressure and sprayed in molten state into moulds; swollen cellulose ester may be moulded without softening and filling materials.

CHROMIUM PLATING

CURRENT DENSITY. Effect of Current Density Upon the Hardness of Electro-deposited Chromium, R. J. Piersol. Am. Electrochem. Soc.—Trans., vol. 56, 1929, pp. 371-376 and (discussion), 376-377. Article indexed in Engineering Index, 1929, p. 400, from Am. Electrochem. Soc.—Advance Paper no. 26 for mtg. Sept. 19-21, 1929; also Metal Cleaning and Finishing, Oct. 1929, and Metallurgist, Oct. 25, 1929.

CITY PLANNING

ITALY. Planning of the City of Aquila, Italy, after the Earthquake of 1915 (Le plan d'aménagement de la Ville D'Aquila, Italie après le tremblement de terre de I915), G. Tian. Génie Civil (Paris), vol. 97, no. 1, July 5, 1930, pp. 16-18, 1 fig. Features of changes made in plan and building ordinances of town of 25,000 inhabitants, located 215 km. south of Rome, in Abruzzi mountains.

COAL CARBONIZATION, LOW TEMPERATURE

GREAT BRITAIN. The Economics and Commercial Development of Low-Temperature Carbonization—Progress in Great Britain, C. H. Lander. Iron and Coal Trades Rev. (Lond.), vol. 121, no. 3256, July 25, 1930, pp. 115-117. Abstract of paper read before World Power Conference, Berlin, previously indexed from Colliery Guardian, June 27, 1930.

COAL INDUSTRY

SOUTH AFRICA. The Coal Industry of South Africa, T. Coulter. Chem., Met. and Min. Soc. of S. Africa—Jl. (Johannesburg), vol. 30, no. 9, Mar. 1930, pp. 261-281 and (discussion) 281. Historical data; geology; description of coal fields; quality of coals; coking coal; mining methods; by-products; grading regulations; marketing and distributing; freight rates and prices; production statistics; available reserves; future of coal industry.

D

DIE CASTING

PROBLEMS OF. Die Casting (Spritzguss), A. Lion. Giesserei-Zeitung (Berlin), vo. 27, no. 13, July 1, 1930, pp. 353-362, 26 figs. Die casting vs. chill casting; problem of deaeration; moulding materials; die-casting machines; compressed-air casting machines; die-casting alloys. (To be continued.)

DIESEL-ELECTRIC LOCOMOTIVES

INDIA. Diesel-Electric Locomotive Design. Gas and Oil Power (Lond.), vol. 25, no. 297, June 5, 1930, pp. 163-165, 4 figs. Description of two units for service in India; mechanical construction; engine speed control; cooling systems; starting arrangements; electric equipment.

DIESEL-ELECTRIC POWER PLANTS

ARGENTINA. New Type of Diesel Engine (Un Nuevo Tipe de motor Diesel), J. Kremzar. Revista Electrotechnica (Buenos Aires), vol. I6, no. I, Jan. 1930, pp. 13-18, 5 figs. Notes on installation of two 4-cycle tandem 2-cylinder double-acting compressorless horizontal engines at Puente Chico electric power station of Argentina sanitary works; cylinders 850 mm., stroke 1,250 mm., speed 125 r.p.m.; generators are also described; data on official tests to comply with contract guarantees.

GERMANY. Large Compressorless M.A.N. Diesel Engines of the Hennigsdorf Peak-Load Plant, Berlin (Die kompressorlosen MAN-Grossdiesel-motoren des Umspannwerks Hennigsdorf), W. Laudahn. Breenstoff und Waermewirtschaft (Halle), vol. 12, no. 11/12, June 1/2, 1920, pp. 135-140, 7 figs. Brief description of power plant with details of 9-cylinder, 11,700-s.h.p. engines and results of tests; mechanical efficiency at full load is 92 per cent that of steam reciprocating machine; speed 215 r.p.m.; weight 292 tons.

Diesel Plant Hennigsdorf of Maerkisches Elektricitaets Works (Dieselwerk Henningsdorf der Maerkisches Elektricitaetswerk Aktiengesellschaft), G. Warrekmann. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 509, June, I930, pp. 258-262, 5 figs. Discussion of peak-load problem; actual impediments which until now have been in way of economical use of Diesel as peak-load engines; difficulties overcome by design of high-speed large Diesel plant in Hennigsdorf and experiences in construction and operation.

SURVEY OF. Present Status and Probable Progress of Diesel Engines (Stato attuale e progressi probabili del motore Diesel), M. Mainardis. Energia Elettrica (Milan), vol. 7, no. 5, May 1930, pp. 405-410, 3 figs. General survey of present day Diesel engineering, with special reference to increase in efficiency and economy; economic study of Diesel-electric versus steam-electric power generation; economy of Diesel-electric stations at present rates for electric power; typical cost data per kilowatt hour for several types of Diesel-electric plants.

DIESEL ENGINES

AIR COMPRESSORS. The Diesel Engine Air Compressor, R. J. Walter. Power Engr., vol. 25, no. 291, June 1930, pp. 222-223, 1 fig. Practical discussion concerning common defects in connection with blast compressors of Diesel engines.

CRANKSHAFTS. Turning and Grinding Large Diesel Engine Crankshafts. West. Machy. World, vol. 21, no. 6, June 1930, pp. 225-227, 5 figs. Methods and equipment used by Atlas Imperial Diesel Engine Co., Oakland, Calif., manufacturers of crankshafts for 3-, 4- and 6-cylinder engines.

DISCUSSION. Diesel Engine Operation, Maintenance and Repair, C. H. Bushnell. N.Y., John Wiley & Sons, 1930; 285 pp., illus., diagrs., tables, cloth; $3.50. Clearly written, concise discussion from point of view of operating engineer; fundamental principles are emphasized and much practical information and advice given. Eng. Soc. Lib., N.Y.

DOUBLE-ACTING. High Powered Oil Engines for Land Purposes, W. S. Burn. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 9, Mar. 1930, pp. 575-576 and 578, I fig. Extracts of paper previously indexed from Diesel Engine Users' Assn.—Report, Jan. 31, 1930.

FUEL INJECTION. Oil Spray Research Suggests Basic Factors for Designing Diesel Engine Nozzle, E. B. Neil. Automotive Industries, vol. 63, no. 2, July 12, 1930, pp. 56-61, 9 figs. Graphs show fuel aspects in oil-engine developments from papers of A.S.M.E.; relation between drop size and injection pressure; Riehm's curves for relation between dynamic pressure and penetration; N.A.C.A. curves for relation between injection pressure and penetration; relation of spray momentum to penetration; distribution of spray injected into compressed air at 200 lbs. per sq. in.

Fuel Spray Penetration Decreases Under Heat, A. G. Gelalles. Automotive Industries, vol. 63, no. 5, Aug. 2, 1930, p. 165. Article previously indexed from Nat. Advisory Committee for Aeronautics—Tech., May 1930.

FULLAGAR. 2,500 H.P. Fullagar-Diesel Stationary Engine. Engineering (Lond.), vol. 130, no. 3364, July 4, 1930, pp. 7-10, 19 figs. Manufacture of Fullagar engine for land use was taken up by English Electric Co. at their Rugby Works; engine illustrated has cylinder bore of 19 in. and piston stroke of 22 in.; rated power is developed at 200 r.p.m.; it is of enclosed type, in common with those of smaller range; crankcase is in five main sections.

HIGH SPEED. Performance of a High-Speed Compression-Ignition Engine Using Multiple Orifice Fuel Injection Nozzles, J. A. Spanogle and H. H. Foster. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 344, June 1930, 18 pp., 26 figs. on supp. plates. Investigation to determine relative performance of single-cylinder, high-speed, compression-ignition engine when using fuel-injection valve nozzles with different numbers, sizes, and directions of round orifices; test results are presented in form of curves and chart which lists nozzles and gives dimensions of orifices and performance obtained.

M.A.N. Double-Acting M.A.N. Two-Stroke Diesel Engine in Hennigsdorf Peak-Load Power Plant Near Berlin (Die doppeltwirkenden MAN-Zweitakt Dieselmotoren im Umspannwerk Henningsdorf bei Berlin), W. Laudahn. Werft-Reederei-Hafen (Berlin), vol. 1I, no. 9, May 7, 1930, pp. 177-182, 11 figs. Particulars of 10-cylinder compressorless engines of 11,700 s.hp.; piston stroke, 900 mm.; speed, 215 r.p.m.; weight, 292 tons; results of tests.

MAINTENANCE AND REPAIR. Diesel Engine Upkeep. Power Plant Eng., vol. 34, no. 14, July 15, 1930, pp. 807-809, 6 figs. Piston rings in Diesel engines require extra car because of high temperature and pressure; detection and overcoming leaky rings and faulty action; fitting rings; checking operation and wear; overcoming gas leakage. (Continuation of serial.)

MARINE. The Heavy Oil Engine For Yachts and Small Craft, J. Calderwood. Junior Instn. of Engrs.—Jl. and Rec. of Trans., (Lond.), vol. 39, 1928-29, pp. 396-413, 11 figs. Article indexed in Engineering Index, 1929, p. 571, from Inst. Marine Engrs.—Trans., Feb. 1929.

MARINE, DOUBLE-ACTING. Double-Acting Two-Cycle Diesel Engine for Ship Propulsion (El motor Diesel de dos tiempos y doble efecto para la propulsión de buques), E. Becker. Ingenieria y Construcción (Madrid), vol. 8, no. 87, Mar. 1930 pp. 120-126, 12 figs. Torque diagram; torsional vibration; balancing; bending vibration; constructional details. (Concluded.) Indexed in Engineering Index 1929, p. 573, from Engineer, June 28, 1929.

RATING STANDARDIZATION. Can We Standardize Diesel Ratings? H. E. Brelsford. Log, vol. I5, no. 4, July 1930, pp. 7-8 and 34. Abstract of paper presented before Am. Soc. Mech. Engrs., previously indexed from Oil and Gas Power (A.S.M.E. Trans.), Sept.-Dec. I929.

SUPERCHARGING. Increasing the Power of Diesel Engines by Supercharging, M. Rotter. Power, vol. 72, no. 3, July 15, 1930, p. 111. Outline of several systems, pointing out advantages and deficiencies of each. Abstract of paper presented before Am. Soc. Mech. Engrs.

Compounding and Supercharging of Diesel Engines (La Question du Compoundage et de la Suralimentation du Moteur Diesel), M. Gautier. Association Technique Maritime et Aéronautique—Bul. (Paris), no. 33, 1929, pp. 471-497 and (discussion) 498-500, 19 figs. Paper indexed in Engineering Index 1929, p. 568, from Bul. Technique du Bureau Veritas, July and Aug. 1929.

UNITED STATES. Development of the Stationary Diesel in America, J. Kuttner. Gas and Oil Power (Lond.), vol. 25, no. 298, July 3, 1930, pp. 185-186. Effect of competition on progress; need for user education; costs capable of reduction; indefinite classification; private stations in majority; cost comparisons; artificial price maintenance. Abstract of paper presented before World Power Conference, Berlin.

DOCKS, FLOATING

LONDON. Tilbury Passenger Landing Stage. Engineer (Lond.), vol. 150, no. 3887, July 11, 1930, pp. 28-31, 8 figs. Stage which is carried on 63 pontoons has total length over end pontoons of 1,131 ft., and overall length, including fenders, of 1,142 ft. with width of 80 ft.; pontoons are built up of mild steel plates; I5 ft. wide and are arranged parallel with one another; communication between stage and shore is effected by means of five bridges.

DOORS

SPECIFICATIONS. The Specification of Stock Doors, W. E. Griffee. Contract Rec. and Eng. Rev. (Toronto), vol. 44, no. 29, July 16, 1930, p. 863. Instructions on selection and ordering of stock doors.

E

ECONOMIZERS

EXHAUST-GAS UTILIZATION. Feedwater and Air Preheating by Exhaust Gases (Speisewasser und Luftvorwaermung durch Abgase), Harraeus. Feuerungstechnik (Leipzig), vol. 18, no. 9/10, May 15, I930, pp. 84-97, 3 figs. Influence of preheating on boiler plants; exhaust-gas utilization for feedwater and air preheating; different arrangements of economizer and air preheater.

ELECTRIC ARCS

EXTINCTION IN LIQUIDS. Extinction of Electric Arc in Liquids (Die Loeschung eines elektrischen Lichtbogens in Fluessigkeiten), F. Kesselring. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 9, Mar. 22, 1930, pp. 200-208, 4 figs. It is shown that for extinction of arcs in liquids variations of temperature of vapour atmosphere and Wilson effect going with it, are responsible.

OIL. Electric and Gas-Analytic Investigations of Arcs in Oil (Elektrische und gasanalytische Untersuchungen von Lichtbogen in Oel), A. V. Engel. Wissenschaftliche Veroefftenlichungen aus dem Siemens-Konzern (Berlin), vol. 9, Mar. 22, 1930, pp. 7-41, 26 figs. Previous investigations; electric properties at arc discharges in oil; gas quantity of stationary and interrupted arcs; composition of gas; measurements on oil calorimeter; oil vapour contents of gas bubbles; spectroscopic analysis; energy balance and gas temperature.

ELECTRIC CABLES

HIGH TENSION, DESIGN. High-Voltage Cables (Ueber Hochspannungskabel), F. Schrottle. Siemens Zeit. (Berlin), vol. 10, no. 6, June 1930, pp. 337-342, 7 figs. Design of compound and oil cables; with voltages from 30 to 100 kv., it is shown why manufacture of 100-kv. compound cable could not have been carried out successfully; curves showing relation between insulation thickness and voltage; electric safety factor; disruptive strength depending on duration of closing of circuit, dielectric losses of 100-kv. cable.

TELEPHONE. Aerial Communication Cable for Power Plants (Fernmelde Luftkabel fuer Kraftwerke), C. Straubel and G. Werner. Siemens Zeit. (Berlin), vol. I0, no. 6, June 1930, pp. 342-347, 17 figs. Self-supporting aerial telephone cable for installation along transmission lines and its equipment; development in Siemens plant has extended over 20 years and experience in practical application is given.

ELECTRIC DRIVE

DEVELOPMENT OF. Lines of Development of Economical Electric Drive in Industry (Entwicklungslinien des wirtschaftlichen elektromortoischen Antriebes in der Industrie), R. Bingel. V.D.I. Zeit. (Berlin), vol. 74, no. 24, June 14, 1930, pp. 848-864, 43 figs. Historical review; general lines of development is traced by examples of one-phase and multi-phase drives in various manufacturing industries; importance of co-ordination between industries and manufacturers for further development of drives of machine tools.

ELECTRIC EQUIPMENT

FAULT LOCATION. Testing for Trouble and Locating Faults in Electrical Equipment, M. Phillips. Power Plant Eng., vol. 35, no. 15, Aug. 1, 1930, pp. 867-869, 4 figs. Testing insulation resistance by means of Megger Periodic inspection to anticipate grounds, shorts and opens, important part of plant routine; description of two main types of tests; details of testing; troubles in control equipment.

HIGH TENSION. Transformers, Switchgear and Metering Transformers (Transformatoren, Schaltgeraete und Messwandler fuer 220,000 V), F. Titze. Siemens Zeit. (Berlin), vol. 10, no. 6, June 1930, pp. 356-364, 12 figs. Equipment used in 220-kv. transmission from Rheinland to Vorarlberg, of Rheinisch Westphalische Elektrizitaetswerke, is illustrated and described.

ELECTRIC FURNACES

FOUNDRY. Automatic Regulation of Electric Furnaces in the Foundry (La régulation automatique des fours électriques de fonderie), A. Levasseur. Revue Générale de l'Electricité (Paris), vol. 27, no. 17, Apr. 26, 1930, pp. 665-670, 7 figs. Advantages of automatic regulation; variation of input power in relation to resistance; pyrometric regulation; automatic regulation of electrode furnaces.

HEAT TREATING. Electric Salt or Lead-Bath Furnaces (Elektrisch Salzoder Bleibns doefen), H. Illies. Feuerungstechnik (Leipzig), vol. 18, no. 9/10, May 15, 1930, pp. 81-82, 3 figs. Advantages and possibilities of steel hardening in salt and lead baths; Russ electric crucible furnace; lead-bath furnace of Hoskins Electric Furnaces Co.; electric pot furnace of American Electric Furnace Co.

Heat-Treating Furnaces Distributed in Line of Machine Shop Production, H. E. Scarborough. Iron Age, vol. 126, no. 6, Aug. 7, 1930, pp. 357-359, 2 figs. Description of operation and layout of heat treating facilities at plant of Caterpillar Tractor Co., at Peoria, Ill.; 24 General Electric furnaces with total connected load of 2,745 kw. are used; plant will average between 8 and 10 lbs. of heat-treated parts per kilowatt hour.

ELECTRIC GENERATORS

VOLTAGE CONTROL. Requirements of 20 Processes That Generator-Voltage Control Meets, S. Martin, Jr. Elec. World, vol. 96, nos. 4 and 6, July 26, 1930, pp. 172-176 and Aug. 9, 1930, pp. 266-269, 9 figs. Advantages of generator voltage control of motors from 3 to 7,000 hp., i.e., on mule haul and car dumper, stokers, cable stranding machines, power shovels and draglines, mine hoists, blast furnace skip hoists, dredges, printing machinery, vertical lift bridges, high-speed elevators, freight elevators, paper machines, pulp grinders, rewinders and other specialties.

ELECTRIC INSULATORS

RESEARCH LABORATORIES. The Research Laboratories of Steatite and Porcelain Products, Ltd. World Power (Lond.), vol. 14, no. 79, July 1930, pp. 47-50 and 53, 8 figs. General description of laboratories and equipment for manufacture and testing of electrical insulators.

ELECTRIC LINES, HIGH TENSION

PROTECTION. Theory and Application of Relay Systems, I. T. Monseth and P. H. Robinson. Elec. Jl., vol. 27, no. 7, July 1930, pp. 411-415, 9 figs. Notes on application of fundamental short-circuit calculations; three-phase short-circuit calculations; machine reactances; zero-sequence network; two-winding transformers. (To be continued.)

ELECTRIC LOCOMOTIVES

ITALY. Direct Current Locomotives of 3,000 Volt, Series E 625 and E 626 (I locomotori a corrente continue a 3,000 volt gruppi E 625 ed E 626), G. Bianchi and S. Elena. Rivista Tecnica delle Ferrovie Italiane (Rome), vol. 37, no. 5, May 15, 1930, pp. 189-250, 52 figs. and numerous figs. on 5 supp. plates. Detailed description of mechanical and electrical equipment of electric locomotives used on Foggie-Benevento line; also results of tests and operating experience; discussion of deficiencies detected and suggestions for improvements.

ELECTRIC MACHINERY

ALTERNATING CURRENT. Behaviour of Asynchronous and Synchronous Machinery in Case of Asymmetrical Voltage (Verhalten der Asynchron und der Synchronmaschine bei unsymmetrischer Spannung), M. Liwschitz. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 9, Mar. 22, 1930, pp. 167-178, 12 figs. Equation for apparent resistance of system of opposite rotary motion of asynchronous machine fed at both ends is developed; it is shown how asymmetrical excitation of asynchronous machines can be considered; experiments of 10,000-kv. reactive generator and comparison of results with calculations.

ELECTRIC NETWORKS

INTERCONNECTED. Recent Problems of Electric Power Supply on Large Scale (Neuzeitliche Aufgaben der elektrischen Grossversorgung), A. Menge. V.D.I. Zeit. (Berlin), vol. 74, no. 24, June 14, 1930, pp. 837-847, 16 figs. Birds-eye view of present status and problems; advantages of closed operation for safety and economy; equipment of network for safe and quick elimination of trouble; measures for load distribution; voltage control; interconnection of large network systems and technical means in coupling of systems of different frequency. Paper read before World Power Conference, Berlin.

ELECTRIC POWER SUPPLY

EUROPE. Europe's Superpower Lines (Europas Grosskraftlinien), O. Oliven. V.D.I. Zeit. (Berlin), vol. 74, no. 25, June 21, 1930, pp. 875-879, 1 fig. Author proposes 400-kv. power line system embracing all countries of continental Europe and extending from Lisbon in Portugal to Rowtov in Ukrainia, and from Oslo in Norway to El Bassan in Albania; discussion of advantages of such system, geographical, climatic, and astronomical factors. Paper read at Second World Power Conference.

UNITED STATES. Recent Studies in Generation and Distribution of Power, F. C. Hanker. Inst. Elec. Engrs. of Japan—Jl. (Tokyo), no. 502, May 1930, pp. 437-444. Developments of generation and transmission of electric power in United States; improvements in design of generating apparatus, factors, affecting stability problem and methods for considering them in calculations. (In English.)

ELECTRIC RESEARCH LABORATORIES

HEINRICH HERTZ. Heinrich Hertz Institute for Oscillation Research (Das Heinrich-Hertz-Institut fuer Schwingungsforschung), K. W. Wagner. Elektrische Nachrichten-Technik (Berlin), vol. 7, no. 5, May 1930, pp. 174-191, 23 figs. Viewpoints which have led to erection; field of activities pertains to general electrical engineering, telephony, telegraphy, radio, high frequency and acoustics; detailed description of building, mechanical, and electrical equipment.

ELECTRIC RECTIFIERS, MERCURY-ARC

BACK FIRING. Origin and Combating of Back Firing in Large Rectifiers (Die Entstehung und Bekaempfung der Rueckzuendungen in Grossgleichrichtern), J. von Issendorff, M. Schenkel and R. Seeliger. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Kozern (Berlin), vol. 9, Mar. 22, 1930, pp. 73-114, 28 figs. Characteristics of back fire; general theory of arc discharge; development of arc discharge at d.c. voltage loading of discharge spacing; glow discharge is fore-runner of arc discharge, stimulating arc formation, residue charges, and back current; relation between back-fire and residue charges; removal of residue charges.

ELECTRIC TRANSFORMERS, CURRENT

CONNECTION. Only Two Current Transformers Needed with Open-Delta Regulators, E. R. Wolfert. Elec. Jl., vol. 27, no. 7, July 1930, p. 387, 1 fig. Comparison of old and new methods of connecting current transformers to any open-delta regulator system; method of bringing currents into proper phase relationship is graphically illustrated.

ELECTRIC WELDING

ARC. Graphical Analysis of Metal Transfer Processes in the Electric Arc (Ueber die graphische Zerlegung der Metalltransporvorgaenge im elektrischen Lichtbogen), P. Flamm. Elektroschweissung (Braunschweig), no. 2, Feb. 1930, pp. 27-30, 2 figs. Arc welding in time process; origin of drops is determined by experiment; of metal electrodes and their fundamentals in conditional diagram; valuation of metal electrodes.

Development in Arc Welding Methods. Can. Engr. (Lond.), vol. 59, no. 4, July 22, 1930, pp. 169-170. General discussion of latest developments in equipment and methods; arc welding in construction of buildings, bridges and machinery; large buildings erected by welding process; summary of advantages for building and machinery construction.

Principles of Steel Mill Practice Applied to Welding, J. B. Austin. Rolling Mill Jl., vol. 4, no. 6, June 1930, pp. 319-322. Abstract of paper read before Assn. of Iron and Steel Elec. Engrs. previously indexed from Iron and Steel Engr., June 1930.

Present Status of Work Testing in Arc Welding Practice (Der heutige Stand der Arbeitspruefung beim Lichtbogenschweissen), W. Fink. Elektroschweissung (Braunschweig), no. 3, Mar. 1930, pp. 45-50, 5 figs. It is claimed that only organized research in way of metallurgical strength testing and design and operation of welding machine can lead to progress in art.

ELECTRODE. Electrode Research, M. Haramiishi. Welding Jl. (Lond.), vol. 27, no. 321, June 1930, pp. 174-177, 17 figs. Abstract of results of investigations of flux-coated and covered electrodes for metallic arc welding.

ELECTRIC WELDING MACHINES

GERMANY. Welding Equipment in Steel Construction (Geraete fuer das Schweissen im Stahlbau), W. Vaas. Elektroschweissung (Braunschweig), no. 2, Feb. 1930, pp. 31-33, 4 figs. Various types of German-made portable and stationary equipment are illustrated and described.

POWER FACTOR. Improvement of Power Factor for Welding Machines (Ueber die Verbesserung des Leistungsfaktors von Schweissmaschinen), J. C. Fritz. Elektroschweissung (Braunschweig), no. 2, Feb. 1930, pp. 34-36, 4 figs. It is shown that improvement can be obtained by parallel connection of condensers; advantages obtained are discussed.

SELECTION. Viewpoints for the Selection of Arc Welding Machines (Gesichtspunkte fuer die Wahl von Lichtbogenschweissmaschinen), G. Falck. Elektroschweissung (Braunsehweig), no. 5, Mar. 1930, pp. 51-55, 10 figs. Fundamental principles in solution; capacity, no-load consumption; efficiency; statical and dynamic characteristics are explained with examples; valuation of arc welding machines is founded on knowledge of these factors.

TESTING. Explanation of Rules for the Valuation and Testing of D.C. Arc Welding Machines (Erlaeuterungen zu den Regeln fuer die Bewertung und Pruefung von Gleichstrom Lichtbogenschweissmaschinen), A. Danz. Elektroschweissung (Braunschweig), no. 5, May 1930, pp. 85-86. Rules developed by professional committee for welding practice of Verband Deutscher Elektrotechnischer are explained.

Rules for Evaluation and Testing of D.C. Arc Welding Machines R.E.S.M./1931 (Regeln fuer die Bewertung und Pruefung von Gleichstrom-Lichtbogenschweissmaschinen R.E.S.M./1931). Elektroschweissung (Braunschweig), no. 5, May 1930, pp. 87-88 Rules developed by professional committee for welding practice of Verband Deutscher Elektrotechnischer are given.

ENGINERING EDUCATION

COMMERCIAL SIDE. The Training of an Engineer, F. W. Burstall. Engineer (Lond.), vol. 149, no. 3884, June 20, 1930, pp. 678-679; see also editorial comment, pp. 689-690. Author claims that commercial side, and more especially aspects of production are hardly touched upon in modern university course; this appears to be side of engineering teaching in Universities which requires to be developed without in any way impairing value of knowledge which is entirely derived from facts of nature; at present only method by which University student can obtain practical knowledge is very limited opportunity offered to him in vacations and perhaps on short period of shop training.

RUSSIA. Technical Training in Russia, J. G. Growther. Elec. Rev. (Lond.), vol. 106, no. 2741, June 6, 1930, pp. 1049-1050. Brief account of training methods and research activities of Electrotechnical Institute, Physico-Technical Institute, and Polytechnic Institute in Leningrad and relationships with industry and State.

ENGINEERING RESEARCH

ENGINEERING RESEARCH. Forschung und Technik; Im Auftrage der Allgemeinen Elektrizitaets-Gesellschaft, W. Petersen. Berlin, Julius Springer, 1930, 576 pp., illus. 40-r.m. Book gives insight into scientific research being carried on in research institutes and by large industrial organizations; specifically, it contains 40 papers upon present problems in various branches of physics, electrical engineering, machine design and transportation, based on recent work of Allgemeine Elektrizitaets Gesellschaft, Berlin, and written by members of its research staff; contents cover wide range and illustrate clearly advantages to industry of systematic scientific research. Eng. Soc. Lib., N.Y.

ENGINEERS

PROFESSIONAL STATUS. The Engineer's Professional Status, W. E. Wickenden. Eng. News-Rec., vol. 105, no. 4, July 24, 1930, pp. 144-145. Profession has no very distinct status, is becoming more undefined as its activities broaden, and licensing has been of little service; suggests society certification of engineers. Abstract of address before Am. Soc. of Civil Engrs.

F

FEEDWATER

ANALYSIS. Oxygen Analysis in the Boiler Room, M. E. Fitze. Power, vol. 72, no. 4, July 22, 1930, pp. 136-139, 3 figs. Description of routine followed at Lakeside Station, where analyses are made hourly of feed-water supply to each boiler.

REGULATION. Automatic Boiler Feedwater Control (Ueber selbsttaetige Kesselspeisewasser regler), H. Luithlen. Sparwirtschaft (Vienna), vol. 8, no. 4, Apr. 1930, pp. 169-174, 5 figs. Float control with mechanical transmission type "Direkt" of Hanneman, Berlin; float control with electric transmission of type "Reubold" of Hanomag; equipment with hydraulic or pneumatic transmission type "Sieger" of Hans Reiser and Co., Cologne, are described.

TREATMENT. The Treatment of Boiler Feedwater, E. P. Fager. Power Age, vol. 7, no. 7, July 1930, pp. 41-42 and 46. General discussion of proper steps to be taken in selection and treatment of feedwater.

High Pressure Feed Systems, D. G. McNair. Elec. Times (Lond.), vol. 77, no. 2017, June 19, 1930, pp. 1235-1237, 2 figs. Methods of maintaining pure, non-corrosive feed supply to high-pressure boilers.

Using Chemicals for Clarifying and Recovering Engine Condensate, A. W. Talbot and E. W. Pace. Power Plant Eng., vol. 34, no. 13, July 1, 1930, p. 746. Oil can be removed from engine condensate by means of chemical reactions which form gelatinous precipitate; only chemical reactions involved are dealt with.

Hot Lime Soda Phosphate of Feed Water for High Pressure Boilers, C. E. Joos. Combustion, vol. 2, no. 1, July 1930, pp. 19-23 and 50, 5 figs. Reasons for care in feedwater treatment; reasons for using more expensive phosphate treatment; how hot lime and soda methods meet requirements.

FLIGHT

See Gliding.

FLOW OF FLUIDS

HYDRAULIC PARADOX. An Hydraulic Paradox. Engineering (Lond.), vol. 129, no. 3362, June 20, 1930, p. 803. It is shown to be possible by perfectly sound and legitimate mathematical analysis to arrive at extraordinary, but impossible, conclusion that mean speed of jet of fluid may be decidedly greater than mean speed of its constituent particles; anomaly arises from faet that there are two perfectly rational, but not necessarily consistent, methods of defining velocities of flow; there is not necessarily any simple relationship between coefficients of discharge and velocities measured in nozzle tester.

STUDY. Application of Hydrodynamic Problem of Fluvial Hydraulics (Application de l'Hydrodynamique à l'étude d'un problème d'Hydraulique Fluviale), E. Doucet. Vie Technique et Industrielle (Paris), vol. 12, no. 129, June 1930, pp. 1367-1373, 8 figs. Theoretical study of distribution of flow velocity in rivers and sewers by means of hydrodynamic equations for viscose fluids; experiments show that theoretically derived formula is correct within 8 per cent.

FLOW OF WATER

EMBANKMENTS. Flow Over Embankments During Floods, D. L. Yarnell and F. A. Nagler. Roads and Streets, vol. 70, no. 7, July 1930, pp. 247-249, 8 figs. Abstract of paper previously indexed from Pub. Roads, Apr. 1930.

Pipes. Loss of Head in Pipes witb Continually Changing Cross-Section (Trykkboidetap i ledninger med kontinuerlig foranderlif tverrsnitt), N. Baashuus Jessen. Teknisk Ukeblad (Oslo), vol. 77, nos. 23 and 24, June 5, 1930, pp. 265-268 and June 12, 1930, pp. 274-276, 6 figs. June 5: Derivation of formulae for determining loss of head. June 12: Use of formulae in practical cases; tabulation of some constants and exponents; three examples are given.

FOUNDRIES

Electric Furnaces. Electric Gray Iron Entirely From Scrap, N. L. Turner. Elec. World, vol. 96, no. 2, July 12, 1930, pp. 68-69. In plant of Beach Foundry, Ltd. of Ottawa, Canada, producing stove parts, point was reached where, witb cupola melting, it was necessary to extend floor space to take care of production; by installing electric furnace for melting, continuous flow of iron was obtained and need of extra floor space for day's run of moulds was overcome; by use of all scrap metal, cost of iron at spout has been reduced, production increased 25 to 30 per cent, and flexibility of method has been proven.

FRAMED STRUCTURES

Earthquake Effect. Tests on Concrete Frames Simulate Effects of Earthquake Action on Buildings. Eng. News-Rec., vol. 105, no. 2, July 10, 1930, p. 55, 1 fig. Report on tests made at University of Illinois to determine action of several details of construction under repeated horizontal loads. Paper read before Int. Eng. Congress at Tokyo.

FUELS

Engineering. Fuel Problems Discussed at Chemical Society Meeting. Fuels and Furnaces, vol. 8, no. 5, May 1930, pp. 643-645. Abstract of papers presented before American Chemical Society; discussion of nature of carbonization and oxidation of carbonized products; mechanism of combustion of pulverized particles; cracking process; formation of hydrocarbons from water gas; gas, coke, and by-product making properties of coal; ash-fusion-point determinations; investigation of peat humus; apparatus for analysis of carbon dioxide and oxygen.

FURNACES

Enameling. Development in Enamel Smelting Furnace Construction, R. D. Cook. Fuels and Furnaces, vol. 8, no. 5, May 1930, pp. 715-716, 3 figs. Operation of furnace, in construction of which, outside of walls and hearth were left exposed to air. Abstract of paper presented before Am. Ceramic Soc.

FURNITURE MANUFACTURE

Metal. Metal Furniture Output Expanding to Meet Wider Popular Appeal, L. Bonney. Iron Age, vol. 126, no. 2, July 10, 1930, pp. 75-77, 4 figs. Brief review of recent developments in design and construction of metal furniture.

Stainless Steel Furniture. Times Trade and Eng. Supp. (Lond.), vol. 26, no. 624, June 21, 1930, p. 354. One of directions in which newer industries have made great progress is production of stainless steel for furniture; some of uses to which it is being put at present time are: all metal furniture, more particularly for office and school use such as desks and chairs, table legs and pedestals, piano fittings, cabinet fittings, etc.

G

GALVANIZING

Continuous. Galvanizing Shops (Galvanische Werkstatt), E. Werner. Werkstattstechnik (Berlin), vol. 24, no. 11, June 1930, pp. 297-303, 3 figs. Outline of principles of construction and operation of electric galvanizing plant for mass production; data on combustion and conductivity of electrolyte sketches show washing equipment.

Prevents Decomposition. Galvanizing Prevents Metallic Decomposition, W. H. Spowers, Jr. Wire, vol. 5, no. 7, July 1930, pp. 268-269 and 289-290. Closer relation between life and rust; pure metal does not oxidize easily; zinc corroded, saves iron; zinc absorbed into metal pores; combined picking and fluxing; how zinc chloride is used.

GAS INDUSTRY

Rationalization. The Rationalization of the Gas Industry, G. Evetts. Gas Jl. (Lond.), vol. 191, no. 3502, July 2, 1930, pp. 31-32. Overcoming obstacles in way of rationalization; legislature difficulties affecting rationalization; tariff problems. (Concluded.)

GASOLINE TANKS

Gasoline Tanks. Oil-Fuel Storage (Aus der Praxis der Betriebsstofflagerung). Petroleum (Berlin), vol. 26, June 25, 1930, (supp.) pp. 1-12. Notes on protection of tanks against gasification; Bowser Xacto Sentry filling stations; measuring apparatus for gasoline filling stations; modern high-duty filling stations; modern gasoline and benzol separator; seamless DWM-Tombak hose in petroleum industry; aluminum coating and foil as protection for tanks in petroleum industry; etc.

GASOLINE TESTING

Significance of. Significance of Tests for Motor Fuels, R. E. Wilson. Soc. Automotive Engrs.—Jl., vol. 27, no. 1, July 1930, pp. 33-41, and (discussion), 42-44, 1 fig. Discussion of various tests in light of extension research work in past few years by various industrial laboratories and U.S. Bureau of Standards; volatility; easy of starting; vapour lock; anti-knock value; gum formation test; corrosion; doctor test; sulphur content; colour stability. Bibliograpby.

GEARS AND GEARING

Efficiency. Can a Machine Reverse if its Efficiency be Less than 50 Per Cent? A. W. Knight. Machy. (Lond.), vol. 36, no. 927, July 17, 1930, pp. 497-499, 5 figs. Discussion of friction effects in spur and worm gears; diagram illustrating how reversal may take place wben efficiency is less than 50 per cent; diagram for determining efficiency of worm gear is given.

Manufacture. Cutting Costs of Production Cleaning, T. L. Wheeler, Jr. West. Machy. World, vol. 21, no. 6, June 1930, pp. 231-235, 7 figs. Cleaning methods used by Warner Gear Co., Muncie, Ind.

Planetary. Planetary Gear Trains with Idler Train Arm, W. Ricbards. Machy. (Lond.), vol. 36, no. 926 and 929, July 10, 1930, pp. 465-469 and July 31, pp. 566-568, 9 figs. Design and calculation of planetary reduction gear; sketches illustrate gear arrangements in whicb driver and driven turn in opposite and in same direction witb fixed and driven internal gears.

Tooth Measurement. Constant Cbord Gauging. Am. Macb., vol. 73, no. 6, Aug. 7, 1930, pp. 250-252, 4 figs. Summary of comments received on W. A. J. Chapman's article published in American Machinist, vol. 72, p. 753; V-jawed caliper can be used with existing gear tables; gear-tooth vernier is proposed to use constant cbord principle without special computations.

GEOLOGY

Australia. The Metamorphic Rocks of North-East Victoria, C. M. Tattam. Geol. Survey of Victoria—Bul. (Melbourne), no. 52, 1929, 61 pp., 18 figs. and 1 map on supp. plate. Report on study of rocks extending soutb southeast about 100 mi. from Murray river in belt about 30 mi. wide.

GEOPHYSICAL EXPLORATION

Electric. The Earth-Resistivity Method of Electrical Prospecting, E. Lancaster-Jones. Min. Mag. (Lond.), vol. 42, no. 6, June 1930, pp. 353-355, 2 figs. Discussion of Gish and Rooney method; field procedure; description of apparatus; consideration of results; application to prospecting for ore. (To be continued.)

GLIDERS

Manufacture. Production of Air Gliders, J. C. Coyle. Indus. Woodworking, vol. 30, no. 11, Aug. 1930, pp. 16, 19 and 22, 6 figs. Woodworking operations included in machining, bending and fabricating of parts used in manufacture of latest type air gliders produced in Alexander Aircraft Co.'s plant.

GLIDING

Hearing. Consideration on Motorless Flight (Considérations sur Le Vol sans Moteur), A. Lafay. Génie Civil (Paris), vol. 96, no. 25, June 21, 1930, pp. 606-607, 4 figs. Importance of sense of hearing for motorless flights is discussed; sketches show microphone arrangement in wings to make air currents audible; cbaracter of sound indicates angle of incidence.

GOLD MINING GEOLOGY

Ontario. Geology of the Fort Hope Gold Area, District of Kenora (Patricia Portion), E. M. Burwash. Ontario Dept. of Mines—Report (Toronto), vol. 38, part 2, 1929, pp. 1-48, 28 figs., maps in pocket. Area lies about 175 mi. due north of Nipigon, on Lake Superior; early explorations; geology along routes; general data and geology of area; economic interest of regions centres in gold deposits; notes on Fort Hope, Hargreaves, Irish-Wording and Northern Aerial Minerals Exploration Co. mining properties; iron formation of Miminiska Lake.

GRINDING

Refinements in. Refinements in Finishing Cylindrical Bores, J. W. Hindes and J. G. Young. Am. Soc. of Mech. Engrs.—Advance Paper, for mtg., June 9-12, 1930, 9 pp. Limitations of boring, reaming, burnishing, and broaching are reviewed; general outline of grinding practice; description of operation and advantages of hone; notes on coolant and abrasive.

H

HANGARS

Braunschweig. Airplane Hangars of the Braunschweig Airport (Flugzeighallen des Braunschweiger Flughafens), H. Maushake. Stahlbau (Berlin), vol. 3, no. 11, May 30, 1930, pp. 124-127, 6 figs. Design and construction of steel-frame structures 200 m. long, 30 m. wide, with head room of 6.6 and 9.6 m.; structural details of steelwork.

Construction. Hangar Construction Simplified. Flight (Lond.), vol. 22, no. 29, July 18, 1930, pp. 804-806, 11 figs. Form of construction of novel hangar is "segmental roof" but better described as "segmental lattice" construction; hangar is 150 ft. long by 80 ft. wide; door 62 ft. wide by 18 ft. high; advantages of this type given; may be set up temporarily or made permanent; details of framework, covering, and foundation.

Friederichshafen. New Airship Hangar at Friederichshafen (Die neue Luftschiffhalle in Friedrichshafen), C. Scharnow. Stahlbau (Berlin), vol. 3, no. 6, Mar. 21, 1930, pp. 61-68, 20 figs. Design and construction of steel-frame structure 248.5 m. long about 51 m. wide; framed three-hinge arcb-ribs, 46 m. high, are spaced 10 m. apart; main structural features of several other similar structures in Great Britain, India, and United States.

HARDNESS TESTING

Conversion Tables. New Conversion Tables Show Relations Among Hardness Tests, T. N. Holden, Jr. Iron Age, vol. 126, no. 2, July 10, 1930, pp. 80-81. Table compares hardness obtained with Rockwell using three loads, 150, 100, and 60 kg. with Brinell, diamond penetrator, and scleroscope results.

HEAT INSULATION

Heat Insulation. The Insulation of Heated and Cooled Surfaces, J. S. F. Gard and R. S. Robinson. Ice and Cold Storage (Lond.), vol. 33, no. 388, July 1930, pp. 170-177, 13 figs. Calculations with external surface conditions; relative efficiency; temperature drop in pipe lines; comparison between various grades; cost of application and saving effected; advantages other than heat saving; domestic applications. (Continuation of serial.)

HIGH BUILDINGS

Foundations. Foundation Construction for Giant Office Building. Contractors' and Engrs.' Monthly, vol. 20, no. 5, May 1930, pp. 72-76, 5 figs. Account of excavation and foundation construction of 85-storey Empire State Building on site of Waldorf Astoria Hotel, New York City.

Wind Bracing. High Wind Pressures on Tall Structures, A. M. Thomas. World Power (Lond.), vol. 14, no. 79, July 1930, pp. 23-32, 5 figs. Attempt is made to estimate by statistical methods probable frequency and magnitude of bigh wind pressures over British Isles; variation of wind velocity with height is considered and three equations expressing this variation are given; using one of tbem, probable frequencies of high wind pressures at various heights are calculated, and final results are embodied in series of curves.

HYDRAULIC MACHINERY

Specific Speed. Specific Speed and Other Characteristics of Hydraulic Turbines, Centrifugal Pumps, Windmills, and Propellers as Dimensionless Characteristics of Physics of Similitude (Die spezifischen Drehzahlen und die anderen Kenngroessen der Wasserturbinen, Kreiselpumpen, Windraeder und Propeller als dimensionsfreie Kenngroessen der Aehnlichkeitsphysik), M. Weber. Schiffbau (Berlin), vol. 31, no. 9, May 7, 1930, pp. 207-209. Characteristic values for bydraulic turbines; special cases are described. (Continuation of serial.)

HYDRAULIC TURBINES

Design. A Contribution to the Design of a Propeller Turbine of Axial Flow Type, K. Kanesige. Soc. of Mech. Engrs.—Jl. (Tokyo), vol. 32, no. 151, Nov. 1929, pp. 440-453, 8 figs. New method for determination of chief dimensions of axial flow water turbine of propeller type, except runner itself, which is to be designed under given condition; its characteristic features are: introduction of index number whicb represents characteristics of guide apparatus into ordinary design formulae, provision of diagrams which may enable turbine designers to select some numerical coefficients with special reference to cavitation phenomena and hydraulic efficiency of runner. (In Japanese.)

Efficiency. Modern Hydro-electric Power Plants (Det moderna Vattenkraftverket), H. O. Dahl. Teknisk Tidskrift (Stockholm), vol. 60, no. 24, June 14, 1930, pp. 369-371. Mechanical equipment is discussed; hydraulic turbines, their efficiency and development.

Low-Pressure. Gefallvermehrung bei Niederdruck-Wasserkraftanlagen, R. Gelbert. (Mitteilungen aus dem Gebiete des Wasserbaues und der Baugrundforschung, heft 2). Berlin, Wilhelm Ernst & Sohn, 1930; 22 pp., illus., diagrs., tables, 3.60 r.m. Book presents results of tests of methods of increasing head of low-pressure hydraulic turbines proposed by John R. Freeman; this method consists in introducing part of surplus water, escaping over dam, into draft tube of turbine, where it reduces discharge pressure and thus increases effective head. Eng. Soc. Lib., N.Y.

Propeller. On the Hydraulic Efficiency of Propeller Turbines and Propeller Pumps, F. Numachi. Tohoku Imperial Univ.—Tech. Reports (Sendai), vol. 9, no. 2, 1930, pp. 231-253, 20 figs. Theoretical study of variations of hydraulic efficiency of propeller turbine and of propeller pump with respect to coefficient of peripheral velocity of rotation, coefficient of axial velocity of flow and ratio of outer diameter to inner diameter of wheel. (In English.)

Regulation. Hydraulic Turbine Governors, F. Johnstone-Taylor. Water and Water Eng. (Lond.), vol. 32, no. 378, June 20, 1930, pp. 277 and 279-281, 2 figs. General principles of automatic operation; Escher Wyss system; Woodward system; synchronizing motor or speed matcher; motor-driven ball heads.

Testing. Low-Head Francis Turbines for Swedish Hydro Plant, G. Willock. Power, vol. 72, no. 6, Aug. 5, 1930, pp. 218-220, 4 figs. Description of two 15,600-hp. Francis turbines, set in reinforced concrete spiral casing of special design operate under head of 64.5 ft. which developed 93.2 per cent efficiency on test; water was measured by current meters. See also Engineering Index 1929, p. 953.

HYDRO-ELECTRIC POWER DEVELOPMENTS

Arizona. Salt River Project, Arizona, T. A. Hayden. West. Construction News, vol. 5, no. 12, June 25, 1930, pp. 294-302, 11 figs. Description of irrigation and hydro-electric development by Salt River Valley Water Users' Association including six large dams, Roosevelt Dam among them. (To be continued.)

Canada. Hydro-Electric Industry of Canada, G. G. Gale. Eng. Jl. (Montreal), vol. 13, no. 7, July 1930, pp. 445-452, 8 figs. History of early developments; improvement in transmission networks, interconnection of stations and systems;

examples of centralized control; consolidation of operation organizations; standardization of electric equipment. Paper presented before Second World Power Conference, Berlin.

Water Power Resources of Canada and Their Development, J. T. Johnston. Eng. Jl. (Montreal), vol. 13, no. 7, July 1930, pp. 407-424, 12 figs. and one supp. map. Available and developed water power in Canada; developments between 1924 and 1930; capital investment; coal equivalent of developed water power; distribution in various industries; review by Provinces. Paper presented before Second World Power Conference, Berlin.

HYDRO-ELECTRIC POWER PLANTS

AUTOMATIC. New Nova Scotia Plant Equipped with Automatic Turbines, K. E. Whitman. Elec. News (Toronto), vol. 39, no. 13, July 1, 1930, pp. 31-34, and 44, 5 figs. Detailed description of plant at Tusket Falls, Nova Scotia.

CANADA. Recent Trends in Water Power Development in Canada, T. H. Hogg. Eng. Jl. (Montreal), vol. 13, no. 7, July 1930, pp. 425-434, 15 figs. Important recent developments in methods of design and construction of hydro-electric power plants and their equipment discussed under intakes, dams, tunnels, draft tubes, waterwheels, governors, bearings, automatic plants, layout of electric equipment, generators, transformers, and storage. Paper presented before Second World Power Conference, Berlin.

GERMANY. The Schluchsee Hydro-Electric Plant (Das Schluchseewerk), A. Eisenlohr. Bautechnik (Berlin), vol. 8, no. 17, Apr. 18, 1930, pp. 259-263, 14 figs. Description of hydro-electric development in Schwarzwald region in Rhine River basin, utilizing storage in natural mountain lake by means of series of tunnels; total useful head of some 600 m. utilized in three stages, developing total of 500,000,000 kw. hrs. per annum; report on construction of tunnels, small dams, power houses, etc.

The Affoldern and Bringhausen Power Plants in the Edertal Dam District (Die Kraftwerkbauten Affoldern und Bringhausen im Gebiete der Edertalsperre), K. Volk. Siemens Zeit. (Berlin), vol. 10, no. 6, June 1930, pp. 404-414, 15 figs. Description of two correlated hydro-electric plants consisting of concrete weir about 10 m. high and earth embankment 3.7 km. long, these two forming reservoirs of 2,200,000 cu. m. capacity; Bringhausen plant is of pumped storage type, water being pumped from upper end of Affoldern reservoir to an artificial reservoir, located about 300 m. above tail-water, and having capacity of 760,000 cu. m.; construction methods, electrical equipment.

GREAT BRITAIN. Lead Mining under Helvellyn. Metropolitan Vicker Gaz. (Manchester), vol. 12, no. 207, June 1930, pp. 128-133, 9 figs. Object of power development has been to make most efficient use of water power available to provide for growing demand of mine for electric energy; pipe line, 21-in. bore and 1,530 ft. long, conducts water to power house, where it supplies two Turgo impulse wheels, direct connected to alternators of 110 kw. and 250 kw. capacity, respectively.

MEXICO. An Automatic Hydro-Electric Power Station in Mexico. Metropolitan Vickers Gaz. (Manchester), vol. 12, no. 207, June 1930, pp. 135-137, 5 figs. Function of station is to utilize available evergy from variable water supply to generate electricity for supply to Necaxa, Noncolco line; two generating sets are installed, one of 3,800-kw. and other of 1,570-kw. capacity together with automatic control gear by means of which all operations otherwise requiring skilled attention are carried out; station requires attendance only of simplest nature.

REMOTE CONTROL. Remote Control at Muskoka Hydro Plant. Can. Engr. (Toronto), vol. 59, no. 1, July 1, 1930, pp. 111-112, 3 figs. Operation features of control of Trethewey Falls Station of Ontario Hydro-Electric Power Commission which is centralized with Hanna chute and South Falls on one station.

I

INDUSTRIAL HEATING

GAS VS. ELECTRIC. Relative Places of Gas and Electricity in Industrial Heating, R. A. Hadfield and R. J. Sarjant. World Power (Lond.), vol. 14, no. 79, July 1930, pp. 19-20. Authors analyze different advantages of electric and gas-fired furnaces in iron and steel industry; each form of energy has its merits, and individual needs can alone decide which should best be employed. Abstract of paper read before World Power Conference, Berlin.

INDUSTRIAL PLANTS

MATERIALS HANDLING. Mass Production Conveyed, J. E. McBride. Black and White, vol. 2, no. 6, Aug. 1930, pp. 17, 19-22, 2 figs. Discussion of mass production in automobile industry; brief description of materials handling methods employed.

POWER COSTS. Power Costs in Industrial Plants and Their Calculation (Energiekosten in Betriebswirtschaft und Abrechnung), F. Landsberg. Waerme (Berlin), vol. 53, no. 25, June 21, 1930, pp. 489-492, 2 figs. Method of cost accounting to determine economy of power generation and financial aspects of power economics for enterprise as a whole.

INTERNAL COMBUSTION ENGINES

DESIGN. Two-Stroke Engines, Some Experiments on a New Type, J. W. Robertson. Automobile Engr. (Lond.), vol. 20, no. 269, July 1930, pp. 267-272, 18 figs. Discussion of two-stroke development and characteristics; detailed description of design and performance of experimental sleeve unit; lower part of sleeve forms charging piston; 28 b.hp. per litre at 2,800 r.p.m.; good idling at 500 r.p.m.

VIBRATIONS. Calculations of Forced Torsional Vibrations of Multiple Mass System With Particular Regard to Internal Combustion Engines (Die Berechnung erzwungener Drehschwingungen von Mehrmassensystem en, mit besonderer Beruecksichtigung der Verhaeltnisse bei Motorenanlagen), H. Behrens. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 21, no. 12, June 28, 1930, pp. 297-304, 27 figs. Formulae for reducing system with arbitrary number of masses and exciting moments to one equivalent mass and one equivalent moment; simplified solution for multi-mass system which consists of masses of same size; examples and graphs illustrate procedure.

IRON DEPOSITS

ONTARIO. Beardmore-Nezah Gold Area, Ontario, G. B. Langford. Economic Geology, vol. 25, no. 3, May 1930, pp. 251-269, 8 figs. Area lies 45 mi. north of Lake Superior; topography; general geology; structure; Timiskaming iron formations; no commercial ore bodies developed; gold in fissure veins; fault fractures formed following intrusion of Algoman porphyries; origin of veins; very little development has been done in this area, except by prospectors; two shafts have been sunk, and it is reported that vein has been followed to depth of 200 ft. with mineable grade and width. Bibliography.

IRON AND STEEL INDUSTRY

JAPAN. Japan's Steel Industry Has Become Our Best Scrap Customer Abroad, G. S. Herrick. Iron Age, vol. 126, no. 2, July 10, 1930, pp. 84-86 and 131, 5 figs. Statistical analysis of production imports and exports showing that in 1929, Japan imported 208,260 tons of steel scrap from United States alone and bought for importation only 79,875 tons of light gauge black sheets.

L

LIGNITE

DRYING. Operating Experiences in Drying Department of Briquet Factory and Recommendations for Control of Drying Process (Betriebserfahrungen im Trockendienst einer Brikettfabrik und Vorschlaege zur Ueberwachung des Trockenprozesses), M. Mayer and Mittelsteiner. Braunkohle (Halle), vol. 29, nos 27 and 28, July 5, 1930, pp. 577-580 and July 12, pp. 601-608, 6 figs. General aspects for applying drying process; drying in draft without sifting; partially fractionated drying with different sifting methods.

RESEARCH. Lignite Research and Pollen Analysis (Braunkohlenforschung und Pollenanalytik), F. Kirchheimer. Braunkohle (Halle), vol. 29, no. 21, May 24, 1930, pp. 448-463, 10 figs. Microfloral, especially pollen-analytical, method as aid in lignite research is discussed. Bibliography.

LIGNITE DEPOSITS

ONTARIO. The Lignite Deposit at Onakawana, Moose River Basin, Ontario, W. S. Dyer. Can. Min. and Met. Bul. (Montreal), no. 219, July 1930, pp. 884-906, 10 figs. partly on supp. plates. Full amplified text of paper previously indexed from abstract in Can. Min. Jl., Mar. 21, 1930.

LOCOMOTIVES

GERMANY. Theory of Steam Locomotive on Experimental Basis (Theorie der Dampflokomotive auf versuchsmaessiger Grundlage), H. Nordmann. Organ fuer die Fortschritte des Eisenbahnwesens (Berlin), vol. 85, no. 10, May 15, 1930, pp. 225-270, 79 figs. Detailed discussion of theoretical and practical basis of locomotive design; combustion problems and boiler efficiency; effect of steam pressure and degree of superheating; steam consumption and efficiency of engine; cylinder arrangement, compound arrangement, etc.; coal consumption, thermal efficiency and output characteristics of locomotive as unit.

Structural Design of State Railway Locomotives (Die konstruktive Durchbildung der Reichsbanlokomotiven), R. P. Wagner and F. Witte. Organ fuer die Fortschritte des Eisenbahnwesens (Berlin), vol. 85, no. 6-7, Mar. 20, 1930, pp. 94-109, 16 figs. Classification of types is given and principal details are discussed and illustrated by sketches.

HIGH PRESSURE. High-Pressure Locomotive. Times Trade and Eng. Supp. (Lond.), vol. 26, no. 627, July 12, 1930, p. 428. Constructed for German Railways Co. on Schwartzkopff-Loeffler system; compared with ordinary low-pressure super-heated locomotive, it is expected to show saving in coal and water of over 40 per cent; pressure in high-pressure circuit and at inlet to high-pressure cylinders is maintained at 1,420-1,700 lbs. per sq. in. gauge, after which steam leaves at pressure of 256 lbs. per sq. in. and passes through centrifugal oil separator to feedwater heater, and to chamber of heat exchanger.

UNITED STATES. On the Question of Locomotives of New Types; in Particular Turbine Locomotives and Internal Combustion Motor Locomotives (Subject V for Discussion at the Eleventh Session of the International Railway Congress Association), A. Lipetz. Int. Ry. Congress Assn.—Bul. (Lond.), vol. 12, no. 7, July 1930, pp. 1683-1700, 12 figs. Design characteristics, dimensions, and operating data of turbine and internal combustion motor locomotives; locomotives with watertube fire-boxes.

WEIGHT DISTRIBUTION. Weight Transfer Compensation for Locomotives, B. D. Wheeler. Elec. Jl., vol. 27, no. 7, July 1930, p. 394, 1 fig. To overcome difficulty, scheme of compensation has been developed by which two motors of truck are connected in series and leading motor operated on short field.

LUBRICANTS

CUTTING. Machinery's Data Sheets 181 and 182. Machy. (N.Y.), vol. 36, no. 11, July 1930, p. 888A. Practice in the use of cutting fluids; number of users for each class of fluid for operations on cast iron, brass, copper and aluminum.

LUMBER INDUSTRY

NEW ZEALAND. New Zealand Lumber Imports Increase in 1929, W. L. Lowrie. Commerce Reports, no. 28, July 14, 1930, pp. 100-102. Analysis of statistics showing that hardwood imports are slightly reduced; softwood imports increase; bulk of hardwood imports come from Australia; about 63 per cent of softwood imports come from United States.

M

MACHINE TOOL INDUSTRY

GERMANY. German Engineering Practice in the Light of the Leipzig Fair (Deutsche Technik 1930 im Spiegel der Leipziger Messe), H. Schelelmann. Giesserei-Zeitung (Berlin), vol. 27, no. 13, July 1, 1930, pp. 347-353, 10 figs. Review of developments in past decade with special regard to machine tools, woodworking machines, etc., outstanding examples of which are described; discussion of extent to which American fabrication methods can be applied in Germany; lessons to be learned by foundrymen.

MACHINE TOOLS

REDUCING COSTS. Machine Tools From the User's Point of View, H. C. Armitage. Machy. (Lond.), vol. 35, nos. 909-910, Mar. 14, 1930, pp. 782-785, Mar. 20, pp. 817-820, and Mar. 27, pp. 849-851, 14 figs. Mar. 14: Cost reduction by installation of new machine tools; manufacturing costs, feeds and speeds, waste handling time; capital recovery after machine purchase. Mar. 20: Bar automatics; centre lathes; drilling machines. Mar. 27: Gear-cutting machines; grinding machines; milling machines; chucking capstans and turret lathes; chucking automatics; electric welding machines. From paper read before Manchester Assn. of Engrs.

REVIEW. Shop Equipment Review. Am. Machinist, vol. 73, no. 3, July 17, 1930, pp. 73-147. Semi-annual résumé of machinery, tools, mechanisms, parts, and materials described in shop equipment news sections of American Machinist during six months of 1930, and also similar résumé of Engineering Workshop equipment sections of European edition for December, 1929, to May, 1930, inclusive.

SPECIFICATIONS. Manufacture of Machine Tools for Wood and Metal Working (Tie Uebereinstimmung in der Herstellung von Werkzeugmaschinen fuer Holz- und Metallbearbeitung), W. Iwascheff. Werkstattstechnik (Berlin), vol. 24, no. 8, Apr. 15, 1930, pp. 213-214. Discussion of suggestions for accuracy of woodworking machines; comparison with metal-working machine shows need for closer tolerances.

MATERIALS HANDLING

MATERIALS HANDLING. Bucket Elevators, Bucket Hoists and Belt Conveyors (Skopelevatorer, Skophissar Och Remtransportoerer), E. Dahlin. Teknisk Tidskrift (Stockholm), vol. 60, no. 25, June 21, 1930, pp. 76-81, 3 figs. Operating costs, wear, maintenance cost, life, safety of operation, and cost calculations. (Concluded.)

PNEUMATIC. Simplified Computations for Branching Ducts and Description of Simple Device for Determination of Proper Rising Speed of Various Conveyed Materials (Vereinfachte Berechnung verzweigter Rohleitungen, etc.), R. Karg. Gesundheits-Ingenieur (Munich), vol. 53, no. 20, May 17, 1930, pp. 305-308, 1 fig.

Velocity of Suspended Substances and Its Determination for Pneumatic Conveying of Material (Die Schwebegeschwindigkeit und deren zuverlaessige Ermittlung fuer pneumatische Materialtransporte), H. R. Karg. Foerdertechnik und Frachtverkehr (Wittenberg), vol. 23, no. 10, May 9, 1930, pp. 191-193, 2 figs. Method for finding correct velocity for pneumatically conveyed materials is described.

METALLURGY

METALLURGY. Some Factors of Solidification in Relation to Metallurgical and Geological Problems. Chem. Met. and Min. Soc. of S. Africa—Jl. (Johannesburg), vol. 30, no. 10, Apr. 1930, pp. 292-301 and (discussion), 301-303. Broad discussion of behaviour of metals in cooling and solidification; physical reactions in cupellation of bullion; solidification of ore metals and minerals from molten magma; segregation.

METALS

AGE HARDENING. Age-Hardening, M. L. V. Gayler. Metallurgist (Supp. to Engineer, Lond.), June 1930, pp. 91-93. Of theories put forward to explain age hardening, one which has gained most ground is precipitation theory which attributes age hardening to precipitation, in highly dispersed state, of particles from super-saturated solid solution; facts which have been established regarding changes which take place during age hardening are strong confirmation that hardening is due to precipitation of highly dispersed particles.

CORROSION TESTING. New Process for Simultaneous Corrosion Testing of Different Metals (Ein neues Verfahren zur gleichzeitigen Korrosionskurzpruefung verschiedener Metalle), G. Gollnow. Giesserei (Duesseldorf), vol. 17, no. 27, July 4, 1930, p. 665, 2 figs. Details of electric process and equipment for measurement of corrosion of metals in solutions, developed by Toedt.

FATIGUE. Fatigue Strength and Tensile and Rupture Strength, W. Kuntze. Metallurgist (Supp. to Engineer, Lond.), June 1930, pp. 94-95. According to author rupture strength plays important part in fatigue phenomena; this property is defined as tensile strength when all deformation is prevented; procedure is to measure breaking tensile stress of number of specimens having circular notches of different depths and to extrapolate curve of maximum stress against area at base of notch to zero area. Translated abstract previously indexed from V.D.I. Zeit., Feb. 22, 1930.

FLOW. Flow Pressure of Metals and Alloys at Various Temperatures, V. P. Shishokin. Tzvetniye Metalli (Moscow), no. 5, May 1930, pp. 662-671, 4 figs. Results of experimental study of flow pressure of metals having low melting point, including tin, lead, cadmium, bismuth, etc.; empirical law of variation of flow pressure with temperature is derived; temperature coefficient of flow pressure is numerically equal to temperature coefficient of Brinell hardness. (In Russian.)

MINING ENGINEERING EDUCATION

WASHINGTON. Washington College Offers Thorough Training, A. E. Drucker. Min. Jl., vol. 14, no. 1, May 30, 1930, pp. 7-8, 2 figs. Dean of School of Mines and Geology, at Pullman, Wash., gives outline description; instruction is given in all branches of mining, metallurgy and geology, with ample opportunity for selection of specialized field.

MINING GEOLOGY

ONTARIO. Geology of the Area between Favourable Lake and Sandy Lake, District of Kenora (Patricia Portion), M. E. Hurst. Ontario Dept. of Mines—Report (Toronto), vol. 38, part 2, 1929, pp. 49-84, 29 figs., map in pocket. Area 230 mi. north of Hudson or Sioux Lookout station; topography, climate, resources, etc.; general geology; mineralization is confined to beds of Keewatin-Timiskaming rocks, at or near contacts, in quartz veins in gabbro or greenstone, and along fractures in acidic volcanics; notes on properties with ores carying gold, silver, lead, zinc and copper.

MINES AND MINING

ACCIDENTS. Mining Accidents in 1928, T. F. Sutherland, G. E. Cole, D. G. Sinclair, J. G. McMillan and A. R. Webster. Ontario Dept. of Mines—Report (Toronto), vol. 38, part 1, 1929, pp. 184-187. Tabular statistics; notes on prosecutions for violation of Safety Regulations.

ONTARIO. Mines of Ontario in 1928, D. G. Sinclair, R. H. Cleland, E. C. Keeley, G. S. Jarrett and A. R. Webster. Ontario Dept. of Mines—Report (Toronto), vol. 38, part 1, 1929, pp. 69-183. Table contains names of all operating properties and works inspected in 1928; lists of principal stone quarries and clay pits are added; notes on activities of principal operators, including cost data and mill statistics in some cases.

Statistical Review of Ontario's Mineral Industry in 1928, W. R. Rogers and A. C. Young. Ontario Department of Mines—Report (Toronto), vol. 38, part 1, 1929, pp. 1-65. Tabular production statistics.

MINERS' PHTHISIS

SOUTH AFRICA. Miners' Phthisis on the Witwatersrand, L. G. Irvine and A. Mavrogordato. Empire Min. and Met. Congress (S. Africa),—Advance Paper for mtg. Apr. 1930, 15 pp. and tabular data on supp. plate; see also abstract in Iron and Coal Trades Rev. (Lond.), vol. 120, no. 3243, Apr. 25, 1930, p. 677. Miners' phthisis and silicosis are used as equivalent terms; important factors concerned are silica dust and tuberculous infection; discussion of what has been done in matter of detection and prevention, and of results accomplished; statistical data for South Africa.

MOTOR BUS DESIGN

TREND OF. The Trend of Motorcoach Design, F. R. Fageol. Soc. Automotive Engrs.—Jl., vol. 27, no. 1, July 1930, pp. 18-21, and (discussion) 21-23, 3 figs. Discussion of body types and sizes; notes on Diesel engine possibilities and speed and driver control devices.

MOTOR TRUCKS

FRANCE. Motor Trucks in France (Das Lastauto in Frankreich), K. Bilau. Automobil Rundschau (Berlin), vol. 32, no. 9, May 1, 1930, p. 182; see also brief translated abstract in Automotive Abstracts, vol. 8, no. 6, June 20, 1930, p. 113. Registration of 350,000 trucks last year shows that one-third of all vehicles belong in this class; 3-and 5-ton types lead field; War Department now concentrates on development of 13-ton type to be used in trans-Sahara transportation; another field of research involves use of inferior fuels.

MOTORSHIPS, DIESEL

"BRITANNIC." The Twin-Screw Passenger Line "Britannic". Shipbldr. (Newcastle-on-Tyne), vol. 37, no. 241, July 1930, pp. 590-614, 45 figs. Similar description previously indexed from various sources.

The Largest British Motorship. Shipbldg. and Shipg. Rec. (Lond.), vol. 35, no. 26, June 26, 1930, pp. 803-812, 9 figs. Similar description previously indexed from various sources.

MOULDING MACHINES

FOUNDRY. Methods of Moulding Castings for Stoves, Heating Apparatus, and Various Builders' Castings, H. Magdelenat. Foundry Trade Jl. (Lond.), vol. 43, no. 725, July 10, 1930, pp. 24-27, 10 figs. Description of methods of moulding pedestal stove, certain cooking range parts; skylight frame and sink; plan and elevation of Rosieres-Bachon continuous moulding machine lay-out; notes on sand preparation; labour; production and wages.

Rational Non-Ferrous Foundry Practice [Rationelle Metallgiesserei Praxis—Das kastenlose Formen (Amerikaguss)]. Zeit. fuer die Gesamte Giessereipraxis (Berlin), vol. 51, no. 26, June 29, 1930 (Metall.), pp. 105-107, 11 figs. Flaskless moulding practice is discussed.

MOVING PICTURES

SOUND. Sound Motion-Picture Photography, J. P. Livadary. Electronics, vol. 1, no. 5, Aug. 1930, pp. 240-242, 5 figs. Fundamental principles underlying sound motion-picture photography; variable density method of sound recording is considered and most definitions are derived from theoretical considerations rather than arbitrary assumptions.

The Sound-Picture Industry Abroad, F. S. Irby. Electronics, vol. 1, no. 4, July 1930, p. 193. Statistics data and table.

N

NATURAL GAS WELLS

PRESSURE REGULATION. Practical Pressure Regulation, T. H. Beals. Natural Gas, vol. 11, no. 6, June 1930, pp. 14-15 and 56. Importance of pressure control; types of well pressure-control devices; classification of regulation; difficulties encountered in effort to obtain proper regulation. Paper read before Southwestern Gas Measurement Short Course.

O

OIL ENGINES

OPERATION. A Low-Compression Heavy-Oil Engine. Motor Transport (Lond.), vol. 51, no. 1323, July 21, 1930, pp. 93-95, 2 figs. Hesselman power unit has electric ignition and special features to insure thorough mixing of fuel and air; fuel pumps and nozzles; special piston design.

OIL FIELDS

EQUIPMENT STANDARDIZATION. Reports of Meetings held by Committees on the Standardization of Oil Field Equipment. Am. Petroleum Inst.—Standardization Bul., no. 104, of mtg. Dec. 2-5, 1929, pp. 1-143, 91 figs. Reports of meetings held by various A.P.I. committees on standardization of oil field equipment during tenth annual meeting of Institute, Stevens Hotel, Chicago, Ill.

WASTE DISPOSAL. Long Beach Waste Handled By Unit Disposal System, B. Mills. Oil Weekly, vol. 58, no. 1, June 20, 1930, pp. 26-27, 3 figs. Method of disposal of 60,000,000 bbls. of rotary mud, tank bottoms, and general field waste in less than 3½ years at cost of less than one-half cent per barrel has been made in Long Beach field by Oil Operators, Incorporated.

OIL SHALES

ESTHONIA. Esthonian Shale as Source of Oil (Der estlaendische Brennschiefer als Oelquelle), H. Von Winkler. Petroleum (Berlin), vol. 26, no. 27, July 2, 1930, pp. 737-740. Shale of this district is known as "kuckersit"; although Esthonian shale is one of richest sources of gasoline in old and new world, it has disadvantage of large coke residues; account of methods which have been employed successfully and otherwise for recovery of oil from these shales; in succeeding article, pp. 740-745, review is given by C. Gaebert of work on Esthonian shale, published by F. Wassermann and edited by author of above article.

OIL WELL DRILLING

CORE. Orientation of Cores, G. A. Macready. Am. Assn. of Petroleum Geologists—Bul., vol. 14, no. 5, May 1930, pp. 559-578, 11 figs. Orientation of cores should be of great value in geological investigations of subsurface structures; historical development of orientation of cores since early German method of seventies is reviewed, recent California practice is touched on, and investigations by writer since 1918 are described. (Bibliography.)

CROOKED HOLES. Crooked-Hole Problems in the Gulf Coast District, P. C. Murphy and S. A. Judson. Am. Assn. of Petroleum Geologists—Bul., vol. 14, no. 5, May 1930, pp. 595-605, 3 figs. Abstract of article previously indexed from Oil and Gas Jl., Mar. 27, 1930.

DEEP. Review of Drilling Below 5,000 Feet in West Texas, R. A. Jones. Oil Weekly, vol. 57, no. 12, June 6, 1930, pp. 28-30, 110, 112, and 114, 1 fig. Important features of University 1-B completed at depth of 8,525 ft.; production of well; geology of section, tests below 5,000 ft.

DIESEL ENGINES. Diesel Engine Drills Deepest Cable Tool Well. Oil Field Eng., vol. 8, no. 1, July 1930, pp. 30-31, 3 figs. Using gas oil as fuel, consumption has been held below 42 gals. per day with one type of Diesel engine, while second varied from 30 to 50 gals. per day.

EQUIPMENT. Largest Electric Drilling Equipment in Oklahoma City Field, W. A. Sawdon. Oil Field Eng., vol. 8, no. 1, July 1930, pp. 18-19 and 39, 4 figs. Importance of calibrating ammeters; results of test made on electric power consumption and time taken in pulling out from depth of 3,160 ft. in Hall and Brisco well Lindsey No. 1.

FISHING. The Use of Acids in Fishing Jobs, S. Klinghoffer. Petroleum Times(Lond.), vol. 23, no. 598, June 28, 1930, p. 1136. In discussing reported advocacy in United States of use of acids for freeing boreholes of tightly-wedged pieces of iron, in cases where customary mechanical fishing practice has proved unavailing, author states that while he does not wish to discourage such important pioneer work, facts as stated in America do not tally with his own experience in laboratory and in practice. Abstract translated from Petroleum, date not specified.

GASOLINE ENGINES. Gasoline Unit Complete 7,818-Ft. Well. Oil Field Eng., vol. 8, no. 1, July 1930, pp. 37-39, 4 figs. Six-cylinder engine, transmission, clutches and brake mounted as unit drills deep cable tool well to pay sand.

WIRE ROPE. Wire Rope Service—How to Increase It, C. A. Perryman. Oil Field Eng., vol. 8, no. 1, July 1930, pp. 16-17. Proper diameter of line exceeding 45,000 ft. long is 1 in.; ways of prolonging life of cable; safe working load; special points to be guarded in drilling practice.

P

PAINT

TESTING. Practical Test for Determining the Hiding Power of Paints, H. A. Gardner, G. G. Sward and S. A. Levy. Metal Cleaning and Finishing, vol. 2, no. 6, June 1930, pp. 537-538. Outline of method of determining hiding power of paint by brushing out paint upon surface of checkerboard linoleum made up of black and white blocks. Abstract of paper presented before Am. Soc. Testing Matls., previously indexed from advance paper.

PATENT LAW

UNITED STATES. Extent of Permissible Monopoly in Patents, L. T. Parker. Power Plant Eng., vol. 34, no. 10, May 15, 1930, pp. 573-574. Review of present laws and high court decisions involving rights of patentees.

PAVEMENTS

ASPHALT. Six Varieties of Cold Laid Asphalt Pavements, A. W. Dow. Contract Rec. and Eng. Rev. (Toronto), vol. 44, no. 30, July 23, 1930, pp. 896-898. Details of types of road surfacing that have become popular and are increasing in use; asphalt amiesite type, cut back asphalt binders, emulsified asphalt binders, colprovia type, macasphalt type.

PETROLEUM ANALYSIS

STANDARDIZATION. Report of the Special A.P.I. Committee on Standard Procedure for Measuring, Sampling, and Testing of Crude Oil, Held at Stevens Hotel, Chicago, Ill., Dec. 4, 1929. Am. Petroleum Inst.—Standardization Bul., no. 104, of mtg. Dec. 2-5, 1929, pp. 144-150. Report as indicated; report of sub-committee on "uniform tank measurements and gauge tables" (group 1.)

PETROLEUM ENGINEERING

EDUCATION. Educating Engineers for the Petroleum Industry, J. F. Dodge. Oil Field Eng., vol. 8, no. 1, July 1930, pp. 43-44. Author believes that recent division of petroleum engineering field into development and production engineering is ill-advised and premature.

PETROLEUM INDUSTRY

RUSSIA. Five-Year Plan for the Development of the Petroleum Industry of U.S.S.R. Gorniy Journal (Moscow), vol. 105, no. 10, Nov. 1929, pp. 1671-1702. General review of present status of petroleum industry in Russia with special reference to available resources, exploration, and new drilling, production of petroleum and natural gas; petroleum refining; financial problems, scientific management of petroleum industry; cost data. (In Russian.)

PETROLEUM PIPE LINES

RUSSIA. Selection of Alignment for the Emba Petroleum Pipe Lines, A. Bondaryevsky. Azerbayjanskoye Nephtyanoye Khozyaistvo (Baku), no. 5, May 1930, pp. 21-30, 1 fig. Comparative discussion of following routes: Dossor-Stalingrad, on Volga, 640 km., Dossor-Saratov, on Volga, 667 km., Dossor-Samara, on Volga, 670 km., and Dossor-Aktyubinsk on Orenburg-Tashkent railroad, 442 km.; author favours last mentioned route for main pipe line with capacity of 2½ million tons per annum, in contrast with Russian government plan for 2 million ton pipe lines to Volga and half million ton line to Aktyubinsk. (In Russian.)

PETROLEUM REFINING

BY-PRODUCTS. Petroleum Residuals and By-Products, A. E. Dunstan. Petroleum Times (Lond.), vol. 23, no. 598, June 28, 1930, pp. 1123-1126. Discussion of utilization of acid sludge, petroleum coke, asphalt residues, and waste gases for power purposes. Abstract of paper read before Second World Power Conference, at Berlin.

Edeleanu Process. Anti-Knock Motor Fuel, L. Edeleanuand W. Grote. Petroleum Times (Lond.), vol. 23, no. 568, June 28, 1930, p. 1148. Advantages of use of liquid sulphur dioxide in refining are stressed; summary of results of experiments with motor fuels of different origins; authors point out that character of cracked gasoline and properties of crude oil from which it originates are important in determining quality of products prepared by their method; where high-boiling fraction over 175 deg. cent. is high in aromatics, anti-knock value of resulting motor fuel will be higher. Abstract translated from Brennstoffchemie, June 1, 1930.

PHOTO-ELECTRIC CELLS

Applications. Automatic Control With Photo-Electric Cells, E. H. Vedder. Elec. Jl., vol. 27, no. 7, July 1930, pp. 407-410, 12 figs. Application of light relay other than automatic control in industry is outlined; examples of controlling light in factory; photo-cell indications of breakage in paper manufacture, flashover protection of electric generators, automatic counting etc. are given.

Electric Oscillations in Photo-electric Cells and Their Application in Reading Machines for the Blind (Bemerkungen ueber die elektrischen Schwingungen in den Photozellen und ihre Anwendung bei den Lesemaschinen fuer Blinde), B. L. Rosing. Zeit. fuer Technische Physik (Leipzig), vol. 11, no. 6, 1930, pp. 178-182, 10 figs. Mechanism of photo cell discharges and action of resistance, capacity and self-induction coefficients on same; oscillations and experimental tests; action of exposure, complete characteristics of photo cells of Elster, Geitel and Karolus.

No Rain Checks Needed for this Ceremony, F. H. Gulliksen. Elec. Jl., vol. 27, no. 7, July 1930, pp. 398-399, 3 figs. Application of photocells of control of crane in lifting of corner stone of new Westinghouse Engineering Laboratory; speaker's table was located indoors several hundred feet away.

Photo-Electric Cell and Its Applications (La cellule photoélectrique et ses applications), L. Dunoyer. Technique Moderne (Paris), vol. 22, nos. 4, 5 and 6, Feb. 15, 1930, pp. 137-144, Mar. 1, pp. 179-182 and Mar. 15, pp. 212-219, 37 figs. Manufacture and properties of photo-electric cells; measurement of photo-electric currents; application of photo-electric cells in telephotography, television, sound, and talking picture practice.

PIG IRON

Hematite. Change in Properties of Hematite Pig Iron Cast in First Charge (Aenderung der Eigenschaften des in erster Schmelzungvergossenen Haematiroheisens), E. Piwowarsky. Stahl und Eisen (Duesseldorf), vol. 50, no. 27, July 3, 1930, pp. 966-968. Temperature losses during transport of ladle from blast furnace to mixer; changes in chemical composition and strength are traced up to finished product; difference in behaviour of specimens cast in chill and in sand.

PIPE

Centrifugal Casting. Chemical Composition and Mechanical Properties of Centrifugal Castings, J. E. Hurst. Metallurgia (Lond.), vol. 2, nos. 7 and 8, Mar. 1930, pp. 13-16 and June, pp. 54-56 and 53, 11 figs. May: Applications of centrifugal casting, to pipe and to drums and cylinders for piston rings, cylinder liners, etc.; British Eng. Standards Assn. Specification as to chemical composition; distribution of constituents; tendency to segregations; microstructure; mechanical properties; data on bursting, collapsing, bending, tensile, and transverse tests. June: Impact tests; Brinell hardness; sand-spun pipe; piston ring and cylinder testing.

PIPE LINES

Wood Stave. Specifications of Construction of Wood Stave Pipe Line (Technische Vorschriften fuer Herstellung einer Holzrohrleitung aus Dauben und Spannringen), Schubert. Gas und Wasserfach (Munich), vol. 73, no. 21, May 24, 1930, pp. 489-499, 8 figs. Text of privately proposed standard specifications, principally for underground pipe lines.

PLATINUM ORE TREATMENT

Transvaal. The Production of Platinum Concentrates from Transvaal Ores, T. K. Prentice. Chem., Met. and Min. Soc. of S. Africa—Jl. (Johannesburg), vol. 30, no. 8, Feb. 1930, pp. 244-245. Author's reply to discussion of paper indexed in Engineering Index 1929, p. 1427, from various sources.

POWER PLANTS

Design. Kraftwerks-Bauten. Berlin, Siemens-Schuckert, 1929; 137 pp., plates. Price not indicated. Portfolio of photographs and plans of number of electric power plants recently built by Siemens-Schuckert works; layout and construction of buildings is considered, not equipment; brief data about capacity and equipment are given, with references to more comprehensive published description. Eng. Soc. Lib., N.Y.

Diesel-Electric. Influence of Peak-Load Plants on Economy of Large Power Plants (Einfluss Spitzenkraftwerken auf die Wirtschaftlichkeit von Grosskraftwerken), M. Gercke. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 482-485, 1 fig. Economy in use of peak-load Diesel engines is illustrated by results obtained in number of German plants; influence of separation of basic and peak load and economic effect of absorption of peak load with special regard to use of Diesel engines are discussed based on American and German studies.

Diesel Power Replaces Steam at Public Utility Plant. Power Plant Eng., vol. 34, no. 15, Aug. 1, 1930, pp. 865-866, 3 figs. Low repair cost characterized operation of Consolidated Public Utility Co.'s plant; installation uses pressure lubrication; low repair record.

Steam vs. Hydro-electric. Hydro Yields to Steam on Economic Grounds, F. B. Lewis. Elec. World, vol. 95, no. 25, June 21, 1930, pp. 1298-1299, 1 fig. At zero load factor annual cost of steam power is less than that of water power; under steam-plant efficiencies and fuel costs obtainable some years ago, additional output expense of steam production, with increased load factor, caused total steam costs to exceed water-power costs, except at relatively small load factors.

Cheap Steam Power Checks Hydro-Expansion, A. H. Markwart. Elec. World, vol. 95, no. 25, June 21, 1930, pp. 1271-1273, 2 figs. Present trend of water-power development costs is upward, because as general thing remaining sites cost more to develop and are less accessible than those sites which have already been developed; influence of price of oil; natural gas going to waste; whole economic trend is toward 100 per cent steam for new installations, unless some very favourable hydro presents itself.

POWER RESOURCES

Canada. Energy Resources of Canada, B. F. Haanel. Can. Chem. and Met., vol. 14, no. 7, July 1930, pp. 203-207. Factors controlling the development and utilization of water-power, raw coal, gas and oil.

POWER TRANSMISSION

Short Centre Drive. Power Transmission With Centre Drives, R. Salmonsen. Power Plant Eng., vol. 34, no. 41, July 15, 1930, pp. 817-820, 5 figs. Details, speeds, and efficiencies of silent chain, V-belt, and flat belt.

PULVERIZED LIGNITE

Italy. Utilization of Pulverized Lignite, etc. (Utilizzazione del polverino di lignite con la combustione a polvere), U. Legnaioli. Elettrotecnica (Milan), vol. 17, no. 14, May 15, 1930, pp. 326-333, 18 figs. Practice of steam-electric plants of Castelnuovo dei Sabbioni (Arezzo) in firing with Valdarno pulverized lignite, originally containing 50 per cent moisture and 17 per cent ashes; B.W. boilers of plant generate steam at 13 atmospheres pressure; 4.3 kg. of fuel produced 1 kw. hr. of electric power.

PUMPS

Water Hammer. Overpressure in Delivery Main (Surpression Provoquée par l'arrêt d'un groupe moto-pompe dans la conduite de refoulement), L. Escande. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 14, Apr. 7, 1930, pp. 855-857; see also brief translated abstract in Water and Water Eng. (Lond.), vol. 32, no. 378, June 20, 1930, p. 297. Calculations to determine overpressure in forced main caused by stoppage of motor-pump unit in case of abrupt throwing out of gear; from characteristics of pump, author plots curves; from which he deduces law of variation of pump delivery.

PUMPS, CENTRIFUGAL

Corrosion. Corrosion in Centrifugal Pumps, C. H. S. Tupholme. Power Plant Eng., vol. 34, no. 10, May 15, 1930, pp. 571-572. Discussion of chemical, mechanical and electrolytic changes which cause trouble.

Pumps, Centrifugal. From Centrifugal to Axial Flow Pumps, I. Hatakeyama. Soc. of Mech. Engrs.—Jl. (Tokyo), vol. 32, no. 151, Nov. 1929, pp. 434-439, 10 figs. Development of Inokuty's centrifugal pump is described statistically, and then, brief explanation is given about different kinds of pumps, from centrifugal to axial flow according to their specific speed together with some results of experiments, such as determination of best form of cross section of spiral casings, influence of mechanical losses upon small pumps, and flow of water in delivery pipe of axial flow pump. (In Japanese.)

PUMPS, FEEDWATER

Centrifugal. Centrifugal Feed Pumps for High-Pressure Boilers (Kreiselpumpen zum Speisen von Hochdruckkesseln), G. Weyland. V.D.I. Zeit. (Berlin), vol. 74, no. 15, Apr. 12, 1930, pp. 467-471, 14 figs.; see also brief translated abstract Power Engr. (Lond.), vol. 25, no. 292, July 1930, pp. 287-288. Stress is laid on importance of reliability in feed pumps for extra-high-pressure boilers; circulating pump, used in Mannheim plant to circulate water through superheater during starting period until steam is available from boiler, can be subjected to pressures up to 100 atmos. and temperatures to 310 cent.; it runs at 1,450 r.p.m. and delivers 40 tons per hr.

Centrifugal Pumps (Kreiselpumpen), G. Weyland. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 473-481, 29 figs. Their application to feed of superpressure boilers is discussed; economic advantages of high feedwater preheating; proper design of hot-water pumps; necessity of reliable feedwater pumps for superpressure boilers, and experiences with such pumps; heating of feed water by flow through pump; condensate return to boiler without any special pump.

Turbine. Centrifugal Feed Pumps for High-Pressure Boilers, G. Weyland. Engineer (Lond.), vol. 149, no. 3883, June 13, 1930, pp. 666-667, 10 figs. Details of turbine-driven pump which automatically comes into operation when electrically driven pump working in conjunction with it is stopped; characteristics of 10-stage Klein Schanzlin and Becker pump with different blades, both designed for same maximum output at highest pressure; turbine-driven feed pump for hot water with output of 180 to 240 metric tons per hr. from Mannheim power station, and turbine, and motor-driven pump built for Benson boiler installation at Berlin Gartenfeld works of Siemens-Schuckert Co.

PULVERIZED COAL

Combustion. Pulverized-Fuel Problems, L. K. Ramzin. Iron and Coal Trades Rev. (Lond.), vol. 121, no. 3256, July 25, 1930, p. 127. Pulverized combustion affords greatest economy of fuel; non-caking fuels with high content of voltaile matter would be burnt to most advantage in pulverized form; profitability of powdered fuel furnace tends to increase smaller content of volatile matter in fuel; relative merits of centralized and unit systems of pulverized-fuel firing.

Dust Problem. Coal-Dust Problem (Betraege zur Kohlenstaubfrage), F. Prockat. Glasers Annalen (Berlin), vol. 106, nos. 8 and 12, Apr. 15, 1930, pp. 93-97 and June 15, pp. 151-154, 14 figs. Mathematical analysis; blow tests with coal dust; precipitation of dust, analysis of grain size, surface formation of coal, and absolute determination of surface; blow tests with slate, coal, and mixtures of both. (To be continued.)

PULVERIZED COKE

Properties. Pulverizing Properties of Coke in Relation to Its Tar Content (Die Mahlbarkeit des Schwelkokses in Abhaengigkeit von seinem Teergehalt), Rosenthal. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 5, May 1930, pp. 169-172, 9 figs. Influence which govern pulverization are discussed, including influence of grain size, water content, and hardness; laboratory tests show that friability of coke depends upon tar residue content.

PULVERIZED LIGNITE

Drying. Preparation of Pulverized Lignite with Pneumatic Circulation Drying (Herstellung von Braunkohlenstaub mit der pneumatischen Umlauftrocknung), P. Rosin and E. Rammler. Braunkohle (Halle), vol. 29, no. 26, June 28, 1930, pp. 557-563, 11 figs. Circulation drying is pneumatic process according to which transport and drying of wet products in suspension are affected by hot gases which circulate at high speed through pipe system; details of circulating drier.

PRESSURE VESSELS

Welding. *See Welding.*

R

RADIO BEACONS

France. Radio Beacons of Bobigny for Aerial Navigation (Le radiophare de Bobigny pour la navigation aérienne), M. Clériot. Aéronautique (Paris), no. 133, June 1930, pp. 221-226, 12 figs. Radio beacons for aviation are new in France; article, after outlining general principles, characteristics, intensity of reception, sensitivity, and stability, etc., gives detailed description of 1-kw. beacon in Bobigny 5 km. from Bourget, employing 7 amp. in antenna.

RADIO EXHIBITION

Atlantic City. Engineering Trends in Receiving Sets at Atlantic City, K. Henney. Electronics, vol. 1, no. 4, July 1930, pp. 176-177, 3 figs. Short note on exhibit at Radio Manufacturers Association trade show at Atlantic City, public-address systems; tone control; new tubes.

RADIO SIGNALS AND SIGNALING

Trans-Oceanic. Vacuum-Tube Applications and Relay Circuits in Trans-Oceanic Photo-Radio, R. H. Ranger. Electronics, vol. 1, no. 5, Aug. 1930, pp. 224-226, 4 figs. Use of tone over circuits as means of indicating on and off conditions and use of vacuum-tube apparatus to put this tone on line and to take tone off and make it perform necessary on and off functions at receiving point; steps taken in complete photo-radio set-up, and adaptation of some principles to other fields.

RADIO TELEPHONE

Ship to Shore. Radio Telephone Service to Ships at Sea, W. Wilson and L. Espenschied. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 7, July 1930, pp. 542-546, 6 figs. Paper previously indexed from Advance Paper for mtg. May 7 to 10, 1930.

RADIO WAVES

Short. Very Short Radio Waves, A. B. Page. Electronics, vol. 1, no. 4, July 1930, pp. 173-175, 4 figs. Some possibilities of four-element tubes for other than radio or medical purposes; biological experiments.

RAILROAD TERMINALS, FREIGHT

Hamilton, Ont. New Freight Terminal at Hamilton Opened by Canada Steamship Lines, Ltd. Can. Ry. and Mar. World (Toronto), no. 389, July 1930, pp. 477-479, 4 figs. Design and features of freight terminal on bay front are discussed; general layout plans are illustrated.

RAYON MANUFACTURE

Review of. The Hollow Rayons and Synthetic Yarns, C. E. Mullin and F. H. Cadwell. Textile Colorists, vol. 52, no. 617, May 1930, pp. 317-319. Review of recent research covering manufacture of hollow fibres and apparatus. Bibliography.

Manufacture of Acetate Silk According to Wet Spinning Process (Ueber die Herstellung von Azetatseide nach dem Nasspinnverfahren), F. Ohl. Kunststoffe (Munich), vol. 20, no. 6, June 1930, pp. 122-125, 3 figs. Review of experimental research and patents covering wet process of acetate-silk manufacture; advantages and difficulties are set forth, and recommendations made for proper application of process.

RAYON SIZING

MIXTURES. Sizing Rayon and Rayon Mixtures, R. W. Pinault. Black and White, vol. 2, no. 6, Aug. 1930, pp. 26-29. Sizing rayon has much in common with cotton sizing, but has also resulted in many improvements in old-time sizing methods; soluble starches; use of finishing compounds; finishing cotton-rayon mixtures.

REFRACTORY MATERIALS

ABRASION TESTING. A Progress Report on the Development of an Abrasion Test for Refractories at High Temperatures, J. B. Shaw, G. J. Blair, and M. C. Shaw. Am. Ceramic Soc.—Jl., vol. 13, no. 7, July 1930, pp. 427-436, 8 figs. Method developed consists of steel chisel point moving back and forth over faces of brick clamped together; eleven bricks are tested at one time; chisel is actuated by means of jack hammer and is water-cooled; data show that principle is correct and capable of differentiating between brick of varying resistances to abrasion at temperatures as high as 1,350 deg. cent.

REFRIGERATION

DESIGN. Some Considerations in the Design of Modern Refrigerating Plant, B. C. Oldham. Brit. Assn. of Refrig.—Proc. (Lond.), vol. 26, no. 2, 1929-30, pp. 5-34 and (discussion) 35-61. Article previously indexed from Ice and Cold Storage, Feb. 1930.

REFRIGERATING PLANTS

TEMPERATURE REGULATION. Temperature Conditions in Automatic Refrigerating Plants (Temperaturverlauf in automatisch gesteuerten Kuehlanlagen), S. Jung. Zeit. fuer die gesamte Kaelte-Industrie (Berlin), vol. 37, no. 6, June 1930, pp. 101-110, 11 figs. Report of investigation undertaken to determine sensitivity and efficiency of temperature-regulating instruments for refrigerating plants; numerous existing plants were investigated and results are discussed.

REFUSE INCINERATORS

BIARRITZ. Incineration of Garbage (l'incinération des ordures ménagères), E. Marcotte. Revue Industrielle (Paris), vol. 60, no. 225, June 1930, pp. 358-369, 22 figs. Description of plant at Biarritz; agricultural and industrial utilization; utilization of refuse from Paris district; types of incinerators, with special reference to Bréchot incinerator and results of tests.

RESERVOIRS, STORAGE

CANADA. How the Cabonga Storage Reservoir Was Constructed, W. B. Hutcheson. Contract Rec. and Eng. Rev. (Toronto), vol. 44, no. 29, July 16, 1930, pp. 861-863. Description of control scheme for half million horsepower on Gatineau River in Quebec, involving storage of 45,000,000 cu. ft. by means of dam 797 ft. long and 26 ft. high; tractor haulage with 20 ton loads.

RIVERS

IMPROVEMENT. Experiments on Effect of Oblique Groynes on Concave Side of River Bend (Versuche ueber die Wirkung inklinanter Buhnen in einer konkaven Flusskruemmung), E. Riepe. Bautechnik (Berlin), vol. 8, no. 25, June 10, 1930, pp. 389-399, 24 figs. Review of previous studies on hydraulic groynes in straight river reaches and report on special experiments performed at hydraulic laboratory of Braunschweig Institute of Technology; photographs of hydraulic models showing eddies and contours of deposition of debris.

ROAD CONSTRUCTION

NOTES ON. Notes on Country Road Construction and Maintenance, T. H. Cross. Jr. Instn. of Engrs.—Jl. and Rec. of Trans. (Lond.), vol. 39, 1928-29, pp. 389-395. Brief description of early Roman roads in Great Britain; methods of constructing water-bound-roads, tarred roads, and concrete roads; road planning.

ROAD MATERIALS

BITUMINOUS. Direct Recovery of Tars by Fractional Condensation, F. Cooke. Gas World (Lond.), vol. 93, no. 2396, July 5, 1930, (Coking Sec.), pp. 13-17. Discussion of paper read before Coke Oven Mgrs. Assn., previously indexed from Mar. 1 issue of same journal.

ROCKET PROPULSION

EFFICIENCY. Propulsion by Reaction, M. Roy. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 571, June 1930, 19 pp., 4 figs. Mathematical investigation of efficiency of propulsion systems of rocket and propeller type; sketch shows propeller arrangement with reaction nozzles at tips of blades. From Technique Aéronautique, Jan. 15, 1930.

S

SEAPLANES

LANDING. Theory of Landing Shock of Seaplanes (Theorie des Landestosses von Seeflugzeugen), W. Pabst. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Muenchen), vol. 21, no. 9, May 14, 1930, pp. 217-226, 14 figs. Brief review of physical laws applicable to landing in waves; experimental determination of accelerated mass of water; mathematical analysis of conditions with flat-bottom pontoons; discussion of pontoons with keel; graphs show effect of keel angle on impact and other relations.

Landing on Ice With Pontoon Equipped Plane (Naogot om Islandning med Flottoerflygplan). Flygning (Stockholm), vol. 8, no. 6, June 1930, pp. 128-129, 2 figs. Brief analysis of forces induced by landing shock and notes on strength of pontoon structure.

Aircraft Seamanship, L. A. Moebus. Aero Digest, vol. 16, no. 4, Apr. 1930, pp. 68-70, 11 figs. Handling of various types of seaplanes in take-off and landing is described and illustrated by sketches; conditions of wind and water require special manœuvres.

SEWAGE DISPOSAL

SLUDGE REMOVAL. New Sludge-Removal Apparatus Developed at Milwaukee, D. W. Townsend and J. Brower. Eng. News-Rec., vol. 105, no. 2, July 10, 1930, pp. 63-65, 3 figs. Description of patented apparatus consisting of four revolving pipe arms with proportioned multiple inlets, designed to minimize interference with sedimentation; settling periods for various activated-sludge concentrations; operating data of settling tanks.

SEWERS

TORONTO, ONT. The Toronto Sewerage System, G. Phelps. Eng. Jl. (Montreal), vol. 13, no. 8, Aug. 1930, pp. 504-507, 4 figs. General description of system serving population of 606,000 having total length of 719 miles; construction methods used in recently completed large sewers.

SHAFTS AND SHAFTING

DESIGN. Approximate Calculation of Shaft (Die Ueberschlaegliche Berechnung von Wellen), W. Vogel. Werkstattstechnik (Berlin), vol. 24, no. 11, June 1930, pp. 304-306, 1 fig. Justification and need of approximate method of computation is discussed; compilation of formulae in tabular form; chart is given which permits reading of diameter of shaft for any torque.

SHEET METAL WORKING

DRILL JIGS. Applications of Drill Jigs to Metal Stampings, C. Sczalanczy. Metal Stampings, vol. 3, no. 7, July 1930, pp. 655-658, 5 figs. Typical single and multiple drill jigs used to advantage in metal stamping plants for production of small diameter holes.

WELDING. Gas-Welded Sheet Metal Products. Welding, vol. 1, no. 9, July 1930, pp. 619-622, 9 figs. Use of welding in manufacture of hospital equipment, metal furniture, metal doors, and sash, steel barrels, sheet metal in airplane manufacture, and for other types of products.

SILICA GEL

CHLORINE ADSORPTION. Adsorption of Chlorine by Silica Gel (Ueber die adsorption von Chlor an Kieselgel), A. Magnus and A. Mueller. Zeit. fuer Physikalische Chemie—Abteilung A (Leipzig), vol. 149, no. 4, June 1930, pp. 241-260, 5 figs. Report on experimental study made in department of physical chemistry, University of Frankfort-on-Main; adsorption isotherms at 0.20 and 40 deg. cent. were determined by means of glass apparatus without cocks and without mercury; free chlorine was condensed in tubes of small diameter and weighed.

REFRIGERANT. Silica-Gel Refrigerating System (Das Silica Gel-Kuehlsystem), Zeit. fuer Eis und Kaelte Industrie (Vienna), vol. 23, no. 4, Apr. 1930, pp. 39-40, 1 fig. Silica-Gel system is described.

SMOKE ABATEMENT

NASHVILLE. Mechanical and Human Elements, G. C. Fisher. Black Diamond, vol. 85, no. 1, July 5, 1930, pp. 21-23. Article previously indexed from Fuels and Steam Power (A.S.M.E. Trans.), Jan.-Apr. 1930.

OBSERVATIONS. Behaviour of Humid Air in Motion (Das Verhalten feuchter Luft in Bewegung), R. Schwanda. Gesundheits-Ingenieur (Munich), vol. 53, no. 15, Apr. 12, 1930, pp. 225-227, 1 fig. Observations of certain paradoxical phenomena in action of smoke condensers; explanation attempted and further lines of research indicated.

Smoke, Causes, Inconveniences, Remedies (La Fumée, Causes, Inconvénients, Remèdes), Varinois. Revue Industrielle (Paris), vol. 60, no. 2249, Apr. 1930, pp. 230-237, 3 figs. Notes on corrosion resulting from chimney gases; tables showing smoke conditions in Chicago in 1912; action of smoke on stone, and metal, on vegetation, influence on health, economic aspects, carbonization, injection of secondary air, etc. Bibliography.

PITTSBURGH. Sulphur Dioxide in the Air at the Pittsburgh Experiment Station of the U.S. Bureau of Mines, E. G. Meiter and C. E. Traubert. U.S. Bur. of Mines—Report of Investigations, no. 3005, June 1930, 5 pp. Daily sulphur dioxide content of air at Pittsburgh Experiment Station of Bureau of Mines was determined by Bureau at request of Committee D-14 on Screen Wire Cloth of American Society of Testing Materials; purpose of investigation was to obtain data for use in interpreting screen-corrosion tests, which were conducted simultaneously and jointly by committee and Bureau of Mines.

SOILS

FROST HEAVING. The Mechanics of Frost Heaving, S. Taber. Jl. of Geology, vol. 38, no. 4, May-June 1930, pp. 303-317, 5 figs. Report on field observations and experiments indicating that soils, when subjected to freezing, under normal conditions, usually behave as open systems; excessive heaving results when water is pulled through soil to build up layers of segregated ice; heaving is limited by tensile stress that may be developed in water and by downward growth of ice crystals in soil voids.

SPINNING MACHINERY

REGULATORS. Knowledge of Technological Processes as Basis for Development of Regulators for Industrial Machinery Exemplified on Ring Spinners (Die Erkenntnis technologischer Arbeitsvorgaenge Grundlage fuer die Durchbildung von Arbeitsmaschinenreglern), F. Oertel. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 9, Mar. 22, 1920, pp. 266-289, 22 figs. Development of regulator code; construction and performance of regulator; reasons for charges in rotary speed; adjustability of built-in regulator; dimensional changes; spinning process from practical example; operating problems.

STATICALLY INDETERMINATE STRUCTURES

STRESSES. Doubly-Asymmetrical Portal with Fixed Supports (Il Portale Doppio Dissimmetrico con i Piedritti Incastrati), O. Belluzzi. Annali dei Labori Pubblici (Rome), vol. 68, no. 3, Mar. 1930, pp. 196-211, 13 figs. Theoretical mathematical discussion presenting solution of certain cases of loading for this type of statically indeterminate structures; numerical examples.

STEAM

HIGH PRESSURE. High Pressure and Highly Superheated Steam in Power Plants (Hochgespannter und hochueberhitzer Dampf in Kraftanlagen), Marguerre. V.D.I. Zeit. (Berlin), vol. 74, no. 24, June 14, 1930, pp. 789-797, 26 figs. Economic aspects of high-pressure steam in back-pressure and condensation installations; influence of initial steam temperature and problems of intermediary heating; problems of design and operation of high-pressure boilers; standard designs and special designs of boilers; feed pump engines; high-pressure locomotives. Paper read before World Power Conference, Berlin.

STEAM CONDENSERS

ANALYSIS OF TROUBLE. An Analysis of Condenser Trouble, G. Smith. Pac. Mar. Rev., vol. 27, no. 7, July 1930, pp. 286-287, 4 figs. Discussion of steam and water circulation of main condenser of intercoastal ship. (Continuation of serial.)

STEAM-ELECTRIC POWER PLANTS

BRAZIL. The Sulzer Boiler Plant with Pulverized Coal Firing in the New Power Plant of Cia. Energia Electrica Rio Grandense at Porto Alegre (Rio Grande Do Sul), Brazil. Sulzer Tech. Rev., no. 2, July 1930, pp. 15-22, 7 figs. Unfavourable qualities of Brazilian coal; description of plant equipped with two 5,000-kw. turbo-alternator, 6,600 volts, 50 cycles, and five Sulzer upright water-tube boilers, of single-bank type, with pulverized-coal firing superheaters and economizers.

GERMANY. Super Power Plant Finkenheerd, with Special Regard to Heat Economics (Das Grosskraftwerk Finkenheerd unter besonderer Beruecksichtigung der Waermewirtschaft), G. Warrelmann. V.D.I. Zeit. (Berlin), vol. 74, no. 22, May 31, 1930, pp. 709-719, 24 figs. partly on supp. plate. Growing importance of lignite as fuel for electric power generation; development of electric power supply in Province of Brandenburg; reasonsfor early application of hot air for combustion, mechanical grates and high-pressure steam; description of plant which will have final output of 400,000 kw.

ITALY. Present Status and Probable Progress in Large Steam Electric Plants of Italy (Stato attuale e progressi probabili delle grandi centrali a vapore in Italia), P. Ferrerio. Energia Elettrica (Milan), vol. 7, no. 5, May 1930, pp. 392-404, 1 fig. General survey of steam electric power generation in Italy; tabulated parallel descriptions of steam-electric power plants of Genoa, Turbigo, Venice, Piacenza, Leghorn and Naples; study of costs.

PEAK LOADS. Extension of Charlottenburg Plant to Peak-Load Plant (Ausbau des Kraftwerks Charlottenburg zum Spitzenwerk), W. Stender and E. Frank. Siemens Zeit. (Berlin), I vol. 10, no. 6, June 1930, pp. 369-376, 11 figs. Extension is to provide for peak load of Berlin network to extent of 40,000 kw. during 3 hours and 67,000-kw.-hr. total supply; 16 Ruth accumulators of 5,000 cu. m. and storage capacity of 610 kg.-tons of steam at 0.5 to 16 atm. are installed; description of equipment, wiring diagrams, etc.

STEAM ENGINES

LUBRICATION. Eliminating Engine Cylinder Lubrication. Power Plant Eng., vol. 34, no. 14, July 15, 1930, pp. 825-826, 3 figs. Details of method of breaking in steam engines to operate without cylinder lubrication.

STEAM HEATING

SATURATED VS. SUPERHEATED STEAM. Superheated vs. Wet Steam for Heating Plants (Heiss oder Sattdampf fuer Heizungsanlagen), F. Kaiser. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 7, July 1930, pp. 247-250, 7 figs. Article previously indexed from Zeit. des Bayerischen Revisions-Vereins, July 15 and 31, 1929.

STEAM, HIGH PRESSURE

ECONOMICS OF. The Economics of High-Pressure Steam, G. A. Orrok. Engineering (Lond.), vol. 130, no. 3364, July 4, 1930, pp. 23-26, 2 figs. Paper presented before World Power Conference, previously indexed from World Power, July 1930.

The Economics of High Pressure Steam, G. A. Orrok. World Power (Lond.), vol. 14, no. 79, July 1930, pp. 63-64, 2 figs. Thermodynamic consideration of steam at high pressures; curves illustrating efficiencies of Carnot and regenerative cycles, also efficiency of practical central-station cycle; curves showing savings due to increase of pressure and temperature. Paper read before World Power Conference, Berlin.

STEAM POWER PLANTS

ASH HANDLING. Ash Handling in Boiler Rooms (La Manutention des Cendres dans les Chaufferies), M. Boulvin. Annales de l'Association des Ingénieurs Sortis Des Ecoles Spéciales De Gand (Ghent), vol. 19, 1929, pp. 307-330, 22 figs. General description of systems, with special regard to mechanical and continuous methods.

DESIGN. Modern Steam Generation, P. E. Rycroft. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 7, Jan. 1930, pp. 414 and 417-418. Extracts from instructive statistical review of steam generating practice during recent years, showing danger of departing from orthodox practice too rapidly; details of British electric power stations' steam plants having overall thermal efficiencies of over 21 per cent; table showing technical details of some of more important British power stations in course of construction (November, 1929).

EFFICIENCY. Subdivision and Efficiency Grading of Steam Power Plants (Die Unterteilung und Leistungsvertileung von dampfkraftanlagen), W. Pauer. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 449-451, 2 figs. Graphic method is described with which it is possible, with given load curve of plant, to determine best performance, at two plants with known cost curves; general recommendations for this useful subdivision into base-load and peak-load plants are given.

EQUIPMENT TESTING. Acceptance Tests (Abnahmeversuche), K. Jaroschek. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 434-436. Purpose of significance of acceptance tests; preparation and performance of tests for boilers, turbines, etc.

FUEL ECONOMY. Fuel Economy as a Function of Financing and Operating Economy (Waermewirtschaft als Teil der Finanz und Betriebswirtschaft), F. Wartenberg. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 5, May 1930, pp. 153-156, 4 figs. Commercial and technical aspects of fuel economy in relation to plant management; it is claimed that very small plants do not require high-salaried manager; but for larger plants, employment of heat engineer will probably prove profitable; functions of heat engineer are outlined.

Optimum of Boiler Heating Surface (Das Optimum der Kesselheizflaeche), F. Wartenberg. Archiv. fuer Waermewirtschaft und Dampfkesselwesen (Berlin), vol. 11, no. 7, July 1930, pp. 239-242, 6 figs. Method of calculating optimum value of heating surface; it is claimed that radiation represents best form of heat transfer; influence of air preheating on heat radiation; use of economizers and air preheaters.

GREAT BRITAIN. Annual Progress Review. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 7, Jan. 1930, pp. 395-404, 17 figs. Résumé of power-plant development during past year with special reference to: water purification, boilers, operating control, and auxiliaries.

HIGH PRESSURE. High-Pressure Steam for Power and Process at Billingham. Power Engr. (Lond.), vol. 25, no. 292, July 1930, pp. 261-279, 33 figs. and supp. plate; see also editorial comment on pp. 253-254. Outline of large and important extension plant of Synthetic Ammonia and Nitrated, Ltd., at Billingham-on-Tees; general illustrated description of equipment and piping is given; plant-lay-out prints are also included.

Balanced Electric and Process Steam Loads in New High-Pressure Power Plant. Power Plant Eng., vol. 34, no. 13, July 1, 1930, pp. 734-740, 12 figs. Waldorf Paper Products Co. of St. Paul goes to 650 lbs. pressure to balance power and steam loads; new $750,000 power plant has two 13,460 sq. ft. pulverized-coal-fired boilers with water walls and air heaters, 12,000 cu. ft. steam accumulator and 4,500 kw. of generating capacity in two units; complete details of equipment arrangement and heat balance for output of 225 tons per day.

Loeffler High-Pressure Steam (Loeffler-Hochdruckdampf), K. Rochel. Waerme (Berlin), vol. 53, no. 24, June 24, 1930, pp. 486-487, 3 figs. Description of extension to super-pressure power plant of Karolin pit of Witkowitz bituminous coal mines.

INDUSTRIAL, FUEL ECONOMY. Some Economies Effected in Old Industrial Boiler Plants, J. S. Gander. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 9, Mar. 1930, pp. 538, 541-542 and 545, 2 figs. Discussion of experiences of two specific installations, in which improved arrangement chiefly concerns cost and handling of fuel, efficiency of steam supply and maintenance charges.

INDUSTRIAL, TEXTILE MILLS. Experience with Industrial Combined Heating and Power Plant (Erfahrungen mit einem Industrie-Heizkraftwerk), R. Schallhart. Elektrizitaetswirtschaft (Berlin), vol. 29, no. 509, June 1, 1930, pp. 274-282, 7 figs. Description of plant for larger textile mill; coupling of power and heating systems; cost of generation of steam and current; influence of fluctuation and rationalization on power economics; depreciation and efficiency.

LIGNITE FIRED. Operation of Lignite Plant and Central Station at Boehlen (Aus dem Betrieb des Braunkohlen und Grosskraftwerkes Boehlen), H. Zeuner. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 5, May 1930, pp. 157-162, 7 figs. Description of lignite briquetting plant and power station; utilization of vapours from briquet-plant driers for recovery of water for boiler operation; utilization of flue gases as protection against explosions in pulverizing plant; operating experiences with pulverized-coal-fired boilers; measuring instruments and electric equipment.

OPERATION. Boiler House Practice, F. Johnstone Taylor. Elecn. (Lond.), vol. 105, no. 2718, July 4, 1930, pp. 20-23, 8 figs. Stacks and draft systems in modern power stations; importance of draft installation; dust and grit extraction; suction fans; flue-gas washing; removal of sulphurous acid.

PRESSURE REGULATION. Regulation for Pressure and Heating Steam, C. L. Hubbard. Power Plant Eng., vol. 34, no. 13, July 1, 1930, pp. 769-771, 3 figs. General discussion of floating auxiliary turbine, reducing valves, sizes and connections.

PULVERIZED COAL FIRED. Description of New Steam Generators at Derby Station, D. Brownlie. Combustion, vol. 2, no. 1, July 1930, pp. 36-38 and 48, 7 figs. Station is cited as notable example of comparatively small plant that embodies very latest practice throughout; boiler plant, including two new units, has total capacity of approximately 400,000 lbs. of steam per hr.; five pulverized fuel-fired units occupy same aggregate floor space previously occupied by eleven stoker-fired units, but have nearly double steaming capacity.

Pulverized Fuel Firing as Affecting Economic Boiler House Operation, G. H. Lake. Colliery Guardian (Lond.), vol. 140, no. 3623, June 6, 1930, pp. 2127-2129. Review of factors which affect economic steam production and influence of these factors in trend of modern boiler house design. Abstracts of paper read before Mun. Elec. Assn.

Pulverized-Fuel Firing as Affecting Economic Boiler-House Operation, G. H. Lake. Elec. Rev. (Lond.), vol. 106, no. 2741, June 6, 1930, pp. 1081-1082 and (discussion) 1082-1083. Reviews of certain factors which affect economic steam production and their influence on trend of modern boiler-house design. Abstract of paper read before Incorporated Mun. Elec. Assn.

STEAM PROPERTIES

GASES. The Thermal Properties of Gases, W. L. Baufre. Combustion, vol. 2, no. 1, July 1930, pp. 31-35 and 50, 4 figs. Thermal properties of perfect gas; specific heats of real gases; specific heats of gases under constant pressure; entropy of real gases.

STEAM TURBINES

APPLICATION. Economic Considerations in the Application of Modern Steam Turbines to Power Generation, A. G. Christie. Mech. Eng., vol. 52, no. 8, Aug. 1930, pp. 757-766, 13 figs. Current practice; data on costs, floor space, and economic performances; and analyses of reheating problems and of economic rating of turbine casings. (Concluded.)

DESIGN. Recent Large Steam Turbines (Neuere Grosse Dampfturbinen), K. Baumann. V.D.I. Zeit. (Berlin), vol. 74, no. 24, June 14, 1930, pp. 805-832, 19 figs. Review of development and discussion of important factors of design; data on reliability, operating conditions and losses; typical makes of large steam turbines are described. Paper read before World Power Conference, Berlin.

Design Problems of Ideal Turbines (Die Grenzturbine als Gestaltungsproblem), E. A. Kraft. Maschinenbau (Berlin), vol. 9, no. 12, June 19, 1930, pp. 401-405, 10 figs. Importance of proper dimensioning of last stage is discussed; description of designs of discs 2,000 mm. in diam. at 3,000 r.p.m.; data on efficiency of turbine gears.

Starting Speed, Operating Safety and Economy of Steam-Turbine Units (Betriebsbereitschaft, Betriebsicherheit und Wirtschaftlichkeit der Dampfturbosaetze), M. Blaensdorf. Waerme (Berlin), vol. 53, no. 27, July 5, 1930, pp. 521-524, 7 figs. These three factors which have influenced design of steam turbines to greatest extent, are discussed, and examples are given showing how these properties have been effected in large modern turbine sets; one of largest in Europe has attained efficiency of 87.7 per cent.

Application of Turbines to Power Generation, A. G. Christie. Power, vol. 72, no. 6, Aug. 5, 1930, pp. 108-211, 7 figs. Abstract of paper presented before World Power Conference, previously indexed from Power Plant Eng., July 1, 1930.

Richardsons, Westgarth-Brown Boveri Turbines. Eng. and Boiler House Rev. (Lond.), vol. 43, no. 10, Apr. 1930, pp. 659-661, 2 figs. Design features incorporated in reaction turbine manufactured by above concern.

EFFICIENCY. Indicated Efficiency of Single-Stage Steam Turbine (Der indizierte Guetegrad von einstufigen Dampfturbinen), W. Riedel. Maschinen-Konstrukteur (Munich), vol. 63, no. 6, Mar. 25, 1930, pp. 118-121, 5 figs. Graphical and mathematical method for determining and comparing efficiency of turbine as function of various ratios of peripheral velocity and velocity at which steam leaves nozzles.

Definition for Thermodynamic Efficiency of Steam Turbines (Definition du rendement thermodynamique des turbines à vapeur), G. Darrieus. Revue Générale de l'Electricité (Paris), vol. 27, no. 25, June 21, 1930, pp. 963-968, 4 figs. Study, which will be presented at next Stockholm meeting of International Electric Commission, points out that in order to be generalized, definition for thermodynamic efficiency should be based on description of usable energy as conceived by Maxwell, Kelvin, Gibbs and Gouy.

EUROPE. European Developments in Kaplan and Propeller Turbines, A. V. Karpov. Power, vol. 72, no. 3, July 15, 1930, pp. 108-110, 8 figs. Part of report made by author after trip through Europe; cavitation problems are of such importance in application of propeller and Kaplan turbines that laboratories have been built in which to study these phenomena; studies have also been extended to Francis-type runners. Abstract of report before Am. Inst. of Elec. Engrs. in Toronto.

GERMANY. Large Turbines of 3,000 Revolutions per Minute (Grossturbinen mit 3,000 U/min.), N. Kasparek. Siemens Zeit. (Berlin), vol. 10, no. 6, June 1930, pp. 376-380, 10 figs. Equipment of 24,000 kw. rated capacity and 30,000 kw. overload capacity built by Siemens and Schuckert for Gerstein Werk of Vereinigten Elektrizitaetswerke Westfalen, are illustrated and described.

HIGH PRESSURE. Turbines for High Pressure Industrial Plants of the Future, I. H. Melan. Power Plant Eng., vol. 34, no. 14, July 15, 1930, pp. 804-806, 4 figs. Advantages of turbines for pressures up to 3,200 lbs.; simplicity, safety, ease of control, and extraction and high efficiency; three-dimensional graphs of turbine efficiency, which is function of Parsons characteristic and steam flow.

RUTHS. Development and Design of the Ruths Turbine (Ruthsturbine Entwicklung und Aufbau), J. Landau. Waerme (Berlin), vol. 53, nos. 23 and 25, June 7, 1930, pp. 409-415 and June 21, pp. 495-500, 24 figs. History of development during years 1920 to 1930, and description of new design of large-scale turbine; behaviour of Ruths turbine for peak-load service and for momentary reserve under different operating conditions.

STARTING. Spindle Turning Gears for Steam Turbines. Power Plant Eng., vol. 34, no. 10, May 15, 1930, pp. 553-555, 4 figs. Starting time of large turbines more than halved by motor-driven equipment which turns spindle at about 25 r.p.m. during warming-up period; plan and sectional views illustrating motor-operated spindle turning gear.

STEAMSHIPS, TURBINE

EMPRESS OF BRITAIN. Steamship Empress of Britain Launched for Canadian Pacific Steamships, Ltd. Can. Ry. and Mar. World (Toronto), no. 389, July 1930, pp. 467-470, 1 fig. Similar description previously indexed from Shipbldg. and Shipg. Rec., June 12, 1930.

NEUMARK. New Cargo Steamers of Hamburg-American Line Built in Kiel (Die Kieler Frachtdampfer-Neubauten der Hamburg-Amerika Linie), H. Herner. Schiffbau (Berlin), vol. 31, no. 9, May 7, 1930, pp. 197-206, 10 figs. Eight vessels, two at Kiel, are being built to utilize discarded machinery of four ships of Albert Ballin class which were converted to higher-speed vessels; Neumark, first of these to be completed, has o.a. length of 152.75 m.; gross tonnage, 11,000; turbines and boilers are those formerly installed in S.S. Hamburg; with total output of 6,200 s.hp., fully loaded, ship has speed of 14.8 knots.

STEAMSHIPS, TURBO-ELECTRIC

VIRGINIA. Some Data on Electric Propulsion. Nautical Gaz., vol. 119, no. 6, Aug. 9, 1930, pp. 21-22. Excerpts from article previously indexed in Eng. Index 1929, p. 1758, from Inst. Mar. Engrs.—Trans., vol. 41, Nov. 1929, pp. 687-701 and discussion 702-720, 5 figs. partly on supp. plates.

STEEL

HEAT TREATMENT. Heat Treatment of Steel and Use of Special Steel in the Machine Industry (Om Varmebehandling av Stal), N. H. Aall. Teknisk Ukeblad, vol. 77, no. 27, July 3, 1930, pp. 304-306. Discussion of plain carbon steel vs. alloy steel with regard to satisfactory control of physical properties by proper heat treatment; ratio of chilling speed to crystallization speed permits conclusions as to whether carbon or alloy steel is more economic.

The Effect of the Rate of Cooling on Steel, J. M. Robertson. Chem. Age (Lond.), vol. 23, no. 575, July 5, 1930 (Met. Sec.), pp. 1-2. Discussion of accepted theories of effect of heat treatment on steel; original theory of relations of martensite, troostite and sorbite to each other and to normal iron-carbon diagram; four series of structures obtained by different methods of cooling.

STEEL FOUNDRIES

RESEARCH. Research and Promotion Will Aid Castings Industry, R. L. Wensley. Steel (formerly Iron Trade Rev.), vol. 87, no. 2, July 10, 1930, pp. 50-51 and 60. Conditions in industry; need for co-operative effort and correction of internal malpractices; advertising for wider markets; advantage of made mark.

STEEL MANUFACTURE

CHEMISTRY. Estimation of Reaction Possibilities in Manufacture of Steel with Aid of Physico-Chemical Data (Die Beurteilung der Reaktionsmoeglichkeiten bei der Stahlerzeugung, etc.), H. Schenck. Stahl und Eisen (Duesseldorf), vol. 27, no. 3, July 3, 1930, pp. 953-965 and (discussion) 966, 20 figs. Notes on "actual" and "best" utilization values of reactions and their relations to extent and trend of chemical conversion; total concentration and concentration of free slag constituents; bearing of best utilization values of manganese, phosphorus and sulphur reactions on slag composition and temperature; conclusions with regard to oxygen absorption of metals.

STOKERS

EFFICIENCY COMBUSTION. Some Elements of Efficiency Combustion, T. A. Marsh. Black Diamond, vol. 85, no. 2, July 12, 1930, pp. 15-16. Abstract of paper read before Midwest Bituminous Coal Conference, previously indexed from Steam Coal Buyer, May 1930.

LIGNITE FIRED. High-Duty Stoker for Slow-Burning Fuels (Hochleistungsrost fuer schwer zuendende Brennstoffe), Berner. Waerme (Berlin), vol. 53, no. 24, June 14, 1930, pp. 431-433. New firing system, developed by Arbatsky, for lignite, is described with which, by acceleration of drying and ignition, specific grate efficiency of 2.75 million kg-cal. per sq. m.-hr. is obtained, and output of 125 tons per hr. of steam.

PEAT FIRING. Mechanical Stokers for Burning of Peat, N. M. Savellov and N. A. Semenenko. Izvestiya Teplotechnickeskovo Instituta (Moscow), no. 1 (54), 1930, pp. 32-57, 29 figs. Report to All-Russia Thermo-Technical Convention treating of peat as fuel and describing design and operation of three classes of mechanical and semi-mechanical stokers, developed in Russia; results of tests presented in tabular form. (In Russian.)

The Kirsch Mechanical Stoker for Burning Peat, M. M. Schegloyev and N. V. Zeitz. Izvestiya Teplotechnicheskovo Instituta (Moscow), no. 1 (54), 1930, pp. 3-11, 8 figs. History of development and features of mechanical stokers invented more than ten years ago; results of tests made in 1929 prove economy and efficiency of Kirsch design; construction cost data. (In Russian.)

UNDERFEED. Firing of Tertiary Bituminous Coal on Underfeed Stokers (Verfeuerung tertiaerer Bitumenkohlen auf Unterschubrosten), B. Kretzschmar. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 5, May 1930, p. 168. Notes on properties and firing of coals from Dutch East Indian islands, Borneo, and Sumatra; these coals have high gas and water content, and are very soft; experiences with burning this coal on underfeed stokers under water-tube boilers on ships of Royal Dutch line.

WASTE FUEL. Burning Waste Fuel With Underfeed Stokers, R. A. Foresman and D. J. Mosshart. Power Plant Eng., vol. 34, no. 15, Aug. 1, 1930, pp. 860-861, 2 figs. Bark, wood waste, coke breeze and other fuels can be handled easily in underfeed stokers.

STREAM POLLUTION

STREAM POLLUTION. Trade Effluents and Sewers. Engineering (Lond.), vol. 130, no. 3365, July 11, 1930, pp. 47-48. Editorial review of report issued by Joint Advisory Committee on River Pollution to Ministries of Health and of Agriculture.

SUBWAY CONSTRUCTION

NEW YORK CITY. New York Subway Construction. Eng. News-Rec., vol. 105, no. 6, Aug. 7, 1930, pp. 200-205, 9 figs. Major construction problems and developments in New York's latest subways; features of new subway-construction practices employing recent inventions and equipment developed to meet changed requirements of street maintenance; broad characteristics of subway structure, construction developments, construction problems and contract requirements for third subway system; organization for subway construction; New York subway history. (To be continued.)

SUPERHEATERS

FOR HIGH TEMPERATURES. Superheaters for High Steam Temperatures (Ueberhitzer fuer hohe Dampftemperaturen), O. H. Hartmann. Waerme (Berlin), vol. 53, nos. 24 and 27, June 14, 1930, pp. 463-468, and July 5, pp. 525-528, 19 figs. Experiences with stationary plants in Germany and other countries; superheater requirements; practical tests with new materials; directly heated superheaters.

SUPERHEATERS. Why Superheaters and What Kind? S. H. Daniels. South. Power Jl., vol. 48, no. 7, July 1930, pp. 58-59. Modern pressures and temperatures, boilers and furnaces have placed new emphasis on superheater application and design, an emphasis resulting in improved adaptability and service.

T

TANKS

WELDING. Manufacturing Welded Metal Products, J. C. Coyle. West. Machy. World, vol. 21, no. 6, June 1930, pp. 242-244, 9 figs. Methods used by Eaton Metals Products Co., Denver, Colo., in manufacture of metal containers for petroleum products ranging from 50-gal. oil drums to 100,000-gal. storage tanks.

TEXTILES

WEAVING. Starting Marks—the Bugbear of Silk and Other Weave Rooms, H. E. Wenrich. Textile World, vol. 78, no. 2, July 12, 1930, pp. 34-36 and 40, 3 figs. Methods to prevent starting marks; use of water on woven part of cloth; handling heavy materials. (Continuation of serial.)

TUNGSTEN CARBIDE CUTTING TOOLS

USE OF. Tungsten-Carbide Cutting Materials, F. C. Spencer. Mech. Eng., vol. 52, no. 8, Aug. 1930, pp. 777-780. Summary of data obtained from users and builders of machine tool regarding use of tungsten carbide cutting materials and influence on design of machines. Progress Report No. 2 of Subcommittee on Tungsten-Carbide Cutting Materials of the A.S.M.E. Special Research Committee on the Cutting of Metals.

The Use of Tungsten Carbide as a Cutting Material on Heavy Machine Tools, C. Seller. Mech. Eng., vol. 52, no. 7, July 1930, pp. 683-689, 15 figs. Brief review of experience of early user of tungsten-carbide tools on cast iron; steps taken to introduce this material into machine shop and method used to follow up results obtained; suggestions for grinding procedure, clearance angles, and shapes of tools; difficulties are listed with possible remedies for each; six typical successful applications.

WIDIA. Widia Tungsten Carbide Tools, R. D. Prosser. West. Machy. World, vol. 21, no. 6, June 1930, pp. 236 and 237, 11 figs. Strength, speed, chip pressure, clearance angle, cost and other factors are considered; special applicatives are suggested. (Continuation of serial.)

TURBO-GENERATORS

STARTING. On the Line in 13 Seconds, F. G. Philo. Elec. World, vol. 96, no. 3, July 19, 1930, pp. 110-113, 6 figs. 4,500-kw. turbine-driven house generator may be brought from cold standstill to full speed and voltage in 12.56 secs. to insure continuity of station auxiliary power at Long Beach steam station of Southern California Edison Co., Ltd.

W

WAGE PAYMENT PLANS

BEDAUX. Bedaux Methods (Das Bedaux-Verfahren), G. Schlesinger. Werkstattstechnik (Berlin), vol. 24, no. 13, July 1, 1930, pp. 354-360, 2 figs. Typical Bedaux analysis sheet is given. (Concluded.)

WASTE ELIMINATION

PLANTS. Eliminating Unnecessary Waste in Plant Operation, J. J. Berliner. Metal Stampings, vol. 3, no. 7, July 1930, pp. 613-616 and 652. Importance of managerial control, close supervision, and other factors for eliminating unnecessary waste of materials and labour.

WATER SUPPLY

REGINA, SASKATCHEWAN. Report on Water Supply at Regina, Sask., R. O. Wynne-Roberts and N. Hill. Can. Engr. (Toronto), vol. 59, no. 1, July 1, 1930, pp. 107-109. Preliminary report covering proposals for increasing water supply; alternative projects discussed.

WATER TREATMENT

NEUTRALIZATION. Graphics of Neutralization of Water Acidity (Betraehtungen ueber die Entsaeuerung des Wassers an Hand graphischer Darstellungen), P. Martiny. Gesundheits-Ingenieur (Munich), vol. 53, no. 25, June 21, 1930, pp. 395-396. Table and explanatory discussion supplementary to previously indexed article published in issue of Mar. 29.

WELDING

AIRCRAFT. Procedure Control for Aircraft Welding, H. L. Whittemore, J. J. Crowe and H. H. Moss. Welding, vol. 1, no. 9, July 1930, pp. 589-590 and 595, 3 figs. Discussion of specifications for material and apparatus used; ability of operator; technique used in each operation; inspection of finished product; brief abstracts of Procedure Control for Welding Aircraft Joints—Report by Committee of American Bureau of Welding.

PLANT REPAIRS. Welding in Plant Repairs, H. W. Benton. Power Plant Eng., vol. 34, no. 15, Aug. 1, 1930, pp. 886-888, 4 figs. Use of right methods and equipment by experienced operators cut costs in manufacture and plant upkeep; welding vs. riveting.

PRESSURE VESSELS. Welding of Super Code Pressure Vessels, L. H. Burkhart. Am. Welding Soc.—Jl., vol. 9, no. 6, June 1930, pp. 28-32, 3 figs. Welding procedure for vessels larger than 60 in. di m. for more than 200 lbs. pressure and which may employ unit stress than 8,000 lbs. per sq. in. of weld section: results of tests of procedure.

WIND TUNNELS

AMERICAN. The New American Wind Tunnels, R. M. Wood. Roy. Aeronautical Soc. (Lond.), vol. 34, no. 235, July 1930, pp. 559-568 and (discussion) 568-576, 3 figs. Discussion of fundamentals of wind tunnel design and aerodynamic characteristics; importance of large scale wind tunnel test is outlined; brief description of N.A.C.A. wind tunnels.

TESTING. The Wind-Tunnel as an Engineering Instrument, A. L. Klein. Soc. Automotive Engrs.—Jl., vol. 27, no. 1, July 1930, pp. 87-88, and (discussion) 88-90. Outline of usefulness of wind-tunnel testing; life, drag, centre-of-pressure travel, interference of wings and fuselage, effect of interference drag of minor parts, and statical and dynamical stability; costs of atmospheric and high-pressure tunnels are compared.

WIRE DRAWING

PRACTICE. The World's Wire Drawing Practice, K. B. Lewis. Wire, vol. 5, no. 7, July 1930, pp. 265-266 and 285-289. Methods being used outside of United States, including Canada, Mexico, Great Britain, Sweden, etc. Paper read before Wire Division, Assn. Iron and Steel Elec. Engrs., June 18, 1930.

WIRE ROPE

PRINCIPLES AND USES OF. Principles and Uses of Wire Rope, W. A. Scoble. Metallurgia (Lond.), vol. 1, nos. 5 and 6, vol. 2, no. 8, Mar. 1930, pp. 203-204, and 214, Apr., pp. 254-255, June, pp. 63-64, 11 figs. Mar.: Locked coil ropes; Trulay ropes; length of lay. Apr.: Analytical discussion of rope details, in relation to strength and efficiency. June: Adjusting tendency of certain layers to twist; different fibres used in formation of rope cores; specifications for rope cores. (Continuation of serial.)

WOOD

METAL COATING. Metallized Wood (Das neue Metallholz), P. Martell. Kunststoffe (Munich), vol. 20, no. 6, June 1930, pp. 125-127. Details of process developed by Kaiser-Wilhelm-Institut fuer Eisenforschung based on years of research; among advantages of new metallized wood is its non-flammable properties and its machinability; among its possible uses are manufacture of furniture, pianos, gramophones and loud speakers, journal bearings, etc.; process is said to be simple and inexpensive.

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A

AIR CONDITIONING

AIR-EXPANSION PROCESS. Colling and Drying Air (Air Conditioning) With Particular Reference to the Air Expansion Process, A. Baumann. Brown Boveri Rev., vol. 17, no. 9, Sept. 1930, pp. 271-282, 14 figs. In private, public, and industrial buildings, direct cooling of air by cold air machine is to be preferred for hygienic, technical, and economic reasons to vapour compression machine; principles of systems are reviewed; Brown Boveri and Co. were pioneers in application of turbo-compressor in refrigerating plants with vapour compression machines and have recently built cold-air machine on turbo principle for gold mines in South Africa; Mollier chart for moist air used for changes in air condition.

AIR PREHEATERS

CONTROL. Control and Safety Devices for Air-Preheater Installations (Regelungs und Sicherheitseinrichtungen an Lufterhitzeranlagen), Harraeus. Feuerungstechnik (Leipzig), vol. 18, no. 13-14, July 15, 1930, pp. 135-138, 13 figs. Devices for regulation of superheated-air temperature; guide channels for flue gases; turning on and off of different air-heated elements; admixture of hot gases or cold air; safety devices against burning of protective elements; cooling of heating gases; coupling of air blower witb governing valves for admission or discharge of heating agent.

AIRPLANE ENGINES

AIR-COOLED. 1,000-Hp. Air-Cooled Engine Will Power Future Aircraft, A. H. R. Fedden. Automotive Industries, vol. 63, no. 9, Aug. 1930, pp. 307-308. Brief review of various types of modern air-cooled engines; notes on supercharging and cowling; future possibilities, particularly of oil engine are outlined. Read before Brit. Inst. Mech. Engrs.

DESIGN. Factors Involved in Developing Light Weight Design, E. A. Ryder Machine Design, vol. 2, no. 7, July 1930, pp. 15-19, 7 figs. Discussion of salient features of ligbt-weight design in Pratt and Whitney engines; physical properties of various materials used in design; table gives specific strength of common materials used in aircraft-engine design.

REDUCTION GEARS. Airplane Engines with Automatically Variable Reduction Gear (Motore di aviazione con demoltiplicatore automaticamente variabile). Ala d'Italia (Milan), vol. 11, no. 8, Aug. 1930, pp. 669-670, 5 figs. Description of 4-cylinder four-cycle experimental rotary engine with pistons acting on individual crankshafts provided with pinions which in turn engage centrally located gear arrangement; sketches and diagrams show principal details; with decreasing air resistance, propeller speed automatically output of engine remaining constant.

TESTING. Engine Performance at Higb Altitudes Studied by the Bureau of Standards, P. M. Heldt. Automotive Industries, vol. 63, no. 8, Aug. 23, 1930, pp. 256-258 and 263, 5 figs. Description of testing facilities for investigations on superchargers, lubricating oils, flame propagation in engine cylinders, effect of humidity on engine operation, ignition phenomena, and combustion at constant pressure; flying heights are simulated by decreasing atmospheric pressure and lowering temperature.

AIRPLANES

AMPHIBIAN. The Saro Flying Cloud. Flight (London), vol. 22, no. 30, July 25, 1930. pp. 831-832, 2 figs. Description of amphibian boat design similar to Cutty Sark and equipped with two Whirlwind engines; length o.a. 47 ft. 9 in.; pay load 1,420 lbs.; maximum speed at sea level 120 m.p.h.; landing speed 55 m.p.h.

ICE-FORMATION PREVENTION. The Prevention of the Ice Hazard on Airplanes, W. C. Geer and M. Scott. Nat. Advisory Committee for Aeronautics—Tech. Note, no. 345, July 1930, 23 pp., 11 figs. Discussion of factors controlling ice formation and outline of possible means of preventing ice; laboratory work done at Cornell University, Ithaca; description of ice-removing overshoe consisting of rubber treated with special oil mixture; inflation by means of compressed air breaks ice on leading edges provided with overshoe.

MILITARY (CAPRONI). The Caproni 90 P.B. Military Airplane (Italian). Nat. Advisory Committee for Aeronautics—Aircraft Circulars No. 121, July 1930, 7 pp., 7 figs. on supp. plates. Giant biplane of 6,000 hp. equipped with six Isotta-Fraschini engines arranged in three tandems; bomb racks are designed for 17,637 lbs.; length 88.39 ft.; height 35.43 ft.; span 114.5; total lifting 5,346.43 sq. ft.; total weight 33,070 lbs.; speed 127.4 mi.-hr. From Aeronautica, Apr. 1930.

MILITARY (COMTE). The Comte A.C. 3" Military Airplane (Swiss). Nat. Advisory Committee for Aeronautics—Aircraft Cir., no. 122, July 1930, 7 pp., 5 figs. on supp. plates. High-wing semi-cantilever monoplane witb two tandem 600-hp. Hispano-Suiza engines; span 85.30 ft.; length 59.05 ft.; wing area 1,011.8 sq. ft.; empty weight 7,496.00 lbs.; armament load or persons 1,669 lbs.; maximum speed with two engines 103 m.p.h.; complete performance data are given. From Aero-Revue, Apr. 1930, and Ailes, May 15, 1930.

PERFORMANCE CALCULATION. A Proof of the Theorem Regarding the Distribution of Lift Over the Span for Minimum Induced Drag, W. F. Durand. Nat. Advisory Committee for Aeronautics—Report No. 349, 13 pp. 8 figs. It is sbown mathematically that elliptical distribution across span gives minimum value of induced drag.

Advance Calculation of Altitude Performance (Die Vorausberechnung der Hochenleistungen), O. Schwager. Flugwesen (Prague), vol. 10, no. 6, 1930, pp. 61-63, 3 figs. Brief discussion of various formulae and comparison with results of test flights.

How Fast is Maximum Speed? E. G. Reid. Aviation, vol. 29, no. 2, Aug. 1930, pp. 86-91, 11 figs. Outline of simplified methods for calculating maximum speed and comparison of advertised figures for group of commercial planes witb figures obtained by actual test for group of typical service planes.

PROPELLERS, VARIABLE-PITCH. Gloster-Hele-Shaw-Beacham Variable-Pitch Airscrew. Machy. (Lond.), vol. 36, no. 931, Aug. 14, 1930, pp. 636-638, 3 figs. Adaptation of this type to requirements of engine; sensitiveness to any change in r.p.m. of engine diagram of variable-pitch gear.

STRESS ANALYSIS. Calculation of Reistance and Static Tests (Calculs de résistance et essais statiques), L. Kirste. Aéronautique (Paris), vol. 12, no. 134, July 1930, pp. 251-252, 1 fig. Outline of standard methods used in France, Germany, United States, England, and Italy for calculating stresses in various types of airplanes under different flying conditions; brief discussion of tests on elasticity, breakdown, and resistance against repeated stresses.

WELDED JOINTS. Metal Joints in Aircraft Construction, T. W. Downes. Welding, vol. 1, no. 10, Aug. 1930, pp. 563-667, 7 figs. Discussion of tecbnique in making joints by each of methods of welding, brazing, and soldering by different welding processes; data on composition of fluxes and strength of welded joints. Abstract of paper presented before Am. Soc. Testing Matls., June 23, 1930.

Strength of Welded Joints in Tubular Members for Aircraft, H. L. Whitteman and W. C. Brueggeman. Nat. Advisory Committee for Aeronautics—Report, no. 348, 1930, pp. 5-41, 31 figs. Investigation on strength, weight, and cost of number of types of welded joints; 40 points were welded under procedure specifications and tested to determine their strengths; weigbt and time required to fabricate each joint.

WINGS, SLOTTED. Practical Experiences with Slotted Wings of Automatic Type (Praktische Erfahrungen mit dam automatischen Spaltflugel), G. Lachmann. Zeit. fuer Flugtechnik und Motorluftschiffahrt (Munich), vol. 21, no. 16, Aug. 28, 1930, pp. 409-419. Description and aerodynamics features of slotted wings and effect on airplane performance; sketches show mechanism of automatic operation.

AIRPLANE WINGS

DESIGN. Span Load Distribution on Two Monoplane Wing Models as Affected by Twist and Sweepback, M. Knight and R. W. Noyes. Nat. Advisory Committee for Aeronautics—Tech. Note, no. 346, July 1930, 7 pp., 12 figs. Discussion of tests made in Atmospheric Wind Tunnel of Langley Memorial Aeronautical Laboratory; data are taken from results of investigation dealing primarily with lateral stability; as presented, they are suitable as aid in structural design of certain monoplane wings.

TAPERED. Calculation of Tapered Monoplane Wings, E. Amstutz. Nat. Advisory Committee for Aeronautics—Tecb Mem., no. 578, Aug. 1930, 20 pp., 16 figs. Analysis of stresses and aerodynamical characteristics of tapered cantilever wings; determination of shape of wing for producing given lift distribution; it is shown that tips of tapered wing are more heavily loaded than middle portion. Translated from Schweizerische Bauzeitung, Apr. 5, 1930, previously indexed.

AIRSHIPS

COMMERCIAL POSSIBILITIES. Tbe Commercial Possibilities of the Airship. Engineer (Lond.), vol. 150, no. 3892, Aug. 15, 1930, pp. 175-176. Editorial comments inspired by recent flight of R 100 from Cardington to Montreal; when it is examined in light of comparable analogy argument popularly developed against possibilities of airship cannot be sustained; cold examination of whole situation leaves writer with no unbounded enthusiasm for commercial possibilities of airship; neither does it leave him with conviction that general public is correct in its superficial impression of facts and features hostile to commercial success.

PRESSURE DISTRIBUTION. Calculation of Pressure Distribution on Airship Hulls, T. Von Karman. Nat. Advisory Committee for Aeronautics—Tech. Memorandum, no. 574, July 1930, 27 pp., 9 figs. Mathematical analysis of air-flow conditions and pressure distribution based on shape of ZR 111, with following simplifications: cars, fins, and rudders removed; all cross-sections replaced by equivalent circular cross-sections; calculations are made for symmetrical case, of flow parallel to axis; unsymmetrical case, or flow at angle to axis.

ALLOYS

ALLOYS. *See Aluminum Alloys.*

BRASS. *See Brass Castings.*

COPPER. *See Copper Alloys.*

HEAT-RESISTING. Behaviour of Heat-Resisting Alloys in Presence of Sulphur and a New Sulphur-Resistant Alloy (Der Verhalten hitzebestaendiger Legierungen gegen Schwefel und eine neue schwefelbestaendiger Legierung), H. Gruber. Stahl und Eisen (Duesseldorf), vol. 50, no. 36, Sept. 4, 1930, p. 1272. Increase of resistance against attack of sulphur compounds by means of aluminum addition (alloy no. 8) is attributed to increase in melting point of sulphide-layer formation and to formation of very thin butgas-impervious skin of aluminum oxide. Abstract from Wilhelm Heraeus 70th Birthday special volume.

ALUMINUM

SHEET, BENDING TEST FOR. The Bending Test for Aluminum Sheet. Metal Industry (Lond.), vol. 37, no. 9, Aug. 29, 1930, pp. 193-195. Scientific application of what used to be considered rough and ready test for selection of aluminum sheet of correct temper for different purposes; American system of grading aluminum sheets according to temper and its comparison with British system.

ALUMINUM ALLOYS

CASTINGS, HEAT TREATMENT OF. Aluminum Alloys for Heat-Treated Casting, R. J. Anderson. Metallurgia (Manchester), vol. 2, no. 10, Aug. 1930, pp. 129-132 and 154, 4 figs. Bulk of present commercial requirements for heat-treated castings can readily be met with relatively few compositions; enumeration and discussion of chief alloys that have been or are used in practice; microstructure as affected by heat treatment; effect of heat treatment on mechanical properties; uses of heat-treated castings.

ARCHES, CONCRETE

FREYSSINET METHOD. Stresses Under the Freyssinet Method of Concrete Arch Construction, J. T. Thompson. Eng. News Rec., vol. 105, no. 8, Aug. 21, 1930, p. 291, 1 fig. Economics and advantages claimed for Freyssinet method; stresses and possible corrections for tbree French arches; comparison of stresses caused by two methods of uncentering 322-ft. concrete arch.

AUTOMOBILE ENGINES

SUPERCHARGING. Supercharging of Internal-Combustion Engine (La suralimentation des moteurs à combustion interne), C. Martinot-Lagarde. Technique Moderne

(Paris), vol. 22, nos. 14 and 15, July 15, 1930, pp. 489-496 and Aug. 1, 1930, pp. 535-537, 23 figs. July 15: Discussion of fundamentals of supercharging and review of principal designs of superchargers; details on Rateau exhaust driven, and Rateau Farman variably geared superchargers; graphs give performance data for both types. Aug. 22: Notes on supercharging of Diesel engines.

The Zoller Supercharger. Autocar (Lond.), vol. 65, no. 1811, July 18, 1930, pp. 130, 4 figs. Notes on design of supercharger driven from crankshaft; mechanical silence is obtained by elimination of gears; sketches show arrangement of blades; output for various sizes varying from 500 to 5,000 ft. deep per revolution for speeds up to 6,000 r.p.m.

AUTOMOTIVE FUELS

ANTI-KNOCK COMPOUNDS. Detonation and Lubricating Oil, R. O. King and H. Moss. Engineering (Lond.), vol. 130, no. 3367, July 25, 1930, pp. 99-101. Review of experimental results; effect of lubricating oil on detonation in practice; effect of lubricating oil and air temperature on matching of fuels of dissimilar composition; application of experimental results to engine lubrication; dispersion and distribution of oil; supercharged engines.

The Use of Water as an Anti-Detonant, G. W. Hobbs and M. L. Fast. Mich. Eng. Experiment Sta.—Bul., no. 31, vol. 1, no. 4, July 1930, 15 pp., 7 figs. Investigation to determine value of water as anti-detonant, and its effect upon actual engine, and ideal cycle, effect of compression ratio upon power efficiency, and air gas ratio.

DETONATION. Methods of Measuring the Anti-Knock Value of Fuels for Internal-Combustion Engines, D. B. Brooks. Motive Power, vol. 1, no. 7, Aug. 1930, pp. 17 and 34. For past two years, Bureau of Standards has been co-operating with seven other laboratories, representing automotive and petroleum industries; programme of tests designed primarily to show how well group of laboratories would agree in rating same set of fuels if they used ideotical equipment and followed same instructions; description of experimental engine. Paper read before Petroleum Technologists of Nat. Petroleum Assn., Washington, D.C.

B

BALANCING MACHINES

THEORY AND DESIGN. Machine for Dynamical Balancing of Rotating Masses (Les machines à équilibrer dynamiquement les pièces tournantes), G. Delanghe. Génie Civil (Paris), vol. 97, no. 8, Aug. 23, 1930, pp. 176-179, 6 figs. Discussion of theory and design of machines built by Mitsubishi; sketches show vibrating bearing of Westinghouse machine.

BEARINGS, BALL

TESTING. Magnetic Hardness Test for Ball Races, H. Sjovall. Metallurgist (Supp. to Engineer, Lond.), Aug. 1930, pp. 121-122, 4 figs. With object of investigating possibilities of developing further methods of magnetic examination, magnetization and hysteresis curves for ordinary ball-bearing steel have been determined; measurements were obtained by ballistic methods with outer races of bearing 1209; results give good idea of manner in which different magnetic properties of steel vary with degree of hardening.

BLAST FURNACES

DESIGN. Technical Progress in Design of High-Capacity Blast Furnaces (Progrès techniques réalisés dans la construction des hauts fourneaux à grande production), M. Derclaye. Revue Universelle des Mines (Liége), vol. 4, nos. 3 and 4, Aug. 1, 1930, pp. 71-80 and Aug. 15, pp. 106-116, 24 figs. Aug. 1: Notes on hearth jackets; mantle brackets, arrangement of columns around furnace; encircling of shaft. Aug.15: Refractory brick; blast-furnace equipment, tuyeres, etc.; charging.

GAS. Mixed Gases Promote Economy in Steelmaking, W. C. Buell, Jr. Steel, vol. 87, no. 8, Aug. 21, 1930, pp. 50, 52, 54 and 56, 2 figs. Data on air preheat and furnace temperature, and blast-furnace-gas preheat; graphs show thermal capacity characteristics of combined air for combustion and blast-furnace gas with gas mixed.

BOILERS

CORROSION. Formation and Properties of Boiler Scale, E. P. Partridge. University of Mich.—Dept. of Eng. Research—Bul., no. 15, June 1930, 170 pp. 21 figs. Complete review of information available up to year 1930 concerning formation and properties of boiler scale; effects of scale upon boiler efficiency and boiler metal temperature; chemical and crystallographic determination of scale constituents; respective solubilities of these constituents in simple solutions, and possibility of calculation equilibria in complex solutions; method and rate of formation of scale; contemporary methods of scale prevention.

DESIGN. Co-efficient of Weakening for Inclined Bolt-Hole Rows of Cylindrical Boilers with Internal Super-pressure (Schwaechungskoeffizient fuer schraege Lochreihen bei zylindrischen Kesseln mit innerem Ueberdruck), A. Korhammer. Waerme (Berlin), vol. 53, no. 29, July 19, 1930, pp. 560-561, 2 figs. Development of graphic process for determination of weakening co-efficients.

FURNACES. Present Status of Boiler Furnaces (Ueberblick ueber den derzeitigen Stand der Dampfkesselfeuerungen), O. Nerfer. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 14 and 15, July 31, 1930, pp. 200-202 and Aug. 15, pp. 213-216. Brief discussion of different fuels and their properties during combustion, followed by notes on design of furnaces and stokers for their use.

Progress in Stoker and Furnace Construction and Results of Tests on Modern Furnaces (Ueber Fortschritte im Rost und Feuerungsbau und Versuchsergebnisse an modernen Feuerungen), R. Schulze. Brennstoff und Waermewirtschaft (Halle), vol. 12, nos. 13-14, July 1-2, 1930, pp. 168-174, 5 figs. By comparison of some entirely modern boiler installations with other 4 to 6 years old, it is shown to what extent modern stokers and furnaces are superior to older types.

HIGH-PRESSURE, FITTINGS FOR. Fittings for Super-Pressure Boilers for 130 Atm. and 500 Deg. Cent. (Armaturen bei Hoechstdruckkesseln), Belohlavek. Waerme (Berlin), vol. 53, no. 28, July 12, 1930, pp. 544-547, 8 figs. Fittings described are employed in all Loeffler boilers and have given satisfaction over period of several years operation.

HIGH PRESSURE (LOEFFLER). Loeffler Boilers Improved. Elec. World, vol. 96, no. 4, July 26, 1930, p. 164, 1 fig. Loeffler boiler for operation at 1,700-lbs. pressure and steam temperature of 932 deg. fahr. was installed at Vitkovice steel works in Czechoslovakia in 1927; success of this boiler led to installation of two more, each with rating of 100,000 lbs. of steam per hr.

Loeffler Boilers in Stationary Plants and on Ships (Der Loeffler-Kessel in ortsfesten und Schiffsanlagen),. F. Englert. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 14 and 15, July 31, 1930, pp. 195-200 and Aug. 15, pp. 209-213, 11 figs. Influence of increase in pressure and temperature on operating conditions and economy of steam power plants; it is shown that Loeffler boiler offers satisfactory solution both technically and economically of problem of superpressure boilers for all fields of application; examples of Loeffler boiler installations are illustrated.

LANCASHIRE. An Improved Lancashire Boiler. Mech. World (Lond.), vol. 88, no. 2279, Sept. 5, 1930, pp. 218-219, 2 figs. Improved Boiler by D. Adamson and Co. was described in this journal, Feb. 10, 1928; brick side flues were eliminated, being replaced by tubes; principle has been further developed in new installation; thermal efficiency by test was 83.24 per cent which compares with usual efficiencies of Lancashire boilers of 60 to 70 per cent; plant is much smaller, more compact, less costly in installation and upkeep, and no high chimney is required.

BOULDER DAM PROJECT

RAILROAD CONSTRUCTION. Boulder Dam Construction Railroad. New Reclamation Era, vol. 21, no. 8, Aug. 1930, pp. 156-157. Outline of projects proposed, including funicular railroad, which will extend from top of canyon, on Nevada side, at elevation 1425, down to elevation 690 at power plant location, below dam; cost estimate, surveys, and work schedules.

BRASS CASTINGS

LEAD CONTENT. Lead in Cast Brass and Bronze, H. C. Dews. Metallurgia (Manchester), vol. 2, no. 9, July 1930, pp. 81-83, 2 figs. Suspicion as to bad effect of lead in brass and bronze is reflected in specifications; insolubility of lead in brass and bronze makes it liable to segregation and liquidation, both in liquid melt and during freezing of alloy; effect of lead on mechanical properties of brass and bronze; main reason for allowing addition of lead to brass and bronze is that improvement in machinability is gained.

BRIDGE PIERS

FOUNDATIONS. Corrugated Steeel Shells in Bored Holes Form New Type Pier Foundations on P. R.R. Bridge. Eng. News Rec., vol. 105, no. 10, Sept. 4, 1930, pp. 366-368, 6 figs. Description of novel method of sinking wells, 80 ft. deep, through Hackensack meadow muck for approach piers of passenger-line crossing over Hackensack river; combination open and pneumatic corrugated steel shells 48 in. and 54 in. in diam. sunk in bored holes belled out to 11 ft. and 12 ft. 3 in. at bottom; detail of piers, boring auger, shaft, muck locks on shells.

KILL VAN KULL. The Substructure of Kill Van Kull Bridge, New York. Engineering (Lond.), vol. 130, no. 3371, Aug. 22, 1930, pp. 227-228, 26 figs. partly on p. 236 and supp. plates. Substructure comprises abutments for arch span, and piers for approaches; two abutments are of concrete and granite masonry, founded upon bed rock and were constructed by use of cofferdams and with floating plant equipment; approach piers are of reinforced concrete, and consist of shafts founded upon footings which rest on bed rock for some piers and on gravel for others.

STRENGTHENING. Repairing the Klodnitz Bridges at Laband (Die Instandsetzung der Klodnitzbruecken bei Laband), Roloff. Bautechnik (Berlin), vol. 8, nos. 27 and 29, June 20, 1930, pp. 428-431 and July 4, pp. 457-460, 19 figs. Description of grouting and concreting operation for reinforcing deteriorated masonry pers.

TESTING. The Effect of a Natural Stone Casing upon the Strength of Concrete Piers (Der Einfluss einer Natursteinverkleidung auf die Festigkeit von Betonpfeilern), Gaber. Beton u. Eisen (Berlin), vol. 29, no. 16, Aug. 20, 1930, pp. 296-301, 10 figs. Report on laboratory test of model of concrete pier of Cologne-Muelheim Bridge over Rhine River; comparison of strength of encased and non-encased concrete piers.

BRIDGES, HIGHWAY

GERMANY. Four New Highway Bridges over the Aller River (Vier neue Strassenbruecken ueber die Aller), Jergens and Huch. Zentralblatt der Bauverwaltung (Berlin), vol. 50, no. 34, Aug. 27, 1930, pp. 600-605, 13 figs. Features of bridges built of concrete and steel trusses with single spans up to 43 m. in length; details of bridge bearings.

BRIDGES, MASONRY ARCH

RECONSTRUCTION. Reconstruction of the Saale Bridge at Merseburg (Umbau der Saalebruecke in Merseburg), Schedler. Zentralblatt der Bauverwaltung (Berlin), vol. 50, no. 30, July 30, pp. 537-539, 9 figs. Report on reconstruction of multiple-arch masonry highway bridge, over 70 m. in total length, with maximum arch span of 13 m. clear; details of strengthening of arches with reinforced concrete; total cost of reconstruction 86,000 marks.

BRIDGES, RAILROAD

RECONSTRUCTION. B. and O. Reconstructs 63 Bridges, P. G. Lang, Jr. Ry. Age, vol. 89, no. 11, Sept. 13, 1930, pp. 533-534, 4 figs. Work of reconstructing and strengthening bridges on Baltimore and Ohio, between Fairmont, W.Va., and Lorain, Ohio, affords outstanding example of application of modern construction methods and expeditious prosecution of construction work under unfavourable weather conditions; rating raised 20 per cent on 290 miles of line.

BRIDGES, STEEL

WELDING. Recent Welded Bridges (Neuere geschweisste Bruecken), R. Bernhard. V.D.I. Zeit. (Berlin), vol. 74, no. 35, Aug. 30, 1930, pp. 1201-1207, 23 figs. Report on design and construction practice followed in three recently completed steel truss and plate girder bridges, in Switzerland and Germany, from 10 m. to 52 m. in length; welding details and features of equipment used; description of X-ray equipment used in testing of completed welds.

WELDING—GERMANY. The First Welded Railroad Bridge for Standard Gauge Trains (Die erste geschweisste Eisenbahnbruecke fuer Vollbahnbetrieb), Schaper. Bautechnik (Berlin), vol. 8, no 22, May 3, 1930, pp. 323-325, 6 figs. Report on fabrication and erection of welded-steel truss bridge, for new railroad line near Muenster, having unsupported span of 10 m.; details of X-ray examination of welds including description of X-ray equipment; static and dynamic tests by means of special apparatus.

BUILDINGS, STEEL

ELECTRIC WELDING. Structural Arc Welding, A. F. Davis. Elec. Specifications, vol. 2, no. 2, Aug. 1930, pp. 30-31, 2 figs. Examples of specifications, if followed in fabrication and erection of steel structures, work will go forward in rapid and efficient manner.

BUNKERS, CONCRETE

DESIGN. Determination of Stresses in Plane Girder Systems (Die Spannungsermittlung in Flaechentragwerken), G. Ehlers. Beton u. Eisen (Berlin), vol. 29, nos. 15 and 16, Aug. 5, 1930, pp. 281-286 and Aug. 20, pp. 291-296, 41 figs. Theoretical mathematical discussion of wall slabs acting as girders of great depth, with special reference to design of reinforced-concrete bunkers, troughs, etc.; illustrative examples.

C

CANALS

WELLAND. New Welland Ship Canal Built for Deep-Draft Vessels. Eng. News Rec., vol. 105, no. 10, Sept. 4, 1930, pp. 356-362, 12 figs. Also note editorial comment on pp. 334, 354 and 355. At cost of more than $120,000,000, fourth canal to be built between Lake Erie and Lake Ontario made Lake Ontario accessible to large vessels used on upper lakes by enlarged canal across Niagara Peninsula in Canada; seven locks overcome head requiring 26 locks in old canal; plan and profile of new canal showing its relation to old canal and natural waterways; details of typical lock, lock walls, lock gates, siphon culverts; gate-operating mechanism, etc.

CARBON DIOXIDE

SOLID, PRODUCTION OF. New Method of Solid Carbon Dioxide Production. Cold Storage (Lond.), vol. 33, no. 389, Aug. 21, 1930, pp. 243-244, 2 figs. Description of "Carba" process, which represents advance of former methods in that ice is compressed as it forms, without exposure to atmosphere and without employment of hydraulic or mechanically operated presses; practical difficulties in application of theory.

THERMAL PROPERTIES. A Characteristic Chart for Solid, Liquid, and Gaseous Carbon Dioxide. Refrig. Eng., vol. 20, no. 1, July 1930, p. 33, 2 charts on supp. plates. Two-page Mollier diagram for carbon dioxide is illustrated and explained; table of physical properties of carbon dioxide is also given.

CAR

RETARDERS. Froelich Hydraulic Car Retarder System. Ry. Signaling, vol. 23, no. 9, Sept. 1930, pp. 329-334, 8 figs. Discussion of design and operating characteristics of system, which is first classification yard in Great Britain to be equipped with Froelich system of hydraulic car retarders, involving semi-automatic switch control and number of other salient features; diagram of hydraulic and braking systems is illustrated; mechanical and electrical apparatus.

CAR LIGHTING

GENERATOR BELTS. Belts vs. Positive Drive for Axle Generators, H. K. Williams. Ry. Elec. Engr., vol. 21, no. 9, Sept. 1930, pp. 273-274. Drive used must take into consideration design of generator and control apparatus; lighting system must not unfit car for service; belt-drive difficulty depends upon torque; top speed limits cut-in speed; qualities of belt drive.

CASE HARDENING

Cyanide Bath. Hardening Steel Commercially by Cyaniding Process, E. F. Davis. Steel, vol. 87, nos. 3, 5, and 7, July 17, 1930, pp. 43-46 and 60, July 31, pp. 47-48 and 53, Aug. 14, pp. 48, 50, and 52, 17 figs. July 17: Outline of history of cyanide, properties and advantages of various grades, and mechanism of hardening process. July 31: Discussion of brittleness of cyanided steels and its relation to cyaniding temperature and quenching methods, cyaniding gears and wire; various advantages and disadvantages of cyaniding as a hardening process. Aug. 14: Description of furnaces and pots for cyaniding, aerocase method, fume prevention, cyanide poisoning, and testing cyanide baths.

CAST IRON

Chilling Properties. Factors Affecting the Chilling Properties of Cast Iron, A. L. Norbury. Foundry Trade Jl. (Lond.), vol. 43, no. 726, July 17, 1930, pp. 44-45, 7 figs. Results are given which illustrate differences in chilling properties that may be obtained from iron of same chemical analysis, while other results illustrate sulphur contents and mould temperatures on chilling properties. Paper presented on behalf of Inst. of Brit. Foundrymen to Pan-European Foundry Congress, Liége, June 1930.

Hardness Testing. The 139-Degree Pyramid Hardness Test on Cast Iron, A. L. Norbury. Brit. Cast Iron Research Assn.—Bul. (Birmingham), no. 29, July 1930, pp. 271-274, 4 figs. Comparison of hardness tests on gray cast iron using 10 mm. Brinell ball and 139-deg. pyramid; effect of size of impression on variations between repeat hardness tests or gray cast iron.

Machinability. Machinability of Cast Iron, E. J. Lowry. Am. Soc. Testing Matls.—Proc., part 2, vol. 29, 1929, pp. 126-127. Paper discusses factors which influence machinability; although machinability of cast iron is function of abrasion, hardness, and ductility, hardness alone cannot be considered as true indicator of machinability since it does nto measure abrasive quality of metal; and influence which tends to eliminate abrasiveness increases machinability such as annealing, higher silicon content, higher carbon content, or addition of nickel, titanium, or any other softening alloy.

Meehanite. Properties of Meehanite Metal—A Pearlitic Iron, A. G. Lambert and F. M. Robbins. Can. Foundryman (Toronto), vol. 21, no. 8, Aug. 1930, pp. 13-15, 3 figs. Outline of development, uses and manufacture of meehanite iron; data on composition and physical properties are given. (To be continued.)

CASTINGS

Shrinkage. Shrinkage of Metals and Alloys (Ueber die Schwindung der Metalle und Legierungen), F. Sauerwald. Giesserei (Dusseldorf), vol. 17, no. 33, Aug. 15, 1930, pp. 793-795, 5 figs. Shrinkage in its relation to expansion coefficient and nature of solidification process is discussed.

CEMENT ADMIXTURES

Data on. Effect of Some Salts, Acids, and Organic Substances on Cement and Concrete (Ueber die Einwirkung einiger Salze, Saeuren und organischer Substanzen auf Zement und Beton), R. Gruen. Zeit. fuer Angewandte Chemie (Berlin), vol. 43, no. 24, June 14, 1930, pp. 496-500, 3 figs. Data on effect of chlorides of calcium, aluminum, iron and barium, hydrochloric acid, aldehydes, sugars, etc., upon time of setting, tensile and compressive strength of portland and blast furnace cements; effect of various concentrations of phosphoric and oxalic acids upon concrete. Bibliography.

CEMENT, PORTLAND

Loam Admixtures. Influence of Loam Admixtures in Sand on Mechanical Properties of Portland Cement Mortar (Der Einfluss der Lehmbeimengungen im Sand auf die mechanischen Eigenschaften des Portlandzementmoertels), G. M. Jeltschaninoff. Zement (Charlottenburg), vol. 19, nos. 24 and 25, June 12, 1930, pp. 556-560 and June 19, pp. 580-585. Review of literature on this subject and results of author's tests (1) to compare influence of loam added to sand in dry state with influences of moist admixtures; (2) to verify R. Gruen's theory that dried loam loses its effective influence after prolonged storage; (3) to determine changes in influence with dried loam admixture after prolonged storage in earth.

Specifications. Moduli Versus Lime Satiation for Computing Portland Cement Compounds, H. Kuehl. Rock Products, vol. 33, no. 18, Aug. 30, 1930, pp. 76-77. Author explains why he introduced silicate modulus and iron modulus, and why previously Michaelis introduced hydraulic modulus; he beleives that for present silicate and iron moduli should be retained and only hydraulic modulus should be replaced by degree of lime saturation. Translated from Tonindustrie-Zeitung, Mar. 20, 1930, previously indexed.

CLUTCHES

Design. Design of Clutches for Internal-Combustion Engines, W. J. Pearmain. Motive Power, vol. no. 6, July 1930, pp. 16-19, 8 figs. Factors of design of spring-loaded clutches; formulae are given for clutch-size determination; practical problems are included.

COAL MINES AND MINING

Mechanization. Direct and Indirect Cost Savings with Mechanized Mining, G. B. Southward. Min. Congress Jl., vol. 16, no. 8, Aug. 1930, pp. 654-655. Direct savings are those made with mechanical loaders, scrapers, and other self-loading devices by eliminating hand labour of shoveling coal, and also with conveyor and pit car loaders by reducing amount of hand shoveling required; indirect savings are those which are made in face preparatory work, gathering, main line haulage, and general items of underground operation and maintenance; discussion of factors influencing amount of savings effected in each case.

The Fallacy of Arguments Against Mechanized Loading, G. B. Southward. Min. Congress Jl., vol. 16, no. 9, Sept. 1930, pp. 721-722. Objections to mechanized loading are met by economic necessity for coal mining to keep pace with modern industrial progress.

The Present and Future Application of Mechanized Loading, G. B. Southward. Min. Congress Jl., vol. 16, no. 7, July 1930, pp. 613-614. Statistical data for 1929; 7.1 per cent of bituminous coal production was mined with some form of mechanized loading; other conclusions are deduced from data.

COLUMNS

Buckling. Buckling of Double Struts Having Parabolically Variable Cross-Section Height (Ueber die Knickung eines doppelwandigen Druckstabes mit parabloisch veraenderlicher Querschnittshoehe), A. Lockschin. Zeit. fuer Angewandte Mathematik und Mechanik (Berlin), vol. 10, no. 2, Apr. 1930, pp. 160-166, 9 figs. Theoretical mathematical discussion of stresses in several types of such struts, under various conditions of fixedness at ends.

COMPRESSORS

Gas. A Seven-Stage Gas Compressor. Engineer (Lond.), vol. 150, no. 3890, Aug. 1, 1930, pp. 118-119, 7 figs. partly on p. 120. Fundamental characteristic of Sulzer hyper-compressor is vertical arrangement of cylinders for sixth and seventh stages; these cylinders are operated hydraulically by means of columns of oil; machine supplied to Compagnie de Bethune, Bully-les-Mines, is designed to deal with effective suction intake of 4,000 to 4,500 cu. m. per hr. at final pressure of 1,000 to 1,100 atmospheres.

CONCRETE

Cost. Nomogram for Determination of Cost of Materials of a Concrete of Certain Mix (Nomogramme zur Bestimmung der Materialkosten einer Betonmischung), Pietrowski. Beton u. Eisen (Berlin), vol. 29, no. 16, Aug. 20, 1930, pp. 301-302, 3 figs. Table and nomograms constructed on basis of theoretical analysis.

Mixing. New Principles of Concrete-Proportioning (Neue Grundlagen der Betonzusammensetzung), O. Stern. Zeit. des Oesterreichischen Ingenieur und Architekten Vereines (Vienna), vol. 82, nos. 31/32, and 33/34, Aug. 1, 1930, pp. 255-257, and Aug. 15, pp. 269-272, 5 figs. on supp. plates, nos. XI, XII and XIII. Outline of Abrams rules combined with Spindel's; graphic method of concrete proportioning; outline of theory of four-axis systems; methods of construction of four-axis diagrams with special reference to concrete proportioning diagram for purpose of attaining a definite concrete consistency.

Slabs, Corrugated. General Theory of Corrugated Plates (Allgemeine Theorie der Faltwerke), H. Craemer. Beton u. Eisen (Berlin), vol. 29, no. 15, Aug. 5, 1930, pp. 276-281, 11 figs. Theoretical mathematical discussion of stresses in prismatic and non-prismatic corrugations, including continuous slabs, bunker bottoms, etc.

CONSTRUCTION INDUSTRY

Costs. Unit Prices from Current Construction Bids. Eng. News-Rec., vol. 105, no. 11, Sept. 1930, pp. 437-438. Unit bids on steel highway bridge and approaches over White river at Clarendon, Ark., estimated at about $1,600,000; asphalt or concrete paving, Sutter Co., Calif.

COPPER ALLOYS

Copper-Silicon. Silicon-Copper Alloys and Silicon Manganese-Copper Alloys, E Voce. Inst. of Metals—Advance Paper (Lond.), no. 543, for mtg. Sept. 9-12, 1930, 31 pp., 16 figs. Survey of alloys, studying their mechanical and physical properties in cast, drawn, and rolled conditions, with view to developing and extending their uses; their resistance to corrosion has received attention, especially in light of development in America of alloys of copper with silicon and manganese in connection with chemical plant.

A New Silicon-Zinc-Copper Alloy, E. Vaders. Inst. of Metals—Advance Paper (Lond.), no. 544, for mtg. Sept. 9-12, 1930, 17 pp., 17 figs. Use of silicon as deoxidizer and as alloying constituent in some copper alloys; preparation of silicon-zinc-copper alloys containing 70-90 per cent of copper and up to 6 per cent of silicon-zinc-copper alloys; mechanical and physical properties and uses of these alloys.

COPPER-NICKEL DEPOSITS

New Brunswick. A Nickel-Copper Deposit in New Brunswick, Canada, B. Low. Eng. and Min. Jl., vol. 130, no. 3, Aug. 9, 1930, pp. 115-118, 6 figs. Brief description of geology and summary of exploration work and of electrical and magnetic survey, undertaken in new district; outline of metallurgical research for treating ore.

COPPER REFINING

Electrolytic. Dimensioning of Baths in Electrolytic Plants and Its Influence on Initial Costs (Die dimensionierung von Baedern in elektrolytischen Grossanlagen und ihr Einfluss auf die Anlagekosten), F. Vogel. Metallboerse (Berlin), vol. 20, nos. 58, 60 and 62, July 19, 1930, pp. 1601-1602, July 26, pp. 1656-1658 and Aug. 2, pp. 1714-1715. Discussion is based on experiences of some copper-refining plants; in none of examples cited, with exception of old Great Falls plant, is there any indication that, in design of bath, consideration was given to relation of bath size to entire plant; importance, however, of this factor, was demonstrated.

CRANES

Control. Energy Required for Stopping of Cranes with Swinging Load (Erforderligt arbete for bromsning av kranar med pendlande upphangning av lasten), J. Bjorklund. Teknisk Tidskrift (Stockholm), vol. 60, no. 33, Aug. 16, 1930 (Mekanik), pp. 97-112, 22 figs. Studies of cranes with swinging loads show that braking power needed usually is less and sometimes considerably less than combined kinetic energies of crane and load; method used and formulae derived are compared with Lagrange's equations and are shown to be sufficiently exact for practical purposes.

Design. Crane Runway Columns Reviewed, R. Fleming. Eng. News-Rec., vol 105, no. 10, Sept. 4, 1930, pp. 369-370, 2 figs. General discussion of design of heavy-duty steel cranes; bending-moment diagrams for crane columns; brackets are unsatisfactory for loads over 10 tons.

D

DAMS

Concrete Arch—Montana. Gibson Dam—Sun River Project—Montana, R. Lowry. New Reclamation Era, vol. 21, no. 8, Aug. 1930, pp. 152-156, 3 figs. Description of concrete-arch dam having maximum height of 195 ft., crest length of 960 ft., containing 161,000 cu. yds. of concrete; spillway, consisting of combined circular shaft and tunnel, both 29 ft. 6 in. in diam., is designed to discharge 50,000 sec. ft.; methods of construction and cost data.

Construction—Crushed Stone Plants. Crushing and Grinding Plant at the Esla Dam in the Province of Tamora, Spain (Die Brech und Mahlanlage der Esla Talsperre, Provinz Tamora, Spanien), A. Bonwetsch. V.D.I. Zeit. (Berlin), vol. 74, no. 35, Aug. 30, 1930, pp. 1211-1214, 16 figs. Layout and equipment of crushing plant for granite rock with individual pieces up to 1 ton in weight, having hourly output of 2,000 cu. m.; description of roller mills having capacity of 30 cu. m. per hr.; design of conveyor system having total length of 380 c. with inclines up to 35 per cent.

Gravity—Anchors. Improvement of Gravity Dams by Means of Steel Anchoring Rods (Perfectionnements aux barrages-poids par l'adjonction de tiges en acier), A. Coyne. Génie Civil (Paris), vol. 97, no. 8, Aug. 23, 1930, pp. 186-187, 3 figs. Author proposes use of extension rods imbedded to depth of about 10 m. in bedrock, under dam foundation, and extending as far as top of dam; analysis of effects such system of reinforcement might have on stability of Assuoan Dam, Egypt, and Cheurfas Dams in Algeria.

DIE CASTING

Dies for. Correct Design and Heat Treatment of Steel Dies for Die Castings, R. L. Johnson. Iron Age, vol. 546-548 and 576. Discussion of important points of mechanical design; chemical composition and heat treatment of alloy steel dies; die life is from 15,000 to 200,000 castings.

Practice. Influence of Casting Practice on Physical Properties of Die Casting, C. Pack. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 346, for mtg. Sept. 1930, 14 pp., 7 figs. Outline of some factors in commercial die-casting practice, to which variations in physical properties may be attributed.

Modern Die-Casting Practice, E. V. Pannell. Engineer (London), vol. 150, nos. 3892 and 3893, Aug. 15, 1930, pp. 168-169, and Aug. 22, pp. 193-194, 2 figs. Aug. 15: Survey of present status of art of casting non-ferrous metals by pressure; modern factory devoted to production of die casting will consist mainly of five departments: (1) metal melting, (2) die casting, (3) trimming, (4) enameling and plating, (5) die making, die-casting machines. Aug. 22: Steel moulds or dies used in die-casting industry; metals and alloys

Pressure Castings. Compressed Metals (Les Métaux comprimés), G. Batta and J. Dessent. Revue Universelle des Mines (Liége), vol. 73, no. 5, Mar. 1, 1930, pp. 133-135, 6 figs. Greater resistance has been developed by employing method of making castings under pressure and by compression; these methods impart to non-ferrous alloys properties of laminated material; first process greatly improves quality of metal giving it fine grained structure, but does not remove danger of air bubbles; second method does not have this defect but must be used only on very pure metal, otherwise malleability is reduced and cracks appear.

DIESEL-ELECTRIC LOCOMOTIVES

India. Diesel-Electric Locomotives for the Indian State Railways. World Power (Lond.), vol. 14, no. 80, Aug. 1930, pp. 130-132 and 135, 5 figs. Diesel vs. steam locomotives; mechanical construction; design features and principal data; Diesel engine characteristics; electrical and auxiliary equipment.

DIESEL-ELECTRIC POWER PLANTS

Berlin. Two 11,700-Hp. Diesel Engines Carry Peak Loads, F. J. Taylor. Power Plant Engr., vol. 34, no. 17, Sept. 1, 1930, pp. 979-981, 7 figs. Large Diesel engines installed in Berlin are characterized by compactness, simplicity of design, and effective scavenging; general plan of station showing relative location of two 11,700-hp. M.A.N. engines and auxiliary apparatus; cross sections of engine showing general conformance to standardized M.A.N. design; generators used as phase regulators; compressed-air type coupling.

DIESEL ENGINES

Compressorless. Tests on Compressorless Diesel Engines (Versuche an einer Kompressorlosen Dieselmaschine), F. Schmidt. V.D.I. Zeit. (Berlin), vol. 74, no. 33, Aug. 16, 1930, pp. 1151-1154, 6 figs. Investigation of effect of friction, cooling, and throttling on fuel consumption at different revolutions and load; determination of indicated efficiency and efficiency of ideal engine by means of exact measurement of air quantity; description of test set up and test data are given.

Fuels. New Comparative Tests of Vegetable and Mineral Oils in Diesel Engines (Nouveaux essais comparatifs des huiles végétales et minérales dans les moteurs diesel), M. Gautier. Revue des Combustibles Liquides (Paris), vol. 8, no. 76, June-July 1930, pp. 258-263, 9 figs. Investigation of behaviour of vegetable oil, such as peanut oil and palm oil, in Diesel engines and their effects on engine performance and combustion character.

Maintenance and Repair. Diesel Engine Upkeep. Power Plant Eng., vol. 34, no. 18, Sept. 15, 1930, pp. 1041-1044, 8 figs. Crankshaft repair methods; method of removing lower boxes without taking out shaft; effects of misalignment; description of various methods for checking crankshaft alignment. (Continuation of serial.)

Scavenging. Studies of Diesel Engines—Scavenging and Charging Phenomena in Two-Cycle Engines (Untersuchungen an der Dieselmachine), K. Neumann. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 334, 1930, pp. 1-20, 23 figs. See also V.D.I. Zeit. (Berlin), vol. 74, no. 32. Aug. 9, 1930, ppp. 1109-1119, 13 figs. Experiments with Junkers opposed-piston engine equipped with special scavenging pump; test data are used as basis for mathematical investigation of scavenging phenomena; typical indicator diagrams are given.

Vibrations. Torsional Deflection in Diesel Crankshafts. Power, vol. 72, no. 7, Aug. 12, 1930, pp. 248-250, 6 figs. Outline of results of tests made recently at Oregon State College to determine difference in crankshaft distortion between load and no load.

DIPHENYL

Properties and Uses. Diphenyl May Solve Reheating Problem, G. B. Cunningham. Power, vol. 72, no. 10, Sept. 2, 1930, pp. 374-377, 1 fig. Physical and chemical properties indicate commercial success as medium for reheating steam to full initial temperature in high-pressure plants; table of physical properties of diphenyl is given; diphenyl has been used for two years in oil-refining process; welded piping is preferred; summary of diphenyl's advantages.

DRAINAGE CANALS

Erosion and Silting. Erosion and Silting of Dredged Drainage Ditches, C. E. Ramser. U.S. Dept. of Agric.—Tech. Bul., no. 184, June 1930, 54 pp., 68 figs. partly on supp. plates. Report on measurements and observations made between 1913 and 1921, on 22 dredged drainage ditches in Mississippi, Tennessee and Iowa; relation of velocity to erosion and silting; conditions affecting erosion and silting in channel: vegetation, caving and sloughing banks, backwater, variation in water stages, enlargement of cross section, silt charge in streams, variation in fall of channels, and volume of run-off water; effect of erosion and silting on discharge capacity of channel; application of results.

DURALUMIN

Aging. The Artificial Aging of Duralumin and Super-Duralumin, K. L. Meissner. Inst. of Metals—Advance Paper (Lond.), no. 533, for mtg. Sept. 9-12, 1930, 28 pp., 21 figs. Effect of aging from 50 to 200 deg. cent. upon two commercial duralumin alloys and upon super-duralumin (duralumin with addition of silicon) were investigated; effect of artificial aging consists, after initial softening at lower temperatures, mainly in raising yield point, while tensile strength is influenced only slightly; elongation, flexibility, and other cold-working properties are decreased markedly; tensile strength of super-duralumin is raised, but rise keeps behind that of yield point, relatively.

E

ELECTRIC CABLES

Terminals. Why Buy Single Conductor Cable for Type H Terminals? E. F. Nuezel. Elec. World, vol. 96, no. 9, Aug. 30, 1930 ,pp. 398-399, 7 figs. Construction of type "H" cable lends itself very satisfactory to single-conductor terminal construction which does not necessitate use of single-conductor cable and yet has all of reliability with none of disadvantages of present single-conductor cable methods.

ELECTRIC CIRCUIT BREAKERS

Oil. Calculation of Mechanical Performance of Oil Circuit Breakers, A. C. Schwager. Am. Inst. Elec. Engrs.—Advance Paper, no. 30-149, for mtg. Sept. 2-5, 1930, 8 pp., 18 figs. Methods of calculating mechanical performance of typical rotary type oil circuit breaker, operated by spring actuated motor control; for given spring characteristic motion of breaker is predicted, time required to reach any position and speed at that position is calculated; general formulae are set up; mechanical test is performed on specific breaker and comparison made between calculated and tested results.

ELECTRIC DISCHARGE

Polarity. The Influence of Polarity on High-Voltage-Discharges, F. O. McMillan and E. C. Starr. Am. Inst. of Elec. Engrs.—Advance Paper, no. 155, for mtg. Sept. 2-5, 1930, 11 pp., 18 figs. Experimental investigation in which particular attention is given to those discharges used in high-voltage measurements; theory of formation of Lichtenberg figures is given together with experimental evidence upon which it is based; polarity indicator utilizing visual Lichtenberg figures; explanation of influence of polarity on spark-over is proposed.

ELECTRIC GENERATORS

Design. Large Three-Phase Generators (Grosse Dreiphasen-Generatoren), E. Hunziker. Schweiz. Elektrotechnischer Verein (Association Suisse des Electriciens) —Bul. (Zurich), vol. 21, no. 14, July 22, 1930, pp. 445-455, 9 figs. Present need of increasing capacity of turbo-generator units and generators for hydraulic plants; it is shown how requirements can be met on basis of developments so far; perspectives on basis of experience gained; factors which at present limit further extension of capacity of such generators. Paper read before World Power Conference, Berlin.

ELECTRIC INSULATORS

Porcelain. The Communication System of the Southern California Edison Company, Ltd., R. B. Ashhrook, and F. B. Doolittle. Am. Inst. Elec. Engrs.—Advance Paper, no. 150, for mtg. Sept. 2-5, 1930, 11 pp., 17 figs. General description of Southern California Edison Company's communication system which not only meets requirements of load dispatching but also serves to bring out close co-operation between outlying district forces and division headquarters; detail of development and construction by Company of Serjdetour arrester made public for first time standardized assemblies of telephone equipment.

ELECTRIC LIGHT AND LIGHTING

Design. The Production of Uniform Illumination Over Large Areas, H. R. S. McWhirter. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 404, Aug. 1930, pp. 1012-1017, 9 figs. It is shown that when planning lighting system for large "working plane" using standardized industrial reflector (B.S.S. No. 232-1926) it is better to place lamps over centres of contiguous rhombuses than over centres of contiguous squares of equal area; new definition is proposed for term of "spacing ratio."

ELECTRIC LINES, HIGH TENSION

Alignment Charts. Transmission Line Nomographs, C. A. Kulmann. Elec. West, vol. 65, no. 3, Sept. 1, 1930, pp. 142-143, 1 fig. Graphical solution for obtaining numerical value of surge admittance in second term of current-characteristic equation.

Calculation. Calculation of Long High-Voltage Transmission Lines (Zur Berechnung langer Hochspannungsleitungen), I. Schwarzkopf. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 31, Aug. 3, 1930, pp. 725-728, 3 figs. Method for long lines on principles applied in method for short lines; complex quantities are avoided and method is suitable for planning purposes and for judgment of operating characteristics.

Construction Features. Construction Features of a Long Transmission Line, A. E. Davison. Elec. News (Toronto), vol. 39, nos. 16 and 17, Aug. 15, 1930, pp. 51-53 and Sept. 1, pp. 38-40, 6 figs. Design features and methods of constructing 200-mi. 220,000-volt single-circuit line from point on Ottawa River near Fitzroy Harbour to Leaside, suburb of Toronto.

ELECTRIC MACHINERY

Welding. Electric Welding in Modern Electric Machinery Manufacture (Die Elektroschweissung im modernen Elektromaschinenbau), G. L. Meyfarth. Schweiz. Elektrotechnischer Verein—Bul. (Zurich), vol. 21, no. 16, Aug. 22, 1930, pp. 533-546, 21 figs. Electric arc welding is superior to gas welding as heat transmitted to large work pieces is less and no warping results in good designs; illustrations of welded electric machinery parts are given; economic importance of this manufacturing method for Swiss industry is pointed out.

ELECTRIC MOTOR-GENERATORS

Industrial Application. Industrial Applications of Motor-Generators, E. C. Diffenbach. Power, vol. 72, no. 10, Sept. 2, 1930, pp. 378-381, 7 figs. Motor-generator sets have become one of power-application engineer's most useful tools; they provide methods of control otherwise impossible for wide-range speed adjustment, and for reversing and precision drives; some of advantages of generator-voltage control are listed.

ELECTRIC MOTORS

Alternating Current—Control. A New System of Speed Control for A.C. Motors. Power, vol. 72, no. 8, Aug. 19, 1930, pp. 282-285, 8 figs. Constant-speed squirrel-cage induction motor supplies base speed, while d.c. motor, usually of much smaller size than former, is used to vary speed from base; this system is being used on power house auxiliary applications in several stations; curves illustrating comparative efficiencies of various systems of speed control as applied to coal pulverizers.

Induction. New Single Phase Clutch Type Induction Motor, H. D. Else. Power Plant Eng., vol. 34, no. 18, Sept. 15, 1930, pp. 1052-1053, 4 figs. Description of design features together with operating characteristics of clutch motor placed on market by Westinghouse Electric and Mfg. Co.; advantages of this type of drive.

Protection. Motors Need Not Stop When Voltage Dips, D. W. McLenegan. Elec. World, vol. 96, no. 10, Sept. 6, 1930, pp. 433-436, 2 figs. Time-delay devices are available to prevent instantaneous under-voltage releases from interrupting production when voltage dips momentarily.

Speed Regulation. Speed Controls for D.C. Motors, L. F. Miller. Elec. World, vol. 96, no. 9, Aug. 30, 1930, pp. 400-404, 9 figs. Advantages and disadvantages of each system so as to make possible easier selection of proper method for any desired application.

Squirrel Cage. Current-Displacement Motors (Stromverdraengungsmotoren), F. Niethammer. V.D.I. Zeit. (Berlin), vol. 74, no. 35, Aug. 30, 1930, pp. 1193-1200, 19 figs. Current displacement or double squirrel-cage and eddy current rotor electric motors are discussed; advantageous conditions in starting of these motors, i.e., 4- to 6-fold increased rotor resistance in starting and its small value under actual running conditions, are indicated.

Starting. Large Alternating-Current Motors with Centrifugal Starters, P. Suter. Brown Boveri Rev., vol. 17, no. 9, Sept. 1930, pp. 283-284, 4 figs. Sale of Brown-Boveri motors with centrifugal starters has continuously increased from year to year; altogether some 37,000 motors of this type are now in operation; features of starting and details of starting device are given.

ELECTRIC NETWORKS

Grounding. Critique of Ground Wire Theory, L. V. Bewley. Am. Inst. Elec. Engrs.—Jl., vol. 49, no. 9, Sept. 1930, pp. 780-784, 13 figs. Work of previous investigators is briefly reviewed, and limitations of their premises pointed out; generalized theory of ideal ground wires; probability of line's being hit; method for computing effect of successive reflections to calculation of potentials on line and ground wires; effect of ground wires on attenuation, telephone interference, zero-phase sequence reactance, corona and reduction in surge impedance due to introduction of extra ground wires; three mathematical appendices are given.

Interconnected. Problems Resulting From Interconnection of Electric Networks (Betrachtung einiger durch den Zusammenschloss elektrischer Netze bedingter Probleme), F. Grieb. Schweiz. Elektrotechnischer Verein (Association Suisse des Electriciens)—Bul. (Zurich), vol. 21, no. 15, Aug. 7, 1930, pp. 485-505, 28 figs. Engineering problems to be solved in parallel operation of power systems, i.e., short-circuit and ground protection; stability in normal operation, and in case of trouble; load distribution is discussed and analyzed.

ELECTRIC POWER INDUSTRY

Canada. One Hundred Millions a Year for Power Plant Construction, D. M. Marvin. Elec. News (Toronto), vol. 39, no. 17, Sept. 1, 1930, pp. 41-43, 1 fig. Power projects now under development in Canada will necessitate expenditure of more than one hundred million dollars per year during each of next three years; present turbine installation averages 583 hp. per thousand of population; distribution of water-power sites.

ELECTRIC REACTORS

Design. Calculation of Iron-Core Reactors with Large Time Constant (Die Berechnung von Eisendrosseln mit grosser Zeitkonstante), F. Emde. Elecktrotechnik und Maschinenbau (Vienna), vol. 48, no. 21, May 25, 1930, pp. 521-530, 7 figs. Mathematical design analysis pertaining to development of basical equations; computation of dimensions, and electro-magnetic quantities.

ELECTRIC SUBSTATIONS

Industrial—Lightning Protection. Lightning Protection for Industrial Substations, H. M. Towne. Indus. Eng., vol. 88, no. 8, Aug. 1930, pp. 421-424, 3 figs. Improvements in protective performance of lightning arrester; application of protective equipment to small industrial plants; economies effected by proper application of principles underlying lightning protective problem.

Rectifier. Montreal Tramways Installs Third Automatic Rectifier Substation, M. L. De Angelis. Elec. Ry. Jl., vol. 74, no. 10, Sept. 1930, pp. 577-580, 7 figs. Following successful use of mercury-arc rectifiers with full automatic control for more than three years, Montreal system continues expansion of its power supply with similar equipment, but with many distinctive features; sectional views of rectifier substations which is held to small over-all dimensions without sacrifice of accessibility.

Remote Control. Miniature Remote Control, J. P. Garvin. Elec. Jl., vol. 27, no. 6, June 1930, pp. 327-329, 2 figs. Equipment described extends maximum economical distance between generating plant and substation without supervisory control equipment.

ELECTRIC TESTING APPARATUS

High Tension. Equipment for Testing and Measurement of High-Voltage Installations (Einrichtung zum Pruefen und Messen von Hochspannungsanlagen), K. Taeuber. Elektrotechnische Zeit. (Berlin), vol. 51, no. 32, Aug. 7, 1930, pp. 1125-1128, 6 figs. Testing equipment in use on electrified sections of railroads in Bavaria also can save widespread application for light and power networks; use is made of transformer with resistance on low-tension side; possibilities of small size and portable arrangement of same equipment are discussed.

ELECTRIC TRANSFORMERS

Design. Numerical Conception of Field Strength in Leakage Spacings (Rechnerische Erfassung der Feldstaerken in Streuraeumen), R. Liebold. Elektrotechnik u. Maschinenbau (Vienna), vol. 48, no. 3, Jan. 19, 1930, pp. 53-56, 5 figs. Mathematical development of approximately exact equations for field strength along leakage path of transformers; equations are verified by experiments.

ELECTRIC WAVES

HARMONICS. A Power-Factor Treatment of Non-Sinusoidal Current Waves, F. B. Vogdes. Gen. Elec. Rev., vol. 33, no. 9, Sept. 1930, pp. 519-521, 6 figs. Non-sinusoidal waves resultant of two or more sinusoidal waves with or without d.c. component; mathematical and graphical analysis of sinusoidal and non-sinusoidal waves combined; illustrated by three dimensional vector model.

ENGINEERING RESEARCH LABORATORIES

GREAT BRITAIN. New Engineering Laboratories at University College, Nottingham. Engineer (Lond.), vol. 150, no. 3888, July 18, 1930, p. 71, 6 figs. partly on p. 70. Accounts of chief points of technical interest in laboratories, and illustrating some of principal machinery for power production and distribution.

EVAPORATION

THEORY. Heat Transmission, Diffusion, and Evaporation (Waermeuebergang, Diffusion, und Verdunstung), W. Nusselt. Zeit. fuer Angewandte Mathematik und Mechanik (Berlin), vol. 10, no. 2, Apr. 1930, pp. 105-121, 2 figs. Theoretical mathematical discussion with special reference to study of heat transmission by means of models; evaporation of water under various wind and temperature conditions; application of theory to design of cooling towers.

F

FANS

TESTING. The Characteristics of Two-Blade Propeller Fans, H. L. Dryden and P. S. Balif. U.S. Bur. of Standards—Jl. of Research, vol. 5, no. 1, July 1930, pp. 185-211, 31 figs. Seven 2-blade propeller fans, 8 ft. in diam. and of pitch diam. ratios 0.250, 0.375, 0.500, 0.625, 0.750, 0.938, and 1.063, respectively, were tested in duct especially constructed to simulate operating conditions encountered in cooling towers; each fan was tested for two operating conditions; with fan operating as blower, and with fan exhausting air from duct.

FLOORS, CONCRETE

STEEL CELLS. Steel Cellular-Floor Construction (Stahlzellendecke). Zentralblatt der Bauverwaltung (Berlin), vol. 50, no. 19, May 14, 1930, pp. 358-359, 5 figs. Corrugated steel units described are intended to replace more usual hollow tiles in concrete-floor construction; each weighs about 9 lbs.

FLOW OF STEAM

ORIFICES. Discussion of the Flow of Steam through Orifices and Nozzles and the Pressure Drop in Steam Pipes, G. E. Reed. Nat. District Heat. Assn.—Bul., vol. 15, no. 4, July 15, 1930, pp. 176-185, 4 figs. Paper deals principally with underlying principles of orifices and derivations leading to formula for orifice size calculation; theoretical curve of steam flow through cylindrical orifices is illustrated.

FLOW OF WATER

CURVED CHANNELS. Recent Experiment on Flow of Water in Curved Channels (Neuere Versuche Ueber den Stroemungsvorgang in Gekruemmten Kanaelen), H. Nippert. Bauingenieur (Berlin), vol. 11, no. 5, Jan. 31, 1930, pp. 76-79, 9 figs. Report on author's laboratory experiments made in Department of Hydro-mechanics of Danzig Institute of Technology; distribution of velocity in cross-section of curved circular pipe; eddying, distribution of velocities, and loss of head in rectangular bend and in 90-deg. curves rounded with various radii of curvatures.

FORGINGS

NICKEL ALLOY. Nickel Alloy Steel Forgings, C. McKnight. Am. Soc. for Steel Treating—Trans., vol. 18, no. 2, Aug. 1930, pp. 129-140 and (discussion) 140-146, 5 figs. Large forgings constitute important and constantly increasing field for alloy steel; data published by Society of Automotive Engineers on properties, analysis, and heat treatments of alloy steel are standard, but not applicable to large forgings as based on tests made on one inch bars; paper deals briefly with manufacture, uses, analysis, heat treatment, and properties of nickel alloy steel forgings larger than four inches in diameter or equivalent section.

FURNACES

INDUSTRIAL, OIL-FIRED. Industrial Heating with Heavy Oils (Le chauffage industriel aux huiles lourdes). Technique Moderne (Paris), vol. 22, no. 14, July 15, 1930, pp. 498-502, 5 figs. Discussion of application of heavy oils for various industrial processes; steam generation, heat-treating furnaces, blast furnaces, and ceramic furnaces; advantages, operations, and design of various types of equipment.

MELTING, PULVERIZED-COAL-FIRED. The Rotary Furnace for Iron Founding, A. Le Thomas. Metallurgist (Supp. to Engineer, Lond.), Aug. 1930, pp. 119-120. Analysis of relative merits of new type and of cupola; account of horizontal cylindrical type of melting furnace fired with pulverized coal; flame from pulverized-fuel burner enters through aperture in one of conical ends of furnace; main advantages claimed are that iron produced is practically unaltered by melting process. Abstract translated from Revue de Métallurgie, May 1930.

G

GASOLINE ENGINES

COMBUSTION. Following Combustion in the Gasoline Engine by Chemical Means, L. Withrow, W. G. Lovell and T. A. Boyd. Indus. and Eng. Chem., vol. 22, no. 9, Sept. 1930, pp. 945-951, 11 figs. Measurements have been made of oxygen concentration in gases withdrawn from cylinder of gasoline engine with new and improved sampling valve which was located at different places in combustion chamber and opened at different times during combustion of charge.

GEOPHYSICAL EXPLORATION

ELECTRIC. Geoelectric Prospecting for Ore, A. Zabelli. Min. Jl. (Lond.), vol. 170, no. 4955, Aug. 9, 1930, pp. 641-642. Natural geoelectric currents, and their use in search for sulphur deposits; oscillatory currents artificially produced in ground, and their use in search for insulating minerals such as sulphur and petroleum. Read before International Congress of Mines, Metallurgy and Applied Geology of Liége.

GRINDING WHEELS

BALANCING. New Dynamic Balancing Machine for Grinding Wheels (Eine neue dynamische Soder-Auswuchtmaschine fuer schleifscheiben), D. Hofmann. Werkstattstechnik (Berlin), vol. 24, no. 16, Aug. 15, 1930, pp. 436-440, 17 figs. Principles and operation of machines built by Hessischen Maschinenfabrik Robert Kunze, Darmstadt; grinding wheel is clamped down on rotating disc and after balancing, centre is cast before removing clamps; sketches show principal details.

H

HARDNESS TESTING

PENDULUM TESTS. "Pendulum" Hardness Tests of Commercially Pure Metals, D. A. N. Sandifer. Inst. of Metals—Advance Paper (Lond.), no. 529, for mtg. Sept. 9-12, 1930, 29 pp., 8 figs. Investigation limited to metallic elements; description of 24 metals tested and of hardness tester; conversion to Brinell hardness numbers; definition of time work-hardening capacity; relation between time hardnesses for different pendulum lengths; relation between scale hardness and scale work-hardening capacity; relations between time hardness, Young's modulus, and relative atomic volume; effects of rolling and of impurities.

HEAT-INSULATING MATERIALS

FLOW OF HEAT. Transient Flow of Heat Through Insulation, A. R. Stevenson, Jr. and H. L. Bojer. Refrig. Eng., vol. 20, no. 1, July 1930, pp. 23-29, 5 figs. Theoretical mathematical analysis of heat flow with special application to variation of temperature in refrigerator; tests on transient heat flow; test with box cooled by refrigerating unit; equation for transient temperature when refrigeration is shut off.

HEAT TRANSMISSION

CONVECTION. The Calculation of Convection Heat Transfer, M. Fishenden and O. A. Saunder. Engineering (Lond.) ,vol. 130, no. 3369 and 3370, Aug. 8, 1930, pp. 177-180, and Aug. 15, pp. 193-194, 7 figs. Aug. 8: Application of principle of similarity to convection; forced convection. Aug. 15: Natural convection; vertical planes; effects of shape and position on natural convection. Communication from Fuel Research Division, Dept. of Sci. and Indus. Research.

COOLING TOWERS. Heat Transmission, Diffusion and Evaporation (Waermeuebergang, Diffusion und Verdunstung), W. Nusselt. Zeit. fuer Angewandte Mathematik und Mechanik (Berlin), vol. 10, no. 2, Apr. 1930, pp. 105-121, 2 figs. Theoretical mathematical discussion with special reference to study of heat transmission by means of models; evaporation of water under various wind and temperature conditions; application of theory to design of cooling towers.

HIGH BUILDINGS

STEEL VS. CONCRETE. Steel vs. Reinforced Concrete in Construction of High Buildings (Stahl oder Eosenbeton im Hochhausbau), R. Frab. Montanistische Rundschau (Vienna), vol. 22, no. 14, (Supp.), July 16, 1930, pp. 49-50. Relative merits of two building materials are compared, and conclusion is reached that steel construction is preferable.

HIGH SPEED STEEL

ANNEALING PHENOMENA. Influence of Nickel and Manganese on Properties of High-Speed Steel (Ueber den Einfluss von Nickel und Mangan auf die Eigenschaften von Schnelldrehstahl), V. Ehmcke. Archiv fuer das Eisenhuettenwesen (Duesseldorf), vol. 4, no. 1, July 1930, pp. 23-35, 21 figs.; see also brief abstract in Stahl u. Eisen, vol. 50, no. 32, Aug. 7, 1930, pp. 1131-1132, 21 figs. Contribution to solution of annealing phenomena in high-speed steel and its adaptability as heat-resisting steel; results of hardening and annealing tests; dilatometric tests; influence of nickel and manganese additions.

HYDRO-ELECTRIC POWER DEVELOPMENTS

ONTARIO. Hydro-Electric Power in Ontario. Engineering (Lond.), vol. 130, no. 3370, Aug. 15, 1930, pp. 207-208. Review of 22nd annual report of Hydro-Electric Power Commission of Ontario for year ending October 31, 1929; electricity generated during year was 23 per cent greater than in 1927-28; number of generating stations operated by Commission increased by ten.

HYDRO-ELECTRIC POWER PLANTS

MALAY. The Perak River Hydro-Electric Power Scheme. Engineer (Lond.), vol. 150, no. 3893, Aug. 22, 1930, pp. 190-192, 13 figs. partly on supp. plate and p. 202. With view to supplying its numerous tin mines with power, Perak River Hydro-Electric Power Co. was formed in 1926; Chenderoh power station is situated at point where river flows between two high banks; dam is hollow reinforced-concrete structure of Ambursen type; Taintor gates consist of skin plate bent to radius of 20 ft.; power house contains three vertical-shaft Francis turbines each coupled to 9,000-kw. generator.

NOVA SCOTIA. A Complete Automatic Hydro-Electric System, C. S. Rickards and D. V. Canning. Elec. News (Toronto), vol. 39, no. 17, Sept. 1, 1930, pp. 31-32 and 36, 3 figs. Description of largest automatic plant in Canada; upper station is equipped with two 3,000-hp. turbines and two generators 3,000-kv., 60-cycle, 6,600 volts; details of two other stations also given.

PUMPED STORAGE. The Development of Pump-Fed Storage Power Stations in Germany. Eng. Progress (Berlin), vol. 11, no. 3, Aug. 1930, pp. 205-206, 5 figs. Installations briefly described; Escher-Wyss storage pump for power input of 27,000 hp. for Niederwartha plant; vertical shaft Escher-Wyss storage pump for power input of 8,000 hp. for Leitzach plant; Voith spiral turbine of 48,000 hp. rated capacity for Herdecke plant; Voith-Sulzer pump for power input of 36,000 hp.; Voith-Foettinger hydro-mechanical coupling.

I

IMPACT TESTING

NOTCHED BAR. Critical Investigation of Notched-Bar Test According to Kr K 100 in Regard to Suitability for Testing of Drawn Metals (Kritische Untersuchung des Schlag-Kerb-Faltversuchs nach Kr K 100), F. Saeftel and H. Rudolph. Automobiltechnische Zeit. (Berlin), vol. 33, no. 20, July 1930, pp. 492-496, 4 figs. Discussion of objectionable features of bending test; table shows effect of various factors upon maximum bending angle; notes on dimensions of notches and tools used for making notches.

INDUSTRIAL PLANTS

ELECTRIC POWER FOR. Power Plant for Modern Factories (Une Centrale d'Usine Moderne), P. Mensier. Société des Ingénieurs Civils de France—Mémoires et Compte Rendu des Travaux (Paris), vol. 83, no. 3-4, 1930, pp. 280-324, 18 figs. Notes on economic production of power in factory which consumes large quantities of steam in production process; steam distribution at various pressures; bleeding turbines and boiler feedwater; detailed study of clothing and dyeing plant in Tourcoing in need of 2,000 kw. and steam for heating at 6 and 3 kg. pressure; equipment installed for driving of 1,800-kw. turbo-generator of 30-kg. pressure.

INTERNAL-COMBUSTION ENGINES

AIR FILTERS. The Efficiency of Air Filters for Internal-Combustion Engines, W. E. Gibbs, A. Brandt and M. L. Nathan. Engineering (Lond.), vol. 130, no. 3371, Aug. 22, 1930, pp. 221-223, 7 figs. Principles governing action of air filters; principle of centrifugal separation is employed in two types, cyclone and perforated-baffle type; filters chosen to represent these are representative cyclone model and Visco RM filter; their efficiencies have been determined; superior efficiency of Visco filter is due to much smaller radius of curvature imparted to air stream, combined with greater proximity of depositing surface, which results from closeness of perforated plates to one another.

EFFICIENCY. Investigation on Volumetric Efficiency of Two-Cylinder Two-Cycle Engine with Crankcase Compression (Untersuchung ueber den volumetrischen wirkungsgrad an einem Zweizylinder-Zweitaktmotor mit Kurbelkammergemischpumpe), F. Buchholz, L. Hoffmann, and K. Joachimssohn. Automobiltechnische Zeit. (Berlin), vol. 33, no. 21, July 31, 1930, pp. 505-510, 8 figs. Determination of volumetric efficiency at vacuum of from 0 to 1,200 mm. water between 800 and 2,000 r.p.m. by direct measurement of air quantity and by calculating air quantity from fuel consumption and exhaust-gas analysis.

HIGH-SPEED. Requirements and Problems of High Speed in Piston Engines (Anforderungen und Problems des Schnellaufs bei Kolbenmaschinen), F. Modersohn. Maschinenbau (Berlin), vol. 9, no. 14, July 17, 1930, pp. 465-470, 18 figs. Discussion of factors determining life of vital parts of high-speed engine; materials, accuracy, surface property, and lubrication; typical cases of wear are illustrated by micro-photographs.

TWO-CYCLE. Working Process of High-Speed Two-Cycle Carburetor Engines (Das Arbeitsverfahren raschlaufender Zweitaktvergaser-Maschinen), O. Kluesener. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens (Berlin), no. 334, 1930, pp. 21-46, 47 figs.; see also V.D.I. Zeit. (Berlin), vol. 74, no. 33, Aug. 16, 1930, pp. 1154-1156, 13 figs. Investigation of process in two-cycle engines with crankcase compression; report on scavenging tests and combustion velocity at speeds up to 3,500 r.p.m.; complete thermal budget is given.

WELDING. Welding Practice on Heavy Engines, O. Adams. Welding, vol. 1, no. 10, Aug. 1930, pp. 674-677, 7 figs. Description of repairs to pistons, cylinder heads, and cylinders of gas and Diesel engines; costs of welding, method of preheating, electric arc welding, and bronze welding.

IRON-CHROMIUM ALLOYS

STUDY OF. A Study of the Iron-Chromium-Carbon Constitutional Diagram, V. N. Krivobok and M. A. Grossmann. Am. Soc. for Steel Treating—Trans., vol. 18, no. 1, July 1930, pp. 1-38, 55 figs. Relationships when chromium content is varied from zero up to about 18 per cent; in absence of carbon, increase in chromium caused region of delta iron to merge with alpha region, eliminating gamma iron when chromium was above 14 per cent; in presence of carbon, range of temperature and carbon content in which austenite was associated with delta iron merged with range in which austenite was associated with alpha iron.

IRON FOUNDRIES

LARGE CASTINGS. The Production of Large and Medium-Sized High-Class Iron Castings, W. Scott. Foundry Trade Jl. (Lond.), vol. 43, no. 729, Aug. 7, 1930, pp. 91-96 and 98, 29 figs. Methods used by Close Foundry of Armstrong, Whitworth and Co. for manufacturing marine, Diesel, and steam-turbine castings. Paper read before Inst. of Brit. Foundrymen.

L

LOCOMOTIVES

DESIGN. Steam Locomotive Design: Data and Formulae, E. A. Phillipson. Locomotive (Lond.), vol. 36, nos. 449, 450, 451, 452, 453, 454, 455 and 456, Jan. 15, 1930, pp. 15-17; Feb. 15, pp. 61-63; Mar. 15, pp. 86-90; Apr. 15, pp. 120-123; May 15, pp. 151-152; June 15, pp. 210-211; July 15, pp. 241-244; Aug. 15, pp. 263-265; 5 figs. Jan.: Mathematical calculation of design features dealing with train resistance, resistance due to acceleration, gradient resistance, curve resistance, and natural wind resistance. Feb.: General remarks, definitions, and data; determination of such factors as evaporative heating surface required per i.hp. developed, boiler demand factor, and engine performance data. Mar.: Estimating steam consumption; calorific value and combustion of fuel; grate area. Apr.: Determination of firebox and tube heating surface; superheater surface; table of leading dimensions and design ratios of tank, freight, mixed traffic and passenger express locomotives. May: Discussion of cardinal points of design. June: Consideration of boiler together with mathematical determination of barrel-plate thickness. July: Consideration of boiler riveted joints and firebox plates; relative merits of steel and copper for inner fireboxes; wide versus narrow fireboxes; relative merits of Belpaire and round topped fireboxes. Aug.: Design features of combustion chambers, foundation ring, fusible plug, brick arch, deflector plates, and firebars.

ELECTRIC. Double-Voltage Operation Features Midland Utilities Locomotive, T. F. Perkinson. Elec. Ry. Jl., vol. 74, no. 9, Aug. 1930, pp. 524-525, 2 figs. Service can be given on 1,500 or 600-volt lines on its several subsidiary railways by changes of circuits and minor adjustments; principal data of double-voltage locomotives is listed.

Electric Locomotives with Welded Frame and Trucks (Elektrische Lokomotive mit geschweissten Rahmen und Drehgestellen), W. Reichel. V.D.I. Zeit. (Berlin), vol. 74, no. 23, June 7, 1930, pp. 767-768, 5 figs. Brief description of welded frame construction used for electric locomotives with individual axle drive; outline of principal types of locomotives built by Siemen Schuckert.

Vertical Motors Feature Austrian Locomotives. Elec. Ry. Jl., vol. 74, no. 9, Aug. 1930, pp. 511-512, 5 figs. Locomotive drive of type differing radically from that in use in America has been found successful on lines of Austrian Federal Railways; principal feature is use of vertical motors connected to driving axles through bevel gears; drive is somewhat similar to that brought out short time previously by Midi Railway of France; specifications of high-speed locomotives are listed.

HIGH-PRESSURE. Experimental Multiple Pressure and New Freight Locomotives, Canadian Pacific Ry. Locomotive(Lond.), vol. 35, no. 456, Aug. 15, 1930, pp. 260-261, 1 fig. At Angus Shops of C.P. Ry. in Montreal, three-cylinder locomotive is being constructed which generates high-pressure steam on Schmidt system; 2-10-4 type with high-pressure cylinder 15½ in. by 28 in., and two low-pressure cylinders 24 in. by 30 in.; driving wheels 5 ft. 3 in.; working pressure 275 lbs. per sq. in.; nominal tractive force at 85 per cent boiler pressure, 83,000 lbs.; total weight of engine 466,000 lbs.; engine wheelbase 46 ft. 0½ in.

OIL-ELECTRIC. Economics of the Oil-Engine Locomotive, A. I. Lipetz. Ry. Age, vol. 89, no. 9, Aug. 30, 1930, pp. 451-455, 2 figs. Comparative data from seven railroads for oil-electric and steam locomotives analyzed; road operating costs; effect of high availability; established trends in America. Portion of report on Question V—Locomotives of New Types, presented before Int. Ry. Congress Assn., Madrid, Spain.

VALVE GEARS. A New Locomotive Poppet Valve Gear. Ry. Engr. (Lond.), vol. 51, no. 608, Sept. 1930, pp. 355-357, 2 figs. Perfect timing for all valve events up to 84 per cent cut-off, simple control, and low first cost are among advantages claimed for Holmes Gear, which is illustrated and described.

LUBRICATION

THEORIES. Coefficient of Fluid Friction (Au sujet du coefficient du frottement fluide), Hanocq. Revue Universelle des Mines (Liége), vol. 4, no. 2, July 15, 1930, pp. 33-38, 6 figs. Elementary theory of film lubrication; experimental verification of theory; study of semi-fluid friction; conclusions regarding coefficient of friction. See reference to author's earlier work indexed in Engineering Index 1929, p. 1107.

M

MACHINE TOOLS

HYDRAULIC DRIVE. Machine Tools for Metals Cutting with Hydraulic Drive and Their Calculations (Spanabhebende Werkzeugmaschinen mit Fluessigkeitsgetrieben und deren Berechnung), F. H. Huth. Maschinen-Konstrukteur (Berlin), vol. 63, no. 13, July 10, 1930, pp. 266-269, 8 figs. Description of Blell-Hydro planer and its hydraulic drive; examples for computing dimensions and performance of pump and motor of hydraulic drive.

MATHEMATICS

FAIRING EMPIRICAL SERIES. Smoothing of Empirical Series (Das Glaetten empirisch gefundener Zahlenreihen), A. Willers. Zeit. fuer Angewandte Mathematik und Mechanik (Berlin), vol. 10, no. 2, Apr. 1930, pp. 166-181. Theoretical mathematical discussion on reduction of experimental data.

METALS

DEFORMATION. Some Applications of the Theory of Plastic Deformations of Ductile Metals, A. Nadai. Phys. Rev., vol. 36, no. 4, Aug. 15, 1930, pp. 762-772, 4 figs. Account of principal conditions which are available to express equilibrium of stress in plastic of ductile metals; ease of rotationary symmetry in plastic body; plastic flow in thick-walled cylinder subjected to high internal pressure with and without longitudinal expansion; distribution of stress during yielding for long cylinder and for flat ring, both subjected to radial pressure; spread of yielding and plastic deformation through walls of cylinder.

HARD FACING. The Metallurgy of Welded-on Overlays, M. C. Smith. Welding, vol. 1, no. 10, Aug. 1930, pp. 681-683 and 688, 5 figs. Discussion of structural changes and formation of alloys which take place in hard facing; technique of applying overlay.

MOTORSHIPS, DIESEL-ELECTRIC

CEMENT CARRIERS. Self-Unloading Cement Carrying Vessel for Canadian Cement, A. C. Blackall. Concrete, vol. 37, no. 3, Sept. 1930, pp. 96-98, 4 figs. Description of Diesel-electric 3,150 ton vessel "Cementkarrier" designed for service on Great Lakes, St. Lawrence and Atlantic Coast, recently completed by Furness Shipbuilding Co., Ltd., Haverton Hill-on-Tees, England, for Canada Cement Transport Co., of Montreal; cargo carried in holds of hopper form; cement pumped ashore by electrically driven system.

N

NATURAL GAS PIPE LINES

HIGH PRESSURE. Some Aspects of High-Pressure Natural Gas Transportation, R. S. Lord. West. Soc. of Engrs.—Jl., vol. 35, no. 4, Aug. 1930, pp. 254-275, 10 figs. Merits of natural gas; growth of natural-gas industry; early developments of natural-gas pipe lines; problems of high-pressure distribution.

NON-FERROUS METALS

COLD ROLLING. Modern Practice in the Cold Rolling of Non-Ferrous Metals, C. E. Davies. Metallurgia (Manchester), vol. 2, no. 10, Aug. 1930, pp. 145-146. Copper, brass, nickel, aluminum, and zinc group, precious-metals group, and soft-metals group are handled by machinery and methods that are alike in principle; modifications in detail are governed by different physical properties of individual metals and alloys; outline of brass strip practice.

O

OIL ENGINES

AUTOMOTIVE, HESSELMAN'S. Hesselman's Low-Pressure Crude-Oil Engine (Hesselman's Lagtrycks-Raoljemotor), E. Hubendick. Teknisk Tidskrift (Stockholm), vol. 60, no. 28, July 12, 1930, pp. 417-427, 31 figs. First authentic and complete account of low-pressure petroleum engine to be used in automobiles, small boats, and locomotives; test show saving over gasoline consumption of 30 per cent and in fuel cost of 68 per cent; same capacity fuel tank will carry car 43 per cent farther than gasoline.

New Oil Engine for Motor Vehicles (Neuer Oelmotor fuer Kraftfahrzeuge), A. Heller. V.D.I. Zeit (Berlin), vol. 74, no. 28, July 12, 1930, pp. 970-972, 9 figs. Description of Hesselman high-speed spark-ignition engines; performance curves are given.

Hesselman New Low-Pressure Oil Engine (Hesselmans neuer Niederdruck-Oelmotor), C. A. Fieber. Sparwirtschaft (Vienna), vol. 8, no. 7, July 1930, pp. 327-331, 10 figs. Outline of advantages of Hesselman engine and report on result obtained with four-cylinder engine built by Grazer Waggon und Maschinen-Fabriks-Aktiengesellschaft.

RUSTON AND HORNSBY. The Ruston High-Speed Airless-Injection Oil Engine. Engineering (Lond.), vol. 130, no. 3371, Aug. 22, 1930, p. 247, 6 figs. partly on p. 246. Engine runs at 900 r.p.m. and can be supplied either as stationary model for belt or direct drives, or arranged for fitting in commercial vehicles, tractors, and so on; cylinder heads are separate castings, held down by studs; inlet and exhaust valves are interchangeable, and both are operated from single camshaft located in crankcase.

OPEN HEARTH FURNACES

REGENERATORS. Large-Scale Tests on Experimental Regenerative Chamber (Grossversuche an einer zu Studienzwecken gebauten Regenerativ Kammer), H. Kistner. Stahl und Eisen (Duesseldorf), vol. 50, no. 29, July 17, 1930, pp. 1027-1028. Determination of heat-transfer co-efficient and pressure losses with doubly staggered and non-staggered grade packing. (Concluded.)

P

PAVEMENTS

SPECIFICATIONS. Preparation of Subgrades and Bases for Pavements. Contract Rec. (Toronto), vol. 44, no. 36, Sept. 3, 1930, pp. 1073-1075. Report of subcommittee no. 4 of General Committee No. 11 of American Road Builders' Assn.; backfilling methods; cushion blanket courses; pavement bases; strength requirements; consistency of concrete; time for curing; central mixed concrete.

PILE DRIVING

FORMULAE. Bearing Capacity of Driven Piles (Zur Frage der Tragfaehigkeit von Rammpfaehlen), E. Rausch. Bauingenieur (Berlin), vol. 11, no. 30, July 25, 1930, pp. 514-516, 4 figs. Derivation as new theoretical formula taking into account "spring-back" of pile and impact co-efficients.

PIPE, CAST IRON

CENTRIFUGAL CASTING. Casts Pipe in Eighteen Foot Lengths, P. Dwyer. Foundry, vol. 58, no. 15, Aug. 1, 1930, pp. 104-109, 10 figs. Description of manufacturing process and equipment at plant of National Cast Iron Pipe Co., Birmingham, Ala.; notes on synchronization of operation, tests, and inspection of pipes.

PLANERS

METAL-WORKING—MANUFACTURE. Grinding or Scraping? (Schleifen oder Schaben?), W. Iwascheff. Werkstattstecknik (Berlin), vol. 24, no. 15, Aug. 1, 1930, pp. 405-410, 10 figs. Superiority of grinding as compared to scraping is outlined; characteristics of scraped and ground surfaces are discussed with regard to structure and suitability for lubrication; detailed description of planing and grinding operation on cheeks of planer bed; data on tolerances.

POWER CONFERENCES

BERLIN. The Second World Power Conference, Berlin, 1930 (Von der II. Weltkraftkonferenz, Berlin, 1930), C. Matschoss. V.D.I. Zeit. (Berlin), vol. 74, no. 29, July 19, 1930, pp. 993-1040. Abstract of papers and discussions of general sessions, including addresses by Einstein, Eddington, and others; also report on proceedings of following special sections; Fuels, Steam Power, Internal Combustion Motors, Water Power, Power Storage, Electricity, Use of Various Forms of Power, Standardization and Statistical Methods, etc.

The World Power Conference, Berlin. Engineering (Lond.), vol. 130, nos. 3366 and 3367, July 18, 1930, pp. 91-92, and July 25, pp. 125-126. July 18: Abstracts of selected papers relating, respectively, to liquid and solid fuels and power economics. July 25: Research work; research divided into two definite parts dealing, respectively, with hydrodynamics and kindred matters, and thermodynamics; costs and comparative efficiency of different types of energy.

POWER PLANT EQUIPMENT

ELECTRIC. Minimizing Breakers in Exciter Layouts, J. B. MacLean. Elec. World, vol. 96, no. 9, Aug. 30, 1930, pp. 397, 2 figs. Spare exciter in new power house for Pennsylvania State College has been connected solidly to exciter transfer bus; in two larger plants under construction this same scheme is being used; elimination of switch between exciter transfer bus and spare exciter does not reduce flexibility of field system, since both exciter transfer bus and spare exciter are mutually dependent for emergency operation.

POWER PLANTS

LOAD DESPATCHING. Some Notes on the Centralized Control System of the Victoria Falls and Transvaal Power Company, Limited, J. Falcke. S. African Inst. of Elec. Engrs.—Trans. (Lond.), vol. 21, part 5, May 1930, pp. 105-115, 7 figs. General idea of control diagram and principles upon which system is operated; evolution of centralized control system; office; indicating and recording instruments; summating wattmeters; communication system; compressed air diagram; load graph; duties of control engineer; operating requirements; continuity of supply and protection; reliability of service; transmission system; power factor and interconnection.

STEAM VS. HYDRO-ELECTRIC. What to Build—Steam or Hydro Plants? A. H. Markwart. Elec. West, vol. 65, no. 3, Sept. 1, 1930, pp. 136-139, 3 figs. Method of analysis that has proved to be useful in guiding determination of related economic factors which dictate proportions in which steam and hydro plants should be built to serve growing load in order to realize maximum overall system economy; curves and tables given.

PRESSURE INDICATORS

PRECISION. Precision Measurement of Liquid Pressure. Engineer (Lond.), vol. 150, no. 3890, Aug. 1, 1930, pp. 116-117, 11 figs. That it is possible to construct highly efficient mercury column for high pressures has been proved by Budenburg Gauge Co. who have fitted up standard mercury column at its worksf or pressures up to 300 lbs. per sq. in.; in precision dead weight testers pressure of liquid, usually oil or glycerine, is balanced by weight of loaded piston floating in cylinder.

R

RAIL MOTOR CARS

Gasoline. Petrol Engine Cars for the Brazilian Central Railways, O. Schamberger. AEG Progress (Berlin), vol. 6, no. 8, Aug. 1930, pp. 259-264, 10 figs. Four-axle cars with double-engine equipment of four cylinders with 150 mm. bore and 180 mm. stroke which develop 100 b.hp. at 1,000 r.p.m.; four speed friction clutches; electro-pneumatic train control.

Storage-Battery. Accumulator Driven Rail Vehicles in Europe, P. L. Balbo. Tramway and Ry. World (Lond.), vol. 68, no. 8, Aug. 14, 1930, pp. 75-76. Discussion of problems associated with storage-battery drive as applied to electric-railroad cars and buses; historical review of this type of drive; results of experiments carried out in various cities of Europe. Abstract of paper presented at Congress of Int. Tramways Union at Warsaw.

REFRIGERATING COMPRESSORS

Design. The Design of Compressors, B. C. Oldham. Refrig. Eng., vol. 20, no. 2, Aug. 1920, pp. 83-93, 9 figs. Following design features of compressor cylinder are discussed; valves, piston, speeds, types, frames; special problems of refrigeration cycle; comparison curves of pressure ratios of refrigerants; capacity as related to compressor design; motive power of refrigerants.

REFRIGERATION

Frozen-Brine. Frozen-Brine Refrigeration, D. K. Warner. Ice and Refrig., vol. 79, no. 2, Aug. 1930, pp. 126-127, 2 figs. Application of frozen-brine principle to household refrigeration in place of water ice and its advantages as refrigerant; cost of producing frozen-brine; process is comparable to old ice-cream freezer; will hold refrigerator colder with more constant temperature and humidity.

New Refrigerating and Ice-Making System, D. K. Warner. Ice and Refrig., vol. 79, no. 2, Aug. 1930, pp. 79-82, 6 figs. Principles of new experiments; requirements of ammonia floats; constant humidity refrigerator operated with frozen-brine; improvement on barometric condenser; mechanical refrigerator with varying temperatures. Address delivered before Am. Soc. Refrig. Engrs.

RESERVOIRS

Storage. Eleven-Mile Canyon Reservoir Permits Denver to Use Full Storage of Lake Cheesman, D. D. Gross. Eng News-Rec., vol. 105, no. 11, Sept. 11, 1930, pp. 425-426, 2 figs. Features of proposed storage project including arched dam 112 ft. high, containing 50,000 cu. yds. of concrete; map of storage and sources of water on South Platte River above Denver and irrigated areas.

ROADS, CONCRETE

Joints. Experiments on Concrete Road Joints. Engineering (Lond.), vol. 130, no. 3370, Aug. 15, 1930, p. 210, 7 figs. Survey of defects, which have occurred on road of fairly recent construction carried out by Technical Advisory Committee appointed by Minister of Transport, previously indexed.

ROLLING MILLS

Aluminum. Rolling Mills, Alloying, and Presswork of Aluminium Industrie A.-G., Neuhausen (Die neuen Legierungs-Walz- und Presswerke der Aluminium-Industrie A.-G. Neuhausen), Zeerleder. Schweizerische Bauzeitung (Zurich), vol. 96, no. 2, July 12, 1930, pp. 15-22, 30 figs. Description of layout, operating methods, and equipment of new Swiss aluminum rolling mills; data on capacity of machinery and power requirements are given.

Electric Drive. How Special Motors and Control Solved Continuous Hot-Rolling Problems, R. H. Rogers. Elec. World, vol. 96, no. 8, Aug. 23, 1930, pp. 352-357, 8 figs. Methods used to obtain compact but accessible motor room; purposes served by four-element motor-generators; avoid starting compensators; use of two-in-one roughing-mill motor; motors and control for successive finishing rolls at proper relative speeds, starting roughing-mill speed of finishing-mill motors; regulating relative speeds of six motors within 0.1 per cent; centralized motor control and load and speed indication.

Flow in Rolling. Influence of Lateral Pressure on Deformation in Rolling and on Quality of Material (Der Einfluss des Seitendruckes auf die Formaenderung beim Walzen und die Guete des Werkstoffes), H. Hilterhaus. Stahl und Eisen (Duesseldorf), vol. 50, nos. 34 and 35, Aug. 21, 1930, pp. 1185-1194 and Aug. 28, pp. 1221-1229, 31 figs. Review of different theories on flow of material with rolling; results of author's own tests on three-high mill; evaluation of tests.

Research. Studies of Efficiency and Power Consumption for Different Sections (Untersuchungen zur Feststellung der Leistungsfaehigkeit und des Kraftverbrauches fuer verschiedene Walzprofile), G. Bulle, C. N. Elsen, and A. Knickenberg. Stahl und Eisen (Duesseldorf), vol. 50, no. 32, Aug. 7, 1930, pp. 1121-1126, 12 figs. Time and energy-consumption measurements were carried out on five rolling mills showing that graphic record of structural units of mill could be easily obtained; investigation of energy consumption for determination of starting energy, no-load output, and productive rolling work, by which is understood work that roll motor has to perform in excess of work at no load.

RUBBER MACHINERY

Lathe. Rubber-Making Machinery. Engineering (Lond.), vol. 130, no. 3371, Aug. 22, 1930, pp. 225-227, 4 figs. Machines used in manufacture of circular steel bands on which solid rubber tires for heavy commercial vehicles are formed; lathe specially designed as single-purpose machine for turning, grooving, and serrating of solid tire bands. (Continuation of serial.)

S

SAND BLAST

Nozzles. Capacity and Efficiency of Sand-Blast Nozzles (Leistung und Wirkungsgrad von Sandstrahlduesen), Nettmann and Faber. V.D.I. Zeit. (Berlin), vol. 74, no. 35, Aug. 30, 1930, p. 1200, 2 figs. Abstract of V.D.I. Bulletin on tests of wooden nozzles operated with sand grains of steel shot; erosive effect of blasted materials upon shape of nozzle channel.

SEAPLANES

Design. The Design of Seaplanes, A. Gouge. Aircraft Eng. (Lond.), vol. 2, no. 18, Aug. 1930, pp. 202-206, 16 figs. Article discusses strength, stability and water and flying qualities of both seaplanes and flying boats; curves illustrate lift and drag characteristics and pressure distribution.

SEWAGE PUMPING STATIONS

Germany. The Ruhrverband Sewage Pumping Plants at Dahlhausen and Essen-Steele (Die Abwasserpumpwerke des Ruhrverbandes in Dahlhausen und Essen-Steel), F. Fries. Technische Gemeindeblatt (Berlin), vol. 33, nos. 4 and 5, Feb. 20, 1930, pp. 44-48 and Mar. 5, pp. 52-55, 25 figs. Description of pumping and treatment plants for sanitary and storm sewage of small communities; pumping capacities are 1.3 cu. m. per sec. and 2.3 cu. m. per sec., respectively; plants are housed in circular structure and are equipped with centrifugal pumps electrically driven; Hume concrete pipe is used.

SHAFTS AND SHAFTING

Stresses in. Shaft Stresses Due to Torsional Impact, W. A. Tuplin. Engineer (London), vol. 150, no. 3890, Aug. 1, 1930, pp. 112-115, 5 figs. Loss of kinetic energy when two masses rotating at different speeds are suddenly connected is determined by considerations of angular momentum; calculations assume that whole of lost kinetic energy is transformed into torsional strain energy of shafts; in practice there will be other strains; however methods outlined give stresses which are higher than true values and therefore err on safe side.

SHEET PILING

Germany. A New Krupp Sheet Piling (Neue Spundwandeisen Bauart Krupp), G. Rueth. Bauingenieur (Berlin), vol. 11, no. 32, Aug. 8, 1930, pp. 554-557, 11 figs. Description, reports on tests, construction experience with new type of interlocking steel sheet piling.

SOLAR ENERGY

Utilization of. Generation of Power by Direct Transformation of Solar Heat (Production de force motrice par transformation directe de la chaleur solaire), H. Delecourt. Revue Universelle des Mines (Liége), vol. 4, no. 4, Aug. 15, 1930, pp. 97-106; Sept. 1, pp. 137-147, 14 figs. Aug.: Historical review, importance of available energy; work of Claude and Boucherot; production of power by utilization of intermediate cycle; utilization of ethyl-chloride vapour cycle; choice of auxiliary fluid; experimental plant of Brabant at Oisquercq; theoretical study of cold vapour cycle. Sept.: Application of recuperation to steam turbine; comparison between exhaust-steam turbine and ethyl-chloride turbine; results of tests at Brabant central station at Oisquercq; details of solar engine; net cost of solar kilowatt-hour; utilization of energy produced and future possibilities.

SOUND

Measurement of. Full Automatic Reverberation Measuring Equipment (Ueber eine vollautomatische Nachhallmessvorrichtung), M. J. O. Strutt. Elektrische Nachrichten-Technik (Berlin), vol. 7, no. 7, June 1930, pp. 280-282, 2 figs. Improved equipment consisting of microphone and vacuum-tube amplifier containing Philips B 405 tube and by which reverberation time can be measured within 0.01 of second exact.

Investigation of Sound Damping Materials (Ueber die Untersuchung von schalldaempfenden Koerpern), H. Tischner. Elektrische Nachrichten-Technik (Berlin), vol. 7, no. 6, June 1930, pp. 236-247, 10 figs. In previous article in May 1930 issue of same journal propagation of sound in tubes was studied by means of compensating equipment and measuring telephone; with same equipment influence of various damping materials on sound propagation in tubes is investigated.

New Automatic Method for Measuring of Reverberation (Ein neues automatisches Verfahren der Nachhallmessung), E. Meyer. Zeit. fuer Technische Physik (Leipzig), vol. 11, no. 7, 1930, pp. 253-259, 9 figs. Graphical construction of reverberation process; control of stop watch; glow lamps, and tube relays; measuring method; examples showing exactitude; influence of air humidity of sound absorption decrement of tuning forks.

SPEED RECORDERS

New Types. New Instruments, D C. Gall. Jl. of Sci. Instruments (Lond.), vol. 7, no. 7, July 1930, pp. 230-231, 2 figs. Variable but constant-speed recording drum, 12 in. diam. by 12 in. long, arranged to be driven at any constant speed between 9 and 12 r.p.m.; high degree of constant speed obtained by phonic motor and electrically maintained tuning fork.

SPRINGS

Stresses in. Stress Strain Relationships in Spring Steels, G. A. Hankins. Engineer (Lond.), vol. 150, no. 3892, Aug. 15, 1930, pp. 178-179, 1 fig. Discussion of stress strain under conditions which are often assumed to be elastic; experimental results on changes in elastic moduli after excessive overstraining of material. Communication from Springs Committee of Department of Sci. and Indus. Research Bibliography.

STEAM ACCUMULATORS

Ruth. Economy of Ruths Accumulator (Wirtschaftlichkeit der Ruthsspeicher), C. Nunn. Maschinen-Konstrukteur (Berlin), vol. 63, no. 13, July 10, 1930, pp. 270-273, 5 figs. Discussion of effect of accumulator on production cost; practical examples from sugar-beet industry are followed through; data on amortization.

Investigation of 50,000-Kw. Ruths Accumulator (Untersuchungen an einer 50,000 Kw-Ruthsspeicheranlage), W. E. Wellmann. V.D.I. Zeit. (Berlin), vol. 74, no. 23, June 7, 1930, pp. 743-753, 18 figs. Description of boiler, turbine, and steam accumulator plant of Charlottenburg Power Plant of BEWAG; detailed discussion of test data and performance of accumulator in meeting peak load; full data on cost of construction and efficiency of plant are given.

Peak-Load Compensation by Means of Ruths Steam Accumulator (Spitzendeckung in Elektrizitaetswerken durch Dampfspeicher, inshesondere Ruthsspeicher), E. Praetorius. Brennstoff und Waermewirtschaft (Halle), vol. 12, nos. 13/14 and 15/16, July 1930, pp. 174-179, and Aug., pp. 194-197, 10 figs. Requirements of peak-load power plants and use of Ruths accumulators for peak-load equalization; examples of Ruths accumulator installations and operating experiences.

Significance of Ruths Accumulators in Electric Power Practice (Die Bedeutung des Ruthsspeichers fuer die Elektrizitaetswirtschaft), T. Stein. V.D.I. Zeit. (Berlin), vol. 74, no. 23, June 7, 1930, pp. 754-760, 38 figs. Discussion of special features of Ruths plant at Charlottenhurg and comparison with similar plants in other countries; possibilities of Ruths accumulators in making electricity supply more economical and preventing interruption are outlined; diagram illustrates efficiency of Ruths accumulators and turbines with regard to peak loads.

STEAM CONDENSERS

Latest Installations. Condensing Equipment. Nat. Elec. Light Assn.—Report, no. 069, July 1930, 37 pp., 46 figs. Tables showing characteristics of latest condenser installations indicate increased use of single pass-condensers for large capacity; condensers with tubes rolled at both ends are in satisfactory operation; satisfactory results for use of chlorine in circulating water; ⅞-in. tubes are being used more frequently.

Maintenance and Repair. Condenser Maintenance: Its Influence on Turbine Performance. Power, vol. 72, no. 9, Aug. 26, 1930, pp. 349-351, 5 figs. Aside from occasional tube renewals, cleaning, and stopping leakage of circulating water and air into steam space sums up maintenance work that generally has to be done on condensers; careful attention of engineer is demanded and neglect may result in loss of turbine economy and feedwater troubles; condenser operating data plotted to show effect of tube fouling and cleaning.

Surface. Dimensioning of Surface Condensers (Die Bemessung von Oberflaechenkondensatoren), P. Danninger. Archiv. fuer Waermewirtschaft (Berlin), vo. 11, no. 9, Sept. 1930, pp. 305-307, 2 figs. Values governing dimensioning of condensers are established, formulae are covered from them, and diagram is developed.

STEAM-ELECTRIC POWER PLANTS

Baton Rouge, La. By-Product Power From Louisiana Station—Electrical Features of Baton Rouge Plant of Louisiana Steam Products, Inc., M. J. Lowenberg. South. Power Jl., vol. 48, no. 9, Sept. 1930, pp. 54-57, 4 figs. High-pressure, non-condensing steam-electric plant designed primarily to furnish process steam to adjacent oil refinery, generates up to 45,000 kw. of electric power, in accordance with conditions of steam demand, which is poured into high-tension network serving central South; cross-section of plant is illustrated showing location of mechanical and electrical equipment.

California. Steam Power Development of the Pacific Gas & Electric Company, R. C. Powell. Am. Inst. Elec. Engrs.—Advance Paper, for mtg. no. 30-147, Sept. 2-5, 1930, 6 pp., 2 figs. After brief history of development of steam power on system of Pacific Gas & Electric Co., fundamental factors entering into problem of providing additional steam plant capacity for this company in accord with changed economic conditions are described; recent work completed and under construction are described; some of economic results obtained and expected are given.

Canada. Saskatoon's New 10,000 Kw. Steam Unit. Elec. News (Toronto), vol. 39, no. 14, July 15, 1930, pp. 45-47 and 61, 4 figs. Province of Saskatchewan installs high pressure steam-electric plant as part of big programme; initial installation of main generating equipment in this new plant consists of one 10,000 kw. turbine-driven generator with 60 kw., 250 volt direct-connected exciter; current is generated at 13,200 volts, three-phase, 60 cycle, and distributed through underground circuits from new station at generator voltage or to old station through two banks of transformers; notes on design features and station auxiliaries.

Another New Steam-Electric Plant. Elec. News (Toronto), vol. 39, no. 15, Aug. 1, pp. 33-34, 5 figs. Latest steam-electric plant to be put in operation in Canada is new Seaboard plant of Dominion Coal Co. located on salt water inlet about mile from seacoast, adjoining coal mine No. 24 of Dominion Coal Co. at Glace Bay, Nova Scotia; provision has been made in coal and ash handling equipment and in construction of condensing water tunnels for 30,000 hp. plant; first 10,000 hp. unit has been installed.

Operation. The Use in Power Stations of Steam Turbines Having, with Their Auxiliaries, Large Overload Capacities, C. A. Parsons, and R. Dowson. World Power (Lond.), vol. 14, no. 80, Aug. 1930, pp. 148-149 and 151-157, 6 figs. Direct comparison is made between cost of generating emergency peak load by (1) turbo-generators with 25 per cent overload capacity, peak load carried by additional plant lying idle during rest of day, and (2) turbo-generators with 75 per cent overload, no additional plant being used for peak. Abstract of paper presented before World Power Conference, June 1930.

STEAM PIPE LINES

High-Pressure. Study of High-Pressure Steam Pipe Lines (Essai de contribution à l'téude des tuyauteries de vapeur à haute pression), L. Perreau. Arts et Métiers (Paris), no. 117, June 1930, pp. 233-241, 14 figs. Notes on choice of metals to be employed; joints most suitable to give satisfactory operation; internal pressures; temperatures; abrasive action of fluid; initial deformations; effects of dilation fatigue, etc.

STEAM POWER PLANTS

Ash Handling. Various Types of Ash Conveyors Used in British Power Station Practice, E. W. Robey. Combustion, vol. 2, no. 2, Aug. 1930, pp. 38-42, 10 figs. Description of various types of water-sealed and sluice-type ash conveyors and discussion of typical applications; novel development of water-sealed type of conveyor is also described; in this conveyor series of buckets, mounted on rollers and joined by rubber connections, forms continuous moving trough in which water remains at fixed level; no particular advantage of relative movement between any part of conveyor and material being handled which results in notably low maintenance.

Coal Handling. Handling Coal in Modern Power Plants, L. O. Millard. Blast Furnace and Steel Plant, vol. 18, no. 8, Aug. 1930, pp. 1319-1324 and 1334, 12 figs. Discussion of equipment and procedure for preparing coal and conveying it from storage pile to boilers; data on unloading equipment, feed control, coal elevating units, coal distribution to bunkers, stokers, and pulverizers.

Maintaining Service in Coal and Ash Handling. Power, vol. 72, no. 9, Aug. 26, 1930, pp. 325-329, 6 figs. With high-sulphur coal, maintenance costs on various types of coal-handling systems range from 4 to 6 cents per ton; coal-handling maintenance approximates 6 per cent of total plant maintenance; table illustrating maintenance costs in large central station coal-handling systems; ash removal.

The 100 Atmos. Installation of the Super-Power Plant in Mannheim (Die 100 at-Anlage des Grosskraftwerkes Mannheim). Elektrotechnische Zeit. (Berlin), vol. 51, no. 31, July 31, 1930, pp. 1105-1108, 5 figs. Details of Hanomag and Humboldt boilers of 835 and 716 sq. m. heating surface, respectively, two 5,000-kw. turbines of Brown Boveri Co., Mannheim, and heat diagram of this extension to initial 57,500 kw. plant.

The Billingham Power Plant of Imperial Chemical Industries. Engineering (Lond.), vol. 130, nos. 3367 and 3369, July 25, 1930, pp. 119-121, and Aug. 8, pp. 183-184, 11 figs. July 25: Quantity of steam required for process purposes is double that necessary to generate requisite electrical energy, so that output of boiler plant is three times that of turbines; adequate stand-by plant had to be provided; high-pressure and high-temperature steam, after utilization in high-pressure turbines, can be passed on to process ranges at original temperature and pressure. Aug. 8: Sectional view is given of one of high-pressure turbines; machines are of single-cylinder type with 16 stages.

Industrial—Cost Accounting. Establishing a Maintenance Cost System, S. W. Allen. Power, vol. 72, no. 9, Aug. 26, 1930, pp. 318-321, 7 figs. While subject of power-plant maintenance is separate and distinct from operating, it is nevertheless, closely tied in with it in its practical application, and it is generally advisable to devise some system for collecting and tabulating all data applicable to both problems.

New York City. Boiler Capacity Doubled Without Increasing Space. Power, vol. 72, no. 10, Sept. 2, 1930, pp. 385-388, 5 figs. New 700,000-lb. unit of New York Steam Corp. installed in room originally alloted for boilers of 325,000-lb. capacity; furnace volume increased; wider economizers installed; auxiliary equipment.

STEAM TURBINES

Design. Recent and Possible Future Developments Affecting the Economics of Large Steam Turbine Practice in the United States, G. B. Warren. Gen. Elec. Rev., vol. 33, no. 8, Aug. 1930, pp. 434-443; Sept., pp. 522-527; 28 figs. Aug.: General trend of large steam-turbine development, as it bears on economics of power-plant operation, with particular reference to designs of General Electric Co. Paper presented at World Power Conference, Berlin, June 16-25, 1930. Sept.: Notes on probable immediate future trend; relative economics of present and possible future steam cycles; effect of new cycles upon possible capacity; effect of more efficient cycles upon turbine design; commercial value; turbine efficiency.

Inspection. Turbine Outage Reduced by Regular Inspection. Power, vol. 72, no. 9, Aug. 26, 1930, pp. 346-348, 3 figs. Power plants, both industrial and utility, are called upon to deliver service that must be continuous and uninterrupted; such service cannot be rendered if main and auxiliary turbines are neglected to such extent that forced shutdowns occur.

Ljungström. Radial Steam Turbines with Special Regard to Ljungström Turbine (Radialdampfturbinen mit besonderer Beruecksichtigung der Ljungström-Turbine), H. Kirst. Waerme (Berlin), vol. 53, nos. 30, 32, and 33, July 22, 1930, pp. 569-574, Aug. 9, pp. 606-609, and Aug. 16, pp. 623-626, 35 figs. Development of radial turbines; differences and advantages in comparison with axial turbines; defects of original design overcome in Ljungström type, which is latest development of radial turbine.

STEEL

Embrittlement. Brittleness-Embrittlement Phenomena in Steels (Sproedigkeitserscheinungen bei Stahl), O. Schwarz. Maschinenbau (Berlin), vol. 9, no. 14, July 17, 1930, pp. 471-472, 9 figs. Discussion of importance of and tests for ductility; behaviour of steel at various temperatures, brittleness as result of age, non-aging steel; notes on various other factors affecting ductility and brittleness.

Molybdenum. Molybdenum in High-Speed Steel, S. B. Ritchie. Army Ordnance, vol. 11, no. 61, July-Aug. 1930, pp. 12-19, 12 figs. Investigation as to practicability of eliminating tungsten wholly or in part from high speed steels undertaking at Watertown Arsenal; comparative test of molybdenum steel with tungsten steel; methods of heat treating molybdenum steel; it was determined that there are no differences of manufacture of molybdenum high-speed steel in desired quantities.

Sheet. Use of Sheet for Stressed Structural Parts (Die Verwendung von Blech fuer beanspruchte Konstruktionsteile), R. Kusserow. Metallboerse (Berlin), vol. 20, no. 62, Aug. 2, 1930, pp. 1713-1714. Author refers to frequent use of commercial fine sheet and warns against its indiscriminate use for highly stressed structural parts; remarks are prompted by tests which are being carried out for purpose of substituting fine sheet for hot-rolled strip steel.

STEEL CASTINGS

Heat Treatment. Effect of Cooling Rate on the Properties of Steel Castings, W. J. Crook, D. J. Martin, and J. W. Halleg. West Machy. World, vol. 21, no. 7, July 1930, pp. 311-314, 8 figs. Experiments and theories of dendritic structure; dendritic structure and its relation to cooling rate; data on physical properties and microphotographs illustrate results.

STOKERS

Traveling Grate. Relation Between Weight and Temperature of Travelling-Grates (Zusammenhang zwischen Gewicht und Temperatur des Wanderrostes), E. Molinder. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 9, Sept. 1930, p. 308, 1 fig. Heat volume transmitted to grate surface through flame radiation is almost constant at a certain flame temperature and temperature increase of grate is inversely proportional to its weight.

STRUCTURAL STEEL

Temperature Effect. Results of Fatigue Tests with Different Structural Steels at High Temperatures (Ergebnisse von Dauerbelastungsversuchen mit verschiedenen Baustaehlen bei hoehn Temperaturen), E. Pohl, H. Scholz and H. Juretzek. Archiv fuer das Eisenhuettenwesen (Duesseldorf), vol. 4, no. 2, Aug. 1930, pp. 100-110, 21 figs. Description of improved testing equipment; evaluation of experimental results on carbon, nickel and molybdenum steel sheets; best behaviour of molybdenum steel in temperature range of 300 to 500 deg. cent.; comparison of process described and that of Pomp and Dahmen for determination of fatigue resistance.

SUPERHEATERS

Heat Transmission in. Heat Transfer in Superheaters (Die Waermeuebertragung in Ueberhitzern), W. Gumz and F. Michel. Feuerungstechnik (Leipzig), vol. 18, nos. 13/14 and 15/16, July 15, 1930, pp. 129-134, and Aug. 15, pp. 152-155, 15 figs. Contribution to calculation and numerical investigation of superheaters; behaviour of superheater in operation; influence of load and temperature regulation; operating troubles.

T

TESTING MACHINES

Fatigue. Design of Fatigue Testing Machines (Zur Konstruktion von Dauerpruefmaschinen), W. Spaeth. Zeit. fuer Technische Physik (Leipzig), vol. 11, no. 4, 1930, pp. 115-118, 5 figs. Theory and principles of construction of Spaeth-Losenhausen machine with details of vibrating motors and apparatus for torsional fatigue testing.

Tensile. New German Machines for Testing Tensile Strength (Neue deutsche Zerreissmaschinen), M. Moser. Stahl und Eisen (Duesseldorf), vol. 50, no. 31, July 31, 1930, pp. 1086-1088, 5 figs. Critical description of universal testing machine and two special tensile strength testing machines with special regard to basic improvements.

TIDAL POWER

France. Tidal Power (L'utilisation de l'énergie des marées). Génie Civil (Paris), vol. 96, no. 20, May 17, 1930, pp. 485-486; see also brief translated abstract in Power Engr. (Lond.), vol. 25, no. 293, Aug. 1930, p. 326. Summary of paper by A. Pawlowski together with one by A. Defour concerning latest improvements in cycle for utilization of tidal power; list is given of 80 places where tidal power could be developed on French coast; only one tidal power station is at present under construction, that at Aber Vrach, which should be ready for service in 1933 and is expected to yield 12,000,000 kw-hr. per year.

TUNNELS

Construction. High-Speed Tunneling, C. S. Hurter. Explosives Service Bul., July 1930, 4 pp., 5 figs. Fundamental principles of speed; advantages of Roger Pass system; economy of drilling time; ventilation; choice of explosives; co-ordinating drilling, blasting and removal of broken rock.

TURBO-GENERATORS

Germany. 62,500-Kva. Turbo-Generators at the Goldenberg Power Station, Germany. Engineer (Lond.), vol. 150, no. 3891, Aug. 8, 1930, pp. 144-145, 9 figs. partly on p. 148. This is largest steam plant in Germany; details of turbo-generators supplied by A.E.G. latest of which have speed of 1,500 r.p.m.

Rotors. Turbo-Generator Rotor Shafts, W. Sharp. Engineering (Lond.), vol. 130, no. 3368, Aug. 1, 1930, pp. 127-129, 27 figs. For machines of this description, there are two classes of steel employed, carbon and 3 per cent nickel; in first method ingot, after being cast, is allowed to cool until centre is solid when it is removed from mould and charged into furnace; in second method, ingot after casting is allowed to cool as before, and is reheated for blooming purposes; carbon steel provides adequate margin of safety for present-day design and it is not advisable to use more expensive steel which is possibly less reliable.

V

VIBRATIONS

Measurement. Practical and Theoretical Study of Instruments for Recording and Determination of Traffic Vibrations (Praktische und Theoretische Untersuchung von Schwingungsmessern zur Aufnahme und Beurteilung von Verkehrserschuetterungen), W. Zeller. Zeit. fuer Bauwesen (Berlin), vol. 80, no. 7, July 1930, pp. 171-184, 18 figs. Classification of vibration recording instruments, their theory and details of construction, including seismographs, cibrographs, piezoelectric apparatus, etc.; precision of instruments; calibration; development of absolute intensity scale for rating of earthquakes and vibrations.

VOLTAGE REGULATION

Revenue. Revenue and Voltage, M. De Merit. Clec. World, vol. 96, no. 10, Sept. 6, 1930, pp. 436-437. Good service as characterized by voltage regulation depends upon conditions under which service is given; improved regulation increases revenues only when accompanied by sales of additional appliances; practical considerations modify theoretical gains.

W

WATER FILTRATION PLANTS

Experimental—Ottawa. The Trial Filtration Plant, Ottawa, Canada, G. G. Nasmith. Am. Water Works Assn.—Jl., vol. 22, no. 8, Aug. 1930, pp. 1017-1046. Process of floc formation; experiments with preformed floc; use of alum as coagulant; sodium aluminate and coagol; use of ferric chloride as coagulant; corrosive action of Ottawa River water; treatment with lime to avoid corrosion; description of original and of redesigned mixing chambers; collection of sludge; floc in redesigned plant; consolidation of settled sludge; character of sludge; effect of sunshine, depth of filter sand, etc.

WATER TANKS

Elevated. New Elevated Tank Built Around Old Standpipe. Eng. News Rec., vol. 105, no. 11, Sept. 11, 1930, p. 415, 1 fig. Description of ellipsoidal-bottom elevated tank of 600,000-imp. gal. capacity inclosing old standpipe at Toronto, Canada.

WATER WORKS

Operation—Ontario. Water Works and Sewerage in Ontario, A. E. Berry. Can. Engr. (Toronto), vol. 59, no. 10, Sept. 2, 1930, pp. 291-294. Review of activities of sanitary engineering division of Ontario Department of Health covering water purification plants, sewerage systems and sewage disposal plants.

WELDING

Spot, Machine for. Electric Spot Welding Machine (Soudeuse électrique par points), L. Lenouvel. Science et Industrie (Paris), vol. 14, no. 199, Aug. 1930, pp. 595-597, 4 figs. Recently developed welding machine of Sciaky type PP. 320 for automatic regulation is described; notes on principal characteristics, power consumption, power factor, strength of welds, water cooling of electrodes, water consumption, etc.

Engineering Index

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A

AERODYNAMICS

Modern German Research. Modern Aerodynamical Research in Germany, J. W. Maccoll. Roy. Aeronautical Soc.—Jl. (Lond.), vol. 34, no. 236, Aug. 1930, pp. 649-679 and (discussion) 679-689, 18 figs. Important results of modern German research upon motion of incompressible fluids; theory of boundary layer and its application for laminar and turbulent conditions; experimental and theoretical investigation of development of turbulence; characteristics of fully developed turbulence; spreading of jets; flow in pipes and channels; convergent and divergent channels; flow between rotating cylinders.

AIRPLANE ENGINES

Air Cooled. Some Recent Progress in Air-Cooled Aero-Engine Development, C. F. Abell. Engineering (Lond.), vol. 130, no. 3373, Sept. 5, 1930, pp. 308-311, 7 figs. To summarize progress made in 10 years, weight per horsepower has been reduced by 25 per cent, power output increased by 50 per cent, and period between overhauls increased by 700 per cent, with corresponding increase in reliability of engine and life of main components; recent changes in design which have led to higher speeds of revolution, higher brake mean-effective pressure, and higher overall efficiency in Jupiter radial engine. Paper read before Section G. of Brit. Assn. Sept. 4, 1930.

Diesel. Air-Cooled Heavy Oil Engines, A. H. R. Fedden. Aircraft Eng. (Lond.), vol. 2, no. 20, Oct. 1930, pp. 261-262, 3 figs. Experiments on single-cylinder 4-cycle airless-injection engine of 8½ liter capacity and 7⅜ by 12 in. bore stroke; for maximum fuel injection of 0.54 cc. engine developed, 77 b.hp. at 1,100 r.p.m.; fuel consumption of 0.446 lb. per b.hp.-hr. at 108 b.m.e.p.; graph shows comparative weight curves for compression-ignition and gasoline engine installations. Paper read before Fifth Int. Air Congress, Hague.

The Packard Diesel Aircraft Engine, L. M. Woolson. Soc. Automotive Engrs.—Jl., vol. 27, no. 3, Sept. 1930, pp. 279-281 and 319. Discussion of paper previously indexed from Apr. 1930, issue of same Journal; elimination of fire hazard; ability to use crankcase oil as emergency fuel; advantages of two-stroke Junkers engine as compared with four-stroke Packard.

Liquid-Cooled. Possibilities of the Liquid-Cooled Aircraft Engine, R. B. Beisel. Soc. Automotive Engrs.—Jl., vol. 27, no. 4, Oct. 1930, pp. 403-407. Advantages of liquid cooling as compared to air cooling; reduced resistance ethylene glycol cooling; reduction in cooling-surface area; adaptability to gearing and high engine speed; characteristics of future engine visualized.

Radial vs. In-Line. In-Line versus Radial Aircraft Engines, W. F. Davis. Soc. Automotive Engrs.—Jl., vol. 27, no. 4, Oct. 1930, pp. 451-453, and (discussion) 454-458. Comparison of advantages with regard to reliability, simplicity of design, weight, visibility, head resistance, installation and service costs; discussion relates experiences with ethylene-glycol cooling; carbureter location.

Supercharging. Geared Centrifugal Superchargers for Airplane Engines, S. A. Moss. Soc. Automotive Engrs.—Jl., vol. 27, no. 2, Aug. 1930, pp. 148-153 and 160, 13 figs. and (discussion), no. 3, Sept. 1930, pp. 340-343. Discussion of design and functioning of General Electric supercharger used in Pratt and Whitney, Curtiss, and Wright engines; notes on development and advantages; supercharging at sea-level and at altitude; maintenance of carburetor efficiency.

AIRPLANES

Dope. Airplane Dopes and Lacquers and Their Application, W. W. McCutcheon. Soc. Automotive Engrs.—Jl., vol. 27, no. 3, Sept. 1930, pp. 263-266 and (discussion) 266-267, 1 fig. General outline of composition, process of manufacture, and application of dopes, lacquers and pigmented dopes, and trouble experienced with available materials; simple and cheap methods of testing dope to ascertain its qualities are explained; primary requisites of good dope and cause and remedy for blushing.

Fuels. Fuel Problems in Aviation Engines, G. W. Vaughan. Oil and Gas Jl., vol. 29, no. 19, Sept. 25, 1930, pp. 38 and 76. President of Wright Aeronautical Corporation deplores fact that knock rating, characteristic that most interests aircraft engine builders, is not definitely and accurately covered by existing specification; thing that must control design of standard engine that goes into general service is anti-knock value of poorest fuel that operator may buy under indefinite and misleading name of domestic aviation gasoline; unsatisfactory situation is holding back commercial development of new industry. Read before Nat. Petroleum Assn.

The Effect of Airplane Fuel-Line Design on Vapour Lock, O. C. Bridgeman and H. S. White. Soc. Automotive Engrs.—Jl., vol. 27, no. 4, Oct. 1930, pp. 444-450 and 458, 9 figs. Measurement of flow through systems of various designs; increases in cross-sectional area along direction of flow are particularly liable to cause vapour lock; weathering of gasoline in carburetor float bowl reduces vapour-locking tendency; fuel-pump experiments.

The Vapour-Locking Tendency of Aviation Gasolines, O. C. Bridgeman and H. S. White. Soc. Automotive Engrs.—Jl., vol. 27, no. 2, Aug. 1930, pp. 218-230 and (discussion) 230-233, 20 figs. Study of properties of gasolines which determine their vapour-locking tendency; conditions under which vapour lock occurs in typical fuel feed of vapour lock; measurement of temperatures existing in fuel-feed systems of representative aircraft during flight.

Landing Speeds. An Investigation of Airplane Landing Speeds, K. F. Ridley. Nat. Advisory Committee for Aeronautics—Tech. Notes no. 349, Sept. 1930, 39 pp. 21 figs. Performance characteristics; experimental work in measuring landing speed of several monoplanes by new photographic method; tests supplemented by available information regarding biplanes were compared with predictions made in accordance with basic aerodynamic theory; fundamental relation between wing loading, lift coefficient and speed of level flight, and effects of aspect ratio and proximity to ground on lift curve slope.

Light Alloys for. The Use of Non-Ferrous Metals in the Aeronautical Industry, D. Hanson. Engineer (Lond.), vol. 150, no. 3896, Sept. 12, 1930, pp. 291-293. Discussion of aluminum and magnesium and their alloys for air-craft construction; wrought alloys; "Y" alloys; cast aluminum alloys; approximate compositions and properties of typical aluminum casting alloys and of magnesium alloys for castings. Ninth autumn lecture to Institute of Metals, Sept. 9, 1930.

Propellers. Theory of Self Rotating Screw. Investigation of Conditions Necessary for Obtaining Maximum Braking (Teoria dell'elica in autorotazione. Ricerca delle condizioni necessarie per ottenere il massimo effeto frenante), G. Serragli. Notiziario Tenico di Aeronautica (Rome), vol. 6, no. 7, July 1930, pp. 40-53, 4 figs. Discussion of propeller action in vertical descent and at great angle of incidence.

Wind-Tunnel Testing. Wind Tunnel Experiments on the Burnelli All-Wing Principle, A. Klemin. Aviation Eng., vol. 3, no. 9, Sept. 1930, pp. 22-24, 4 figs. Summary of test results on large twin-engined transport plane; curves for various coefficients of aerodynamic efficiency are given and body and wing arrangement illustrated.

AIRSHIPS

Rigid. The Development of Rigid-Airship Construction, V. C. Richmond. Engineering (Lond.), vol. 130, nos. 3374 and 3376, Sept. 12, 1930, pp. 341-344 and Sept. 26, pp. 412-414, 2 figs. Idea of what future airships may look like may be gained from trend of development described; increase to twice capacity of existing vessels, and more, in lifetime of present generation can be foreseen without insuperable engineering difficulty; such ships, 1,000 ft. long and of 200 ft. girth, will constitute largest moving structure in world; with present speed of 70 to 80 m.p.h., saving in time constitutes great advantage over other forms of transport. Paper read before Section G, Brit. Assn.

ALLOY STEEL

Castings, Heat Treatment of. Trends in Heat Treatment of Alloy Steel Castings, A. W. Lorenz. Iron Age, vol. 126, no. 11, Sept. 11, 1930, pp. 693-695 and 705-756, 3 figs. Brief review of manufacturing methods and equipment; properties and application of principal alloy castings.

ALUMINUM ALLOYS

Aluminum-Iron-Silicon. Constituents of Aluminum-Iron-Silicon, W. L. Fink and K. R. Van Horn. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 351, for mtg. Sept. 1930, 11 pp., 6 figs. Result of uncompleted study of constituents of aluminum-iron-silicon system; methods employed; preparation of specimens; X-ray methods; silicon; aluminum-iron compound found in aluminum-iron alloys up to 40 per cent iron; alpha and beta iron-silicon compounds; table of interplanar spacings. Bibliography.

Aluminum-Silicon-Magnesium. Aluminum-Silicon-Magnesium Casting Alloys, R. S. Archer and L. W. Kempf. A.I.M.E.—Tech. Pub., no. 352, Sept. 1930, 34 pp., 19 figs. Object of work described was development of alloys and heat treatment for production of sand castings and permanent-mould castings having advantages of binary aluminum-silicon alloys; constitution of alloys; theory of heat treatment; previous work on castings; experimental methods and materials used; effect of pouring temperature; corrosion resistance; machinability; some properties of castings. Bibliography.

Die-Cast Castings. Pressure Die-Cast Aluminum Alloy Test-Pieces, J. D. Grogan. Inst. of Metals—Advance Paper (Lond.), no. 530, for mtg. Sept. 9-12, 1930, 18 pp., 14 figs.; see also Engineering (Lond.), vol. 130, no. 3374, Sept. 12, 1930, pp. 345-347, and (discussion) pp. 334-335, 11 figs. Investigation of mechanical strength of aluminum alloys when pressure cast in form of small tensile test pieces; behaviour of selected alloys when subjected to attack of molten aluminum alloy and method of entry of metal under pressure into simple cylindrical mould; results indicate that, if certain technical difficulties can be overcome, process will yield products of excellent mechanical properties.

Properties. Modulus of Elasticity of Aluminum Alloys, R. I. Templin and D. A. Paul. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 366, Sept. 1930, 9 pp., 5 figs. Modulus of elasticity as affected by alloying elements commonly used; results of tensile tests made on aluminum-magnesium series of alloys, both heat-treated and not heat-treated, on number of alloys of aluminum-magnesium type containing different percentages of various alloying elements, and on number of aluminum alloys containing appreciable amounts of alloying elements; apparatus used; method of determining E from tensile stress-strain data.

ALUMINUM-SILICON ALLOYS

Heat Treatment. Influence of Heat Treatment on Resistance of Aluminum-Silicon Alloys Containing up to 2.5 Per Cent Silicon (Influence du traitement thermique sur la résistivité et la résistance mécanique des alliages aluminium silicium contenant jusqu'à 2.5 % de silicium), L. Guillet and M. Ballay. Revue de Métallurgie (Paris), vol. 27, no. 8, Aug. 1930, pp. 398-403, 9 figs. Results of tests on 21 alloys, compositions of which are given.

AMMETERS

High Frequency. New Current Meter for High Frequency (Ein neuer Strommesser fuer Hochfrequenz), K. Schlesinger. Zeit. fuer Hochfrequenztechnik (Frankfort), vol. 36, no. 2, Aug. 1930, pp. 62-65, 7 figs. New hot-wire ammeter by which stretch is not measured directly but by change in natural frequency of wire when heated.

AUTOGIROS

THEORY OF. The Autogiro Analyzed, W. L. Le Page. Soc. Automotive Engrs.—Jl., vol. 27, no. 3, Sept. 1930, pp. 257-262, 9 figs. Brief history of its development and elementary theory of flight; mast upon which hub is mounted generally is set sligbtly to one side to correct for lack of symmetry; climbing speed is not as good as tbat for equivalent airplanc, but angle of climb is greatly superior.

AUTOMOTIVE FUELS

PROPERTIES. Suitability of Fuels for Modern Internal-Combustion Engine (Les carburants appropriés aux moteurs à explosion modernes), A. Grebel. Chimie et Industrie (Paris), vol. 23, nos. 4, 5 and 6, Apr. 1930, pp. 825-833, May, pp. 1082, 1091, and June, pp. 1353-1358, 15 figs. Survey of properties, cbemical composition and combustion characteristics of gasoline and oil fuels for all kinds of internal-combustion engines; control of detonation by compounding and addition of various substances.

TESTING. Latent Heat of Vaporization of Fuels and Measuring Method (Die Verdampfungswaerme der Kraftstoffe und eine Metbode zu ihrer Bestimmung), Wawrziniok. Automobiltecbnische Zeit. (Berlin), vol. 33, nos. 25 and 26, Sept. 10, 1930, pp. 618-620 and Sept. 20, pp. 644-646, 3 figs. Effect of heat of vaporization on engine performance. New principle and apparatus for determining its value for non-homogeneous liquids give accurate cbecks; tables give data on alcohol-benzol mixtures.

VOLATILE. Volatile Liquid Fuels, H. C. Dickinson. Petroleum World (Lond.), vol. 26, nos. 358 and 359, July 1930, pp. 248-254 and Aug., pp. 273-274. July: Fuel volatility and economy; dilution of crankcase oil; engine starting; engine acceleration; vapour lock; knock cbaracteristics of fuels; gasoline specifications. Aug.: Potential sources of motor fuel. Paper read at World Power Conference, Berlin.

(*See also Airplanes, Fuels.*)

B

BEAMS

BENDING. Correcting an Error in Application of Flexure Formula, F. B. Seely. Macbine Design, vol. 2, no. 9, Sept. 1930, pp. 32-34, 8 figs. Determination of distance of shear-centre from web-centre line by experiment and calculation.

CONCRETE. Steel Requirements of Reinforced-Concrete Beams (Der Eisenbedarf der Eisenbeton-Balken), K. Bernhard. Zement (Charlottenburg), vol. 19, nos. 25, 27, 28 and 29, June 19, 1930, pp. 591-595, July 3, pp. 637-640, July 10, pp. 663-666 and July 17, pp. 688-690, 1 fig. Notes on iron coefficient; comparison witb slabs; increasing, sbear and bending reinforcement; special examples; main and auxiliary reinforcement; total steel requirement of beam field; pressure reinforcement.

BEARING METALS

BRONZE. Bearing Bronzes witb Additions of Zinc, Pbosphorus, Nickel, and Antimony. U.S. Bur. of Standards—Jl. of Research, vol. 5, no. 2, Aug. 1930, pp. 349-364, 16 figs. Study was made of copper-tin-lead-bearing bronzes with and without additions of zinc, pbospborus, nickel, and antimony; test made included wear resistance, resistance to impact, Brinell bardness, and resistance to repeated pounding at several temperatures.

BOILERS

DESIGN. Developments in Boiler Design. World Power (Lond.), vol. 14, no. 81, Sept. 1930, pp. 257-259, 1 fig. Design of steam-raising boilers has undergone various developments and modifications during recent years in order to meet improvements in methods of combustion, introduction of new systems of combustion, and notably higher steam pressures whicb have become common; illustrated description of design features incorporated in Cbalk boiler.

FURNACES. Modern Grate Furnaces (Neuere Rostfeuerungen—Fortschritte und Versuchsergebnisse), R. Schulze. Waerme (Berlin), vol. 53, no. 36, Sept. 6, 1930, pp. 665-669, 6 figs. Notes on progress and experimental results; by comparison of some entirely new boiler installations with otbers 4 to 6 years old, extent of improvement in past few years is shown.

Relations between Furnace, Furnace Temperature, Combustion Process and Efficiency (Feuerraum, Feuerraumtemperatur, Verbrennungsvorgang, Wirkungsgrad), Marcard. Waerme (Berlin), vol. 53, no. 39, Sept. 27, 1930, pp. 714-726, 26 figs. Critical study of mean furnace temperature and its influence on furnace design and combustion process; metbods of determining heat volume transmitted in furnace through radiation; discussion of efficiency based on different losses; examples of practical applications.

HEADS. Calculation of Boiler Heads Exposed to Internal Pressure (Calcul des fonds soumis à une pression intérieure), E. Hoebn. Cbaleur et Industrie (Paris), vol. 11, no. 123, July 1930, pp. 314-319, 15 figs. Discussion of test results and methods for calculating stresses in disbed boiler heads.

HIGH PRESSURE. Super-Pressure Boiler at Bradford Power Station. Engineer (Lond.), vol. 150, nos. 3895-3896, Sept. 5 and 12, 1930, pp. 244-246 and 279-280, 20 figs. Sept. 5: Duty of boiler is to generate normally 75,000 lbs. of steam per hr. at pressure of 1,100 lbs. per sq. in. and temperature of 800 deg. fabr. though output of 94,000 lbs. of steam per hr. can be continuously maintained; boiler is cross-drum marine type; furnace is entirely water cooled, tubes connected witb boiler system abstracting beat from side walls, back and arch witb its front wall. Sept. 12: Stoker is of Babcock and Wilcox's latest compartment type; it has working lengtb of 18 ft. and is 21 ft. 5 in. wide, thus having total working surface of practically 386 sq. ft.; it is largest single stoker in service in Great Britain; feature of grate is absence of any stress in links tbemselves; stoker is equally suitable for balanced or simple induced draft, change from one to other being effected in few moments.

RIVETING. A New System of Riveting. Engineer (Lond.), vol. 150, no. 3896, Sept. 12, 1930, pp. 276-277, 7 figs. Attempt to avoid difficulties of scale, and insufficient upsetting of shank at bead end, resulted in introduction of Schucb system of riveting; heat of rivet is conical before closing to allow scale to escape readily, and to promote swelling of upper end of shank; Skoda Works, Czechoslovakia, have eliminated all previous manufacture of rivets and use plain lengths of rivet iron cropped from bar; process facilitates workmansbip of highest class, while minimizing production cost; Skoda works employ pin riveting for all locomotive boilers.

VIBRATIONS. Observations on Pulsating Boilers (Beobachtungen an brummenden Dampfkesseln), F. Kaiser. Zeit. des Bayerischen Revisions-Vereins (Munich), vol. 34, nos. 16 and 17, Aug. 31, 1930, pp. 223-225 and Sept. 15, pp. 234-236, 2 figs. Number of examples are cited to show to what extent pulsation can be attributed to certain factors, such as nature of combustion, design of flues, and cleanliness of boilers.

WOOD-WASTE-FIRED. Design of Furnaces and Fuel Feeders for Burning Refuse, M. A. Hofft. Am. Soc. Mecb. Engrs.—Advance Paper, for mtg. Oct. 16-17, 1930, 9 pp., 10 figs. Recent development in design of furnace for burning dry wood refuse in suspension; factors influencing design of wood-burning furnaces in industrial plants; development of inclined-grate furnaces for burning refuse fuels; development of automatically controlled dry wood-refuse feeders and storage bins.

BRAZING

ELECTRIC-RESISTANCE METHOD. Brazing by Resistance Method, W. C. Reed, M. Unger and G. E. Gifford. Gen. Elec. Rev., vol. 33, no. 10, Oct. 1930, pp. 568-570, 7 figs. Many metals such as copper, nickel, silver, steel, and their alloys can be brazed electrically; tbis type of brazing has been perfected in Pittsfield Works Laboratory of General Electric Co. and used extensively in production work for two years; equipment required; bandling capacity; preparation of joints; tecbnique of brazing operation.

Electric Resistance Brazing Affords Durable Joints, G. E. Gifford. Steel, vol. 87, no. 11, Sept. 11, 1930, pp. 59-60, 3 figs. Description of methods and equipment developed by General Electric Co., Scbenectady, N.Y.; difference between pressure brazing and resistance brazing is explained and data are given on fluxes and silver alloys.

BRICKMAKING MACHINERY

VIMAX. The Vimax Brick-Making Macbine. Engineering (Lond.), vol. 130, no. 3374, Sept. 12, 1930, pp. 337-338, 6 figs. partly on p. 330. Vimax bricks manufactured by Vimax Macbinery Co. are prepared from good-quality cement, combined with sand obtained from Folkestone beds; correct proportions of sand and cement in dry state are put into ordinary mixer of pan type, and after thorough mixing, sufficient water is added to cause material to just bind when squeezed by hand; machine is driven from line sbafting by belt; it has normal output of some 2,400 bricks per hr.

BRICKMAKING PLANTS

POWER CONSUMPTION. Power and Fuel Consumption in Sand-Lime Brick Factories, W. Leder. Tonindustrie-Zeitung (Berlin), vol. 54, nos. 59 and 60, July 24, 1930, pp. 975-978, and July 28, pp. 993-995, 1 fig. Power can be supplied by steam engine, oil engine or electric motor; tables are given showing power and fuel consumption in factories with different technical equipment and manufacturing processes.

BRIDGE DESIGN

CONTINUOUS GIRDER. Continuous Girder of Multi-Span Bridges with Supports Fixed at Their Base (Travi continue da ponte solidali con piedritti incastrati alla base), C. Guidi. Annali dei Lavori Pubblici (Rome), vol. 68, no. 6, June 1930, pp. 477-495, 4 figs. Theoretical mathematical analysis of concrete structures of this type, showing that author's formula gives results of satisfactory precision, better than formulae usually employed; application of methods of influence lines for determination of bending moments and shears.

STRESSES. The Proportioning of Bridgework, J. S. Wilson. Engineering (Lond.), vol. 130, no. 3376, Sept. 26, 1930, pp. 399-400. Editorial review of paper read before Britisb Association comparing past and present specifications for bridge work; it would be well if, when new bridge specifications were being prepared, "why" of each clause should be considered before its final adoption.

BRIDGE PIERS

FOUNDATIONS. Experimental Ramming and Loading for New Limfjord Bridge (Beretning om proveramning og provebelastning for den nye Limfjordsbro), O. Kielrulff. Ingenioren (Copenhagen), vol. 39, no. 35, Aug. 30, 1930, pp. 417-425, 9 figs. Report on driving of bollow reinforced-concrete test piles, 50 cm. external diam., 23 to 35 m. long; data analyzed in ligbt of Eytelwein formula.

BRIDGES, CONCRETE

DESIGN. Some Points in Reinforced Concrete Bridge Design, C. S. Chettoe. Soc. of Engrs.—Trans. (Lond.), 1929, pp. 193-209 and (discussion) 209-219, 17 figs. Problems in design of reinforced-concrete slabs, beams, rigid frame, abutments, wings, walls, and arches.

BRIDGES, CONCRETE ARCH

BELLEVILLE, ONT. Handsome Concrete Bridge Completed at Belleville, C. A. Mott. Contract Rec. (Toronto), vol. 44, no. 39, Sept. 24, 1930, pp. 1133-1134, 5 figs. Description of two-span bow-string structure, 220 ft. long overall, completed in less tban four months; splash panel is novel feature of design.

BRIDGES, STEEL TRUSS

VANCOUVER. Large Bridge, 2,817 ft. Long, to be Built in Vancouver. Contract Rec. (Toronto), vol. 44, no. 37, Sept. 10, 1930, p. 1085. Features of projected steel-truss highway bridge with individual spans up to 295 ft. 5 ins. in length.

BRIDGES, SUSPENSION

DETROIT RIVER. Tbe Ambassador Bridge, J. Jones. Military Engr., vol. 22, no. 125, Sept.-Oct. 1930, pp. 401-404, 5 figs. General description of suspension bridge baving main span of 1,850 ft.; roadway 47 ft. wide; heat-treated vs. cold-drawn wire; replacement of cables; characteristics of anchorages; terminals.

BUILDINGS

FOUNDATION REPLACEMENT. Foundation of Fourteen Storey Building Replaced under Basement Floor. Eng. News-Rec., vol. 105, no. 13, Sept. 25, 1930, pp. 496-499, 5 figs. Report on how 14-storey building in San Francisco was transferred from foundation of 1,100 wooden piles to 210 concrete piers, without disturbing tenants of building or causing any appreciable settlement; hydraulic jacks place load on needle beams; foundation plan, showing footings, caissons and connecting beams; transferring column loads to caissons.

BUILDINGS, CONCRETE

FRAMEWORKS. Reinforced-Concrete Frameworks (Skelettbauten aus Eisenbeton), G. Rueth. Zement (Berlin), vol. 19, nos. 31 and 32, July 31, 1930, pp. 728-733 and Aug. 7, pp. 755-758, 18 figs. Advantages of use of high-grade cement in framework of buildings and examples of sucb constructions.

WINTER CONSTRUCTION. Winter Concreting Methods Applied on Contract of Moderate Size, R. C. Johnson. Concrete, vol. 37, no. 4, Oct. 1930, pp. 13-16, 5 figs. Report on winter construction of four-storey Y.M.C.A. building in Kenosha, Wisconsin, 120 ft. by 100 ft.; wall-bearing construction prolonged concreting period; frequent tests made; winter concrete plant equipment; coal and coke consumption of boiler and salamanders; cost of winter concreting.

BUILDINGS, STEEL FRAME

WIND BRACING. Notes on the Bracing of Steel Framed Building, W. Smith. Structural Eng. (Lond.), vol. 8, no. 9, Sept. 1930, pp. 330-339, 15 figs. Discussion of metbods of bracing of various types of structures; rafter girder; horizontal girder at tie level; continuous tie angles at tie level; crane girders; tie joists; vertical bracings.

C

CABLEWAYS

ELECTRIC MOTORS. Special Motors Increase Tramway Speed. Elec. World, vol. 96, no. 14, Oct. 4, 1930, pp. 650-651, 5 figs. Electrification of 2,500-ft. tramway for transporting lumber in carloads across American River Canyon in California; employs two 225-hp., wound-rotor, intermittent-duty, boist motors operating electrically and mecbanically in parallel meets maximum power requirements; new tram is designed to carry narrow-gauge railroad car loaded with lumber and to make 70 trips in 8-hr. sbift.

CAMS

MILLING. Milling Cams Correctly, A. L. DeLeeuw. Am. Mach., vol. 73, no. 13, Sept. 25, 1930, pp. 503-505, 5 figs. Rapid wear in barrel cams is avoided by special machine wbich produces tbeoretically correct grooves, built by American Machine & Foundry Co.; master cam engages fixed roller to actuate cam blank during cut; data on feeds, speeds and output.

CANALS

WELLAND. The Welland Ship Canal. Engineering (Lond.), vol. 130, no. 3373, Sept. 5, 1930, pp. 285-288, 40 figs. partly on supp. plates. Details of Chippawa Creek siphon; structure consists of six low-level tubes 22 ft. in internal diameter with, at eacb end, vertical tubes of same size rising to surface; upper ends of each set of tubes terminate in concrete structure divided by walls into three sections, each containing two tubes. (Continuation of serial.)

CARBON DIOXIDE RECORDERS

Duscom Type. A New Combustion Recorder. Eng. and Boiler House Rev. (Lond.), vol. 44, no. 3, Sept. 1930, pp. 182 and 184, 2 figs. Illustrated description of operation of Duscom carbon dioxide and carbon monoxide recorder; record chart showing carbon dioxide and carbon monoxide readings.

CASE HARDENING

Carburizing. Normal and Abnormal Steel (Normaler und anormaler Stahl), E. Houdremont and H. Mueller. Stahl und Eisen (Duesseldorf), vol. 50, no. 38, Sept. 18, 1930, pp. 1321-1327, 13 figs. Report of Subcommittee on Case Carburizing Testing of Materials Committee of Verein deutscher Eisenhuettenleute; metallographic characteristics of normal and abnormal steels; physio-chemical methods of analysis; influence of treatment on behaviour of steel; metallurgical processes and their relations to observed phenomena. Bibliography.

Cyanide Bath. Structure of Steel Immersed in Cyanide Bath (Gefuege un Zyanidsalzbad eingesetzten Stahles), W. Henninger and H. Jurich. Stahl und Eisen (Duesseldorf), vol. 50, no. 38, Sept. 18, 1930, pp. 1334-1335, 4 figs. By etching with hot concentrated sodium-picrate solution, it is possible to detect eutectoid and needles in structure of low-carbon case-hardened steel after 5-hr. treatment in cyanide hardening flux and subsequent slow quenching; carbon and nitrogen absorption in cyanide flux is shown in curve.

CAST IRON

Electric-Furnace Melting. The Manufacture of Cast Iron in the Electric Furnace, W. Lister. Foundry Trade Jl. (London), vol. 43, no. 733, Sept. 4, 1930, pp. 165 and 167. Outline of advantages over cupola such as reduction of sulphur content, complete solution of carbon, and uniform structure; neutral higher temperature; data on melting procedure and duplexing method are given; table shows analysis of cupola-melted irons before and after treatment in electric furnace.

High-Test. Progress in Gray Iron Castings, H. Bornstein. Metal Progress, vol. 18, no. 4, Oct. 1930, pp. 43-46, 6 figs. Physical properties and composition of high-strength cast iron, alloy cast, iron, and heat treatment of gray-iron castings; microphotographs illustrate various structures; heating temperature and machinability.

CASTINGS

Centrifugal. Large Centrifugal Castings Made at Navy Yard, J. F. Crowell. Iron Age, vol. 126, no. 15, Oct. 9, 1930, pp. 994-996, and 1037, 3 figs. Methods and equipment for making centrifugal castings, including pipe for water, gas and oil mains; cylinder liners for engines and pumps; babbitt bearing surfaces of large bearing brasses, and sleeves for tail shaftings: sketch shows plan of elevation of centrifugal machine for castings 14 ft. long and 28 in. diam.

Cleaning. Cleaning of Castings by Means of Water Jet (Kritische Betrachtungen ueber das Putzen von Gusstuecken mittels Wasserstrahl), A. Rodehueser. Giesserei (Duesseldorf), vol. 17, nos. 36, 37 and 38, Sept. 5, 1930, pp. 882-884 and Sept. 12, pp. 896-903, and Sept. 19, pp. 926-930, 14 figs. Action of water jet; design of wet cleaning plant and experimental arrangement; volume of water required per second; influence of pipe friction; maximum kinetic energy with given nozzle diameter; influence of length of pipe line; back pressure; distribution of wages and water costs in relation to nozzle diameter; relations between physical and economic optimum nozzle.

CEMENT ANALYSIS

X-Ray. The X-Ray Method Applied to a Study of the Constitution of Portland Cement, L. T. Brownmiller and R. H. Bogue. Am. Jl. of Science, vol. 20, no. 118, Oct. 1930, pp. 241-264, 3 figs. Report from U.S. Bureau of Standards outlining X-ray method of analysis and its application to cement chemistry; examination of commercial cement clinkers; results obtained by X-ray methods are in agreement with those obtained by phase equilibria, chemical and microscopical methods. Bibliography.

CHIMNEYS

Concrete. Monolithic Reinforced-Concrete Chimneys (Monolithische Eisenbeton-Schornsteine), O. Hoffmann. Zement (Berlin), vol. 19, no. 35, Aug. 28, 1930, pp. 828-834, 13 figs. Examples of German designs by Wayss and Freytag.

CHROMIUM-VANADIUM STEEL

Properties and Uses. Vanadium Additions Improve Steel, N. Petinot. Steel, vol. 87, nos. 8, 9, 10, Aug. 21, 1930, pp. 43-45 and 48, Aug. 28, 1930, pp. 47-49 and Sept. 4, pp. 56-57, 60, 7 figs. Development of vanadium-containing steels in United States, properties and present application in major industries; effects of vanadium upon steels; properties of vanadium steels and discussion of commercial applications; use of vanadium as process element. Paper read before sixth International Congress of Min., Met. and Applied Geology in Liége, Belgium, June 22-28, 1930.

CITY PLANNING

Land Subdivision. Land Subdivision: The Effect of Density on Acreage Values and on Lot Values, R. Whitten. City Planning, vol. 6, no. 4, Oct. 1930, pp. 259-263. General discussion of subdivision practice; correlation of subdivision and building; housing density, and land and lot values.

CLUTCHES

Jaw. Design and Production of Jaw Clutches with Sloping Teeth (Nochmals einfache Konstruktion und Herstellung von Klauen-Kupplungen mit schraegen Zaehnen), R. Matthes. Werkstattstechnik (Berlin), vol. 24, no. 17, Sept. 1, 1930, pp. 472-473, 6 figs. Outline of calculating method for jaw clutch with arbitrary number of teeth which can be cut in one milling operation; practical examples are given.

COAL MINES AND MINING

Electric Substations. Changing Manually-Operated Substation to Automatic, R. W. Monroe and H. S. Littlewood. Elec. Jl., vol. 27, no. 9, Sept. 1930, pp. 515-519, 5 figs. Consolidation Coal Co., Somerset, Pa., was confronted with problem of moving existing manually operated converter substation to new location two miles away and making it automatically operated; operations at their Bell Mine, at which manually operated station had been located, were to be discontinued; how operations were carried out and details of equipment.

Mechanization. Modern Methods of Machine Mining, N. E. Nicholson and W. Widdas. Colliery Guardian (Lond.), vol. 141, no. 3635, Aug. 29, 1930, pp. 754-757, 6 figs. Machines are described, and layout of districts and application of machines are discussed; conveyor-loader, designed for semi-long-wall system in United States, installed at Mainsforth coal mine; belt conveyor; chain coal cutters; main-and-tail haulage system; electric power; scraper loader.

COBALT DEPOSITS

Ontario. A Qualitative and Quantitative Determination of the Ores of Cobalt, Ont., L. Thomson. Economic Geology, vol. 25, nos. 5 and 6, Aug. 1930, pp. 470-505, and Sept.-Oct., pp. 627-652, 32 figs. Aug.: Eight new microchemical reagents have been developed for differentiation of arsenic minerals; crystal habits, modes of occurrence, and interrelationships of nine of these minerals; relative abundance of common minerals. Sept.: Relations of metallic minerals to diabase sill; minerals favourable and unfavourable to deposition of native silver; rarer minerals; details of ore genesis. Bibliography.

COLD STORAGE PLANTS

Air Conditioning. Cooling and Ventilating Cold Storage Rooms, C. L. Hubbard. South. Power Jl., vol. 48, no. 9, Sept. 1930, pp. 77-81, 10 figs. Cooling by direct expansion is simple, definite; cooling by brine systems, more flexible and readily controlled; both have their proper applications; arrangement of cooling surface; fan systems; insulation.

COMPRESS AIR RECEIVERS

Explosions, Prevention of. The Prevention of Air-Receiver Explosions, E. Ingham. Mech. World (Lond.), vol. 88, no. 2278, Aug. 29, 1930, pp. 203-204, 1 fig. Air receiver's strength to resist any required pressure is easily determined, and there is little reason why possibility of explosion should not be almost entirely eliminated; safe type of air receiver is cylindrical mild-steel vessel with butt-riveted joints for longitudinal seams, lap-riveted joints for circumferential seams and with outwardly cambered endplates.

COMPRESSED AIR LINES

South Africa. Compressed Air System on the Rand, B. Price. S. African Eng. (Lond.), vol. 41, no. 9, Sept. 1930, pp. 229-230, 1 map. Pipe system of Victoria Falls and Transvaal Power Co., Ltd., supplies compressed air for power purposes to mines on Central Rand; consumers are fed by short single branch pipes from network of mains, which affords duplicate supply to all branches excepting those situated east of Rosherville; anchoring of bends; joints; joint packing; drainage of condensed moisture and collection of grit; internal and external corrosion; value of aluminum powder paint.

CONCRETE

Vibrated. Vibrated and Pervibrated Concrete (Le béton vibré et pervibré), Trêves. Société des Ingénieurs Civils de France—Mémoires et Compte Rendu des Travaux—Bul. (Paris), vol. 83, no. 5-6, May-June, 1930, pp. 450-474, special plate of drawings. Historical review of development of methods in France; advantages of vibration methods; features of electric and compressed-air apparatus used; details of modern methods; future of vibrated concrete construction.

Waterproofing. Watertight Concrete (Zur Frage der Wasserundurchlaessigkeit von Beton), Vogeler. Bautechnik (Berlin), vol. 8, no. 23, May 30, 1930, pp. 342-343, 1 fig.; see also Bldg. Science Abstracts, vol. 3, no. 8/9, Aug./Sept. 1930, p. 291. Evidence and argument in defense of method of designing mixes for watertight concrete, introduced by Ostendorf and incorporated in instructions on mortar and concrete issued by German Railway, as against criticism by Marx, who maintained that method of proportioning fine to coarse aggregate necessitates their separation, thus precluding direct use of natural mixtures. See also supplementary remarks by Ostendorf on p. 34.

CONCRETE CONSTRUCTION

Stresses. Shear Cracks in Reinforced-Concrete Cantilever (Schubrisse in einem Kragtraeger), Marcus. Bauingenieur (Berlin), vol. 11, no. 17, Apr. 25, 1930, p. 302, 3 figs.; see also brief translated abstract in Bldg. Science Abstracts, vol. 3, no. 8/9, Aug./Sept. 1930, p. 322. Cantilever in which reinforcement was placed in accordance with usual practice, developed few days after stripping, nearly horizontal cracks, towards but not reaching outer end; phenomenon is explained by comparison with behaviour of wooden cantilevers, and it is recommended that inclined bars be spaced approximately uniformly rather than in accordance with shear diagram.

CONCRETE DESIGN

Slabs. More Economic Design by Utilization of Slabs in Reinforced-Concrete Walls and Floors (Wirtschaftlicherer Entwurf durch Ausnutzung der Scheibenwirkung von Eisenbetonwaenden und Decken), H. Craemer. Zement (Berlin), vol. 19, no. 30, July 24, 1930, pp. 703-708, 12 figs. Reciprocal influence of neighbouring construction elements due to monolithic construction of reinforced concrete-resulting stress equalization and its economic importance; effect of self-supporting slabs in silos; wall obviates use of beams; practical examples; in one case waste of over 300 cu. m. of reinforced concrete is shown in medium-sized building.

CONVEYORS

Cement Plants. Mechanical Conveying in Cement Manufacture. Mech. Handling (Lond.), vol. 17, no. 10, Oct. 1930, pp. 335-338, 3 figs. Various mechanical-handling processes involved in manufacture of cement, and conveying appliances employed.

Redler Type. A New Conveyor Principle, G. F. Zimmer. Mech. Handling (Lond.), vol. 17, no. 10, Oct. 1930, pp. 317-319, 5 figs. Redler system of conveying based on principle of conveyor which carried continuous mass upon series of narrow strips of chain links in bottom of trough.

COPPER ALLOYS

Heat Conductivity. Thermal Conductivity of Copper Alloys—Copper-tin Alloys—Copper-phosphorus Alloys, C. S. Smith. Am. Inst. Min. and Met. Engrs.—Tech. Pub., no. 360, Sept. 1930, p. 11, 4 figs. Continuation of Tech. Pub. no. 291, previously indexed; thermal conductivity of copper is rapidly reduced by addition of tin until with 10.41 per cent it is only 0.121 cal./sq.cm./sec./deg. cent. at 20 deg. cent.; phosphorus is 10 times as powerful as tin; electrical conductivity decreases more rapidly on alloying than does thermal conductivity, and Wiedemann-Franz-Lorenz ratio increases rapidly at first, but beyond 2.0 per cent tin or 0.15 per cent phosphorus remains almost constant.

Heat Treatment. Shaping and Annealing Treatment of Copper and Copper-Zinc Alloys, Mendl. Metal Industry (Lond.), vol. 37, no. 10, Sept. 5, 1930, pp. 217-220, 1 fig. Hot and cold deformation, annealing and impurities of copper; equilibrium diagram and stretching stresses of copper alloys. Translated from Metallwirtschaft, Mar. 21, 1930.

Copper-Silicon-Zinc. A New Silicon-Zinc-Copper Alloy, E. Vaders. Foundry Trade Jl. (Lond.), vol. 43, no. 735, Sept. 18, 1930, pp. 202-204, 5 figs. Composition and physical properties of various silicon-zinc-copper alloys; diagram gives ternary system silicon-zinc-copper, showing solubility curve of silicon; cooling curves of silicon-zinc-copper alloys; curves showing dependence of tensile strength elongation and hardness of silicon content; notes on foundry practice. Abstract of paper read before Inst. Metals, previously indexed from Advance Paper, no. 544.

COPPER REFINING

Electrolytic. El Paso Refinery of the Nichols Copper Company, F. R. Corwin and C. S. Harloff. Min. and Met., vol. 11, no. 286, Oct. 1930, pp. 459-465, 6 figs. Yearly capacity of 100,000 tons of anodes; detail of layout, equipment, slime treatment, wire-bar furnace construction, sampling, electrolysis, etc.

COPPER-ZINC ALLOYS

Constitution of. Constitution of Alloys of Copper and Zinc (Sur la structure des alliages cuivre-zinc), W. Broniewski and J. Strasburger. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 24, June 16, 1930, pp. 1412-1415, 2 figs. Variations with composition of 8 physical properties of copper-zinc alloys, namely conditions at 0 deg., coefficient of electric resistance between 0 and 100 deg., thermoelectric potential at 0 deg. referred to lead, change of thermoelectric potential between minus 78 and plus 100 deg., maxima of e.m.f. coefficient of dilation at 0 deg., change of this coefficient between minus 183 and plus 218 deg. and Brinell hardness; data are represented by means of curves.

COPPER-ZINC MINES AND MINING

Manitoba. Proposed Mining and Milling Practice at Sherritt Gordon Mine. Can. Min. and Met. Bul. (Montreal), no. 220, Aug. 1930, pp. 1012-1038, 13 figs.

partly on supp. plates. Mine in development stage, located 90 mi. north of The Pas; history; geology; ore characteristics; exploration and development; ore testing data and pilot mill results; development and production plans; proposed stoping method; concentrator equipment and flow sheet; flotation reagents, etc.

COPPER-ZINC ORE TREATMENT

MANITOBA. Concentration and Cyanidation at Flin Flon Pilot Mill, S. P. Lowe. Can. Min. and Met. Bul. (Montreal), no. 221, Sept. 1930, pp. 1183-1205, 7 figs. Assays of heavy sulphide ore and disseminated ore; laboratory tests; experimental 2-ton plant; 25-ton flotation plant and 10-ton cyanide plant; 3,000-ton mill is described; flow sheets.

COUPLINGS

FLEXIBLE. Selecting and Installing Flexible Couplings, F. A. Annett. Power, vol. 72, no. 14, Sept. 30, 1930, pp. 534-537, 8 figs. Most of troubles experienced with flexible couplings can be eliminated by selecting right size and type for job, and by giving them reasonable amount of care after they have been properly installed; service factors for flexible couplings.

CUTTING METALS

ECONOMICAL METHODS. Need for Economical Cutting Methods (Ueber die Notwendigkeit wirtschaftlicher Zerspanungsarbeit), F. Theimer. Maschinenbau (Berlin), vol. 9, no. 18, Sept. 18, 1930, pp. 598-600, 5 figs. Mathematical investigation of losses and loads under various operating conditions of machine tools; diagrams illustrate speed, feed, and forces with different metals; effect of load on efficiency.

CUTTING TOOLS

TUNGSTEN CARBIDE. Cutting Tests with Cemented Tungsten Carbide Lathe Tools, T. G. Digges. U.S. Bur. of Standards—Jl. of Research, vol. 5, no. 2, Aug. 1930, pp. 365-383, 12 figs. Investigation was made for purpose of developing method of testing cemented tungsten-carbide lathe tools under heavy duty and to extend to new cutting material some of laws originally developed by Taylor and his associates for cutting with carbon and high-speed steel tools; relations were determined between speed, feed, depth of cut, and tool life for selected form and size of tool; results are presented in both graphic and tabular forms.

D

DAMS

BOULDER DAM PROJECT. Controlling the Colorado, R. F. Walter. Eng. News-Rec., vol. 104, no. 6, Feb. 6, 1930, pp. 247-253, 9 figs. Chief engineer of U.S. Bureau of Reclamation discusses Boulder Canyon project; discharge of Colorado River; flood control; irrigation and power storage; silt storage; dimensions of dam; plans for building involve earth-fill cofferdams and four diversion tunnels; outlet works; railroad from Las Vegas, Nev., will be first item of construction; total expenditure of $165,000,000 is provided for in Boulder Canyon Act.

CONSTRUCTION. Hydro Construction Costs Reduced. Elec. World, vol. 96, no. 13, Sept. 27, 1930, pp. 590-591, 6 figs. Construction plant minimized in erecting Waterville dam; diversion sluices useful on Osage project for Union Electric Light & Power Co.; generator repair pedestal saves in hydro construction; precast dam closes narrow channel.

Suspended Pumps Dewater Dam. Constructor, vol. 12, no. 9, Sept. 1930, p. 39, 2 figs. Two electrically operated Byron Jackson pumps suspended from cables stretched across canyon were used to remove water from site of dam being constructed at Owyhee, Ore.; pumps handled almost 5,000 gals. of water per min.

DAMS, ARCH

DESIGN. Design Features of High Arch Dams, F. Vogt. Can. Engr. (Toronto), vol. 59, no. 11, Sept. 9, 1930, pp. 303-306. Fundamental views in analysis of arch dams; elastic properties of concrete; elastic deformation in foundation; direct water load on canyon; stresses in cross-section; external loads on dams; transfer of heat in concrete; periodical changes in temperature. From paper presented at Second World Power Conference, Berlin. (To be continued.)

DAMS, CONCRETE

CONSTRUCTION. Derricks Place 1,850 Yds. Per Day in Concreting Connecticut River Dam. Construction Methods, vol. 12, no. 10, Oct. 1930, pp. 36-40, 14 figs. Report on Construction of Fifteen Mile Falls Lower Development involving concrete dam, up to 180 ft. in height; plant consisting of four 1 yd. mixers and battery of derricks made consistently high placing record of more than 1,850 yds. per day; five cofferdams contained 37,378 cu. yds. of rock-filled cribs; 275,000 yds. of earth fill was placed.

DAMS, CONCRETE ARCH

CONSTRUCTION. Material Handling and Methods Used on the Ariel Hydro-Electric Project on the Lewis River, Wash., W. A. Scott. Contractors and Engrs. Monthly, vol. 21, no. 3, Sept. 1930, pp. 71-76, 6 figs. Report on construction of hydro-electric plant costing $8,500,000, including concrete arch dam about 300 ft. maximum height, 760 ft. long at crest, also concrete lines diversion tunnel 1,467 ft. long, etc.; unwatering dam site; digging below river bed; operation of slackline cableways; proportioning and mixing plant.

DESIGN. Circular Concrete Arch Dam Designed by Simple Method, R. P. V. Marquardsen. Concrete, vol. 37, no. 4, Oct. 1930, pp. 27-29, 5 figs. Simple method for obtaining stresses in concrete dam of circular-arch type having constant cross-section in any one horizontal plane; working formulae and diagrams required by designer are given. (To be continued.)

DIES

FORGING. Use of Special Steels for Forging Dies (Die Verwendung von Sonderstaehlen fuer die Anfertigung von Pressgesenken), V. Fabian. Maschinenbau (Berlin), vol. 9, no. 17, Sept. 4, 1930, pp. 582-583, 6 figs. Discussion of experience with special steel of uniform hardness which increases life of dies from 5 to 40 times; data on composition and heat treatment are given.

FORMING AND BENDING. Dies for Bulldozing and Upsetting, G. A. Smart. Heat Treating and Forging, vol. 16, no. 9, Sept. 1930, pp. 1147-1151, 15 figs. Description and sketches of various types of bulldozer and upsetter dies; die holders; adjustable back stop; adjustable bending dies; angle iron bending dies; channel iron bending dies; progressive bending dies (inserts, etc.); combination bending dies; piercing dies; dies used in conjunction with drop hammer operations; selection of steel; one, two, and three pass dies, showing all essential points; piercing dies for gears, bushings, etc.

DIESEL-ELECTRIC POWER PLANTS

COSTS. Low Diesel Operating Costs, H. J. Achee. Power Plant Eng., vol. 34, no. 19, Oct. 1, 1930, pp. 1100-1101, 3 figs. Seven years operation with Diesel power at Woodward, Oklahoma, demonstrates economy of investment; operating costs with old steam plant; cost summary; chart showing varying cost and operating data for 7-yr. period.

DIESEL ENGINES

FLYWHEEL DESIGN. Simplified Calculation of Diesel Alternator Flywheels for Parallel Operation, T. Schou. Diesel Power, vol. 8, no. 9, Sept. 1930, pp. 474-479, 17 figs. Calculation of flywheels for Diesel-engine-driven alternators, when correctly carried out on basis of fundamental differential equation given by Doherty and Franklin, is laborious and difficult; results worked out for 16 of commonest engine arrangements; with aid of various factors inertia of flywheel for any other type of engine belonging to group of 16 may be easily arrived at by use of simple multiplication formula; specific examples are illustrated.

DRAINAGE PUMPING PLANTS

DESCRIPTION OF. Modern Drainage Pumping Stations (Neuzeitliche Schoepfwerkanlagen), E. Schulz. V.D.I. Zeit. (Berlin), vol. 74, no. 36, Sept. 6, 1930, pp. 1225-1233, 21 figs. Description of several high-capacity low-head pumping plants located in Germany, Egypt, etc., having individual pump capacities up to 8 cu. m. per sec.; features of Wasserhorst propeller pump, having diameter of 1,800 mm., capacity 7.5 cu. m. per sec., working against head of 1.75 m.; comparison of characteristics of Francis and propeller pumps.

DREDGES

DIESEL-ELECTRIC. Diesel-Electric Hoppers for French Account. Shipbldg. and Shipg. Rec. (Lond.), vol. 36, no. 10, Sept. 4, 1930, pp. 271-272, 8 figs. Deutsche Werft-built vessels for Dieppe, Dunkerque and Le Havre; built to class with Bureau Veritas; length o.a. 182 ft.; deadweight capacity 800 tons; one main Diesel generating set supplies current to two propulsion motors, twin-screw arrangement having been adopted.

E

ELECTRIC CIRCUIT BREAKERS

QUENCHED ARC. The Braking Performance of High-Power Switchgear of a New Form of Quenched-Arc Switch, L. C. Grant. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 405, Sept. 1930, pp. 1089-1110 and (discussion) 1111-1117, 44 figs. Circuit breaker embodying entirely new principles has been evolved and tested under short-circuit conditions; its performance is superior to that of usual oil switch, and unit of given size and weight is capable of breaking many times power broken by oil switch of similar dimensions, while its performance appears to be wholly consistent.

ELECTRIC EQUIPMENT

SELF-SYNCHRONIZING. Principles of Selsyn Equipments and Their Operation, L. F. Holder. Gen. Elec. Rev., vol. 33. no. 9, Sept. 1930, pp. 500-504, 9 figs. System includes small self-synchronous instruments used as electrical means of transmitting accurate angular motion between two or more remote devices which cannot conveniently be mechanically interconnected; principles involved; selective and multiple operation; differential system; mechanical construction and applications.

ELECTRIC FURNACES

HIGH-FREQUENCY. High Frequency Steel Furnaces, D. F. Campbell. Engineering (Lond.), vol. 130, no. 3376, Sept. 26, 1930, pp. 409-411, 5 figs. Survey of present status of ironless induction furnace shows that its field of utility is much wider than is generally supposed; ironless induction furnaces of Ajax-Northrup type of hourly output of 20 to 25 cwt. have been operated since July 1929; at present largest units are furnaces of 20 to 25 cwt. capacity per heat, giving output of 20 tons per day, but design of furnaces of 3 to 5 tons presents no technical difficulties; steel making operations to which these furnaces have been applied. Paper read before Iron and Steel Inst. at Prague, Sept. 16, 1930.

ELECTRIC GENERATORS

DESIGN. Theory of Self-Excited Welding Dynamo of the G. E. Co. and Fundamentals of its Calculation (Theorie der eigenerregten Schweissdynamo nach dem System der General Electric Co. and die Grundlagen fuer ihre Berechnung), W. T. Kassjanoff. Elektrotechnik und Maschinenbau (Wien), vol. 48, no. 35, Aug. 31, 1930, pp. 797-803, 9 figs. Construction and operation of equipment consisting of double-pole armature, three commutator brushes and four-pole magnetic system; quantitative and graphical construction of characteristics as basis for design and calculation.

PROTECTION. Field-Weakening Gear. AEG Progress (Berlin), vol. 6, no. 10, Oct. 1930, p. 318, 4 figs. Modern generator design, particularly of large units, demands large-scale development of field-weakening equipment; for special cases; A.E.G. therefore, supplies specially designed quick de-exciting devices.

SYNCHRONOUS. Increased Voltages for Synchronous Machines, C. M. Laffoon. Power, vol. 72, no. 11, Sept. 9, 1930, pp. 416-417, 2 figs. At present time there are number of turbine generators either in service or under construction by different American manufacturing companies with 22,000-volt armature windings; design of armature windings.

WELDED. Third Steigitz Electric Generator; Welding in Manufacture of Electric Machinery (Der dritte Teigitsch-Stromerzeuger), E. Rosenberg, V.D.I. Zeit. (Berlin), vol. 74, no. 34, Aug. 23, 1930, pp. 1165-1170, 26 figs. Development of Styrian Water Power and Electric Co. since 1925 and installation of third generator of 13,000-kva. generator, of which base, casing and other parts are welded; detail drawings of equipment are given.

ELECTRIC HOISTS

DESIGN. Requirements and Progress in Design of Electric Hoisting Machinery (Anforderungen und Fortschritte beim Bau elektrischer Foerdermaschinen), W. Philippi. Elektrotechnische Zeit. (Berlin), vol. 51, nos. 36 and 37, Sept. 4, 1930, pp. 1253-1257, and Sept. 11, pp. 1293-1298, 20 figs. Best conception of status in design of electric hoisting machinery and their importance in mining practice is obtained by consideration of main problems to be solved, i.e., to develop equipment of high dependability and installations of high efficiency and economy; comparison of German and other equipment on basis of installations in operation; comparison between three-phase a.c. and d.c. (Concluded.)

ELECTRIC LINES

CONSTRUCTION COSTS. Building Rural Lines for $1,300 per Mile, S. C. Murray. Elec. World, vol. 96, no. 13, Sept. 27, 1930, p. 614, 2 figs. It was impossible to construct lines for $1,440 per mile under old standards using weatherproof wire with 30 or more poles per mile, log anchors, etc.; in order to reduce cost fewer poles per mile had to be used, and after considerable experiment No. 2 A.C.S.R., with average span of 400 ft. using 40-ft. poles, was decided upon.

GROUNDS. Double Ground in Single Line Supplied at Either End in Light of Computation with Symmetric Components (Der Doppelerdschluss in einer zweifach gespeisten Einfachleitung, etc.), Oberdorfer. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 9, no. 2, June 12, 1930, pp. 77-87, 10 figs. Attempt to discover mechanism of double ground by means of example and calculus as outlined; problem can be represented in substitute circuit which separates three component systems and shows their interrelation; suggestions for further development. Bibliography.

ELECTRIC LINES, HIGH TENSION

COMPENSATION. Automatic Reactive Current Compensation on Long Transmission Lines (Selbsttaetige Blindstromkompensation auf langen Hochspannungsleitungen), E. Friedlaender. Siemens Zeit. (Berlin), vol. 10, no. 9, Sept. 1930, pp. 522-529, 26 figs. Details of system, i.e., delayed time and selective protection and relays; complete wiring diagram with interlocking and protection connections; regulating process with control wiring diagrams; extension to involved control processes; installed equipment.

CONSTRUCTION. Speeding Construction of 220-Kv. Aluminum Line, H. J. Kingsley. Elec. World, vol. 96, no. 14, Oct. 4, 1930, pp. 647-648, 3 figs. Two tractors and two trailers replaced eight teams and saved about $30 per day in material haulage in systematic procedure maintained in construction of New England

Power Association's 220-volt, 126-mile line; it was completed 16 months after excavation was started for tower footings; each of two initial circuits of 795,000 circ. mils aluminum conductor is carried by semi-flexible steel tower lines spaced 183 ft. apart on 350-ft. right-of-way.

CORONA LOSSES. Corona Loss Measurements on a 220-Kv. 60 Cycle Three-Phase Experimental Line, J. S. Carroll, L. H. Brown and D. P. Dinapoli. Am. Inst. Elec. Engrs.—Advance Paper, no. 152, for mtg. Sept. 2-5, 1930, 8 pp., 10 figs. Corona loss measurements were made on seven different conductor specimens; losses were measured directly, on three-phase line 700 ft. long by means of three single-phase high-voltage wattmeters; object of test was to obtain data for choice of conductor to be used on 220-kv. 60-cycle line. Results show effect of weathering of conductors, comparison of conductors of different diameters, stranding and surface conditions.

DESIGN. Mechanical Means in Planning High-Tension Power Lines (Essai de production mécanique des projets de lignes aériennes de transport d'énergie électrique), A. C. Raes. Revue Universelle des Mines (Liège), vol. 4, nos. 5 and 6, Sept. 1, 1930, pp. 129-137, and Sept. 10, pp. 164-166, 5 figs. Sept. 1: Curves, graphs, etc., to shorten calculation of lines with respect to electrical mechanical characteristics; diagram and alignment charts for lines of negligible capacity. Sept. 10: Lines with capacity to be considered; method of calculation and example of application; design of conductors from mechanical viewpoint; design curves and charts.

GROUND WIRE. Critique of Ground Wire Theory, L. V. Bewley. Am. Inst. Elec. Engrs.—Advance Paper, no. 145, for mtg. Sept. 2-5, 1930, 18 pp., 15 figs. Work of previous investigators is briefly reviewed, limitations of premises pointed out; generalized theory of ideal ground wires taking into account law of cloud discharge, distribution of bound charge, and formation of travelling waves; probability of line's being hit; effect of ground wires on attenuation, telephone interference, zero phase sequence reactance, corona, and reduction in surge impedance due to introduction of extra ground wires.

LIGHTNING PROTECTION. Applying Lightning Arresters to Transmission Lines, C. L. Fortescue. Elec. Jl., vol. 27, no. 6, June 1930, pp. 330-334, 8 figs. Arrester selection must be balance between degree of protection desired and allowable risk of arrester failure; arrester can be considered as insurance against failure of valuable apparatus; its cost being analagous to premium required; typical time-lag curves for insulators with and without arcing rings and for suspension insulators with conductor positive.

ELECTRIC MACHINERY

DIRECT CURRENT. Direct-Current Machine Free of Harmonics; Ground Wave and its Suppression (Beitrage zur oherwellenfreien Gleichstrommaschine die Grundwelle und ihre Unterdrueckung), K. Euler. Archiv fuer Elektrotechnik (Berlin), vol. 24, no. 2, Aug. 23, 1930, pp. 230-256, 22 figs. Theoretical mathematical analysis with reference to conception of ground wave; fundamentals of e.m.f. generated at brushes by rotation and transformation; sources of generation of ground waves; means of suppression; experimental verification of study. Communication from Institute of Technology, Breslau.

ELECTRIC NETWORKS

THREE-PHASE. Determination of Asymmetry of Three-Phase, A. C. Networks (Bestimmung der Unsymmetrie von Dreshstromnetzen), M. Zorn. Elektrotechnische Zeit. (Berlin), vol. 51, no. 35, Aug. 28, 1930, pp. 1233-1238, 14 figs. Summary and completion of literature on subject since 1920; analytical and vectorial methods; connections for measurement for determination of symmetrical components of asymmetric three-phase system.

ELECTRIC POWER FACTOR IMPROVEMENT

CONDENSERS. Use of Condensers for Improvement of Power Factor With Special Reference to Practical Experience (Die Verwendung von Kondensatoren zur Verbesserung des Leistungsfaktors unter besonderer Beruecksichtigung praktischer Erfahrungen), M. Tama. Elektrotechnische Zeit. (Berlin), vol. 51, no. 35, Aug. 28, 1930, pp. 1227-1231, 13 figs. Application of electrostatic condensers to power-factor conditions in Hirsch's brass and copper plant; factory at present has peak load of 7,500 kw. at power factor of 0.99 which has been obtained exclusively with condensers; equipment is described in detail.

ELECTRIC POWER FACTOR MEASUREMENTS

STUDY OF METHODS. Low Power-Factor Measurements at High Voltages, E. H. Rayner, W. G. Standring, R. Davis and G. W. Bowdler. Instn. Elec. Engrs.—Jl. (Lond.), vol. 68, no. 405, Sept. 1930, pp. 1132-1142 and (discussion) 1142-1148, 14 figs. Study of methods of measuring dielectric losses carried out with object of determining nature and magnitude of various errors to which different methods are liable; method is developed of shielding simple resistor of flowing water so that current is in phase with voltage within about 0.0001 radian; resistor has been developed on these lines for 150 Kv.

ELECTRIC RECTIFIERS

MULTIPLE-PHASE. Rectifier with Three Four-Phase Transformer (Ein Gleichrichter mit Drei-Vierphasentransformator), J. G. W. Mulder and D. H. Duinker. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 36, Sept. 7, 1930, pp. 826-827, 6 figs. Author applied Scott's connection in combination with three core transformer of which centre core has 1.414 times larger cross-sectional area than outside cores; equipment finds application in small equipment like projector arc lamps, small regulating motors, electro-magnets, etc., up to 1.6 kw. capacity and is manufactured by Philips Works in Eindhoven-Holland.

ELECTRIC SUBSTATIONS

RECTIFIER. The Mercury-Arc Rectifier Installations of the Consolidated Mining & Smelting Company of Canada, Ltd., Trail, B.C., H. C. Beck. Brown Boveri Rev. (Baden), vol. 17, no. 10, Oct. 1930, pp. 311-314, 5 figs. Details of equipment and layout of station.

ELECTRIC SWITCHGEAR

METAL-CLAD. Progress in Metal-Clad Switchgear. Elec. World, vol. 96, no. 13, Sept. 27, 1930, pp. 562-563, 4 figs. Refinements of design that have resulted in greater compactness, better utilization of inclosed space, better arrangement and use of materials, improved factory production methods, easier installation, and more satisfactory performance are marks of definite progress and have their effects on attitude of engineers toward new development.

ELECTRIC TRANSFORMERS

NON-RESONATING. The Non-resonating Transformer, W. A. McMorris and J. H. Hagenguth. Gen. Elec. Rev., vol. 33, no. 10, Oct. 1930, pp. 558-565, 16 figs. Behaviour of transformer windings under lightning voltage excitation is analyzed; in new type of transformer, in which internal voltage oscillations are eliminated by proper use of electrostatic shields, all desirable characteristics of older type have been retained, and ability to withstand transient voltages has been increased; comparison with core-type, shell-type and non-resonating transformers. Bibliography.

PROTECTION. The Protection of Transformers, W. Wilson. World Power (Lond.), vol. 14, no. 81, Sept. 1930, pp. 204-207, 4 figs. Discussion of methods of securing appropriate sensitivity combined with stability and simplicity design of protective gear is complicated by separate windings on incoming and outgoing sides and by flow of magnetizing and transient switching currents.

ELECTRIC WELDING, ARC

SHRINKAGE STRESSES. Shrinkage Stresses in Arc Welding (Schrumpfspannungen und deren Beachtung beim Lichtbogenschweissen), Lottmann. V.D.I. Zeit. (Berlin), vol. 74, no. 38, Sept. 20, 1930, pp. 1340-1345, 19 figs. Causes and conditions leading to shrinkage; practical shrinking coefficients; shrinkage stresses in case of complete and incomplete fixedness of welds; effect of peening; rules for minimizing shrinkage stresses.

TESTING. Develops New Technique in Electric Arc Welding, J. D. Knox. Steel, voi. 87, no. 15, Oct. 9, 1930, pp. 62 and 65, 3 figs. Results of tests made with new electrode developed by Babcock & Wilcox Co.; data on composition of electrode material and physical properties of arc weld; maximum of 74,500 lbs. per sq. in. ultimate tensile strength.

ELECTRIC WELDING MACHINES

VOLTAGE RECOVERY. Developments in Voltage Recovery in Arc Welding Machines, A. F. Davis. Elec. Mfg., vol. 5, no. 3, Mar. 1930, p. 64, 2 figs. Explanation of recent discoveries in better performance of direct current welding machines to increase speed of operation; oscillograms showing length of time consumed in recovery of voltage from zero or short circuit to 95 per cent of final voltage in standard welding machines; use of small circuit breakers are advocated.

F

FLOTATION

XANTHATES. Flotation with Xanthates (Grundlagen der Flotation mit Xanthogenaten), K. Kellermann and E. Bender. Kolloid Zeit. (Leipzig), vol. 52, no. 2, Aug. 1930, pp. 240-243, 4 figs.; see also Chem. and Indus. (Lond.), vol. 49, no. 38, Sept. 19, 1930, p. 867. Flotation effect of xanthates is not property of xanthate radical, but is due to simultaneous effect of two products of hydrolysis; when carbon disulphide and alcohol were led simultaneously by means of stream of air bubbles into suspension of finely divided galena in water, normal flotation occurred; best conditions were realized with butyl alcohol.

FLOW OF FLUIDS

PIPES. Modern Measurements of Pressure Loss in Pipes and Law of Surface Friction with Large Reynolds Coefficients (Die neueren Messungen des Druckverlustes in Rohren und das Gesetz der Oberflaechenreibung bei grossen Reynoldsschen Zahlen), H. Lerbs. Werft Reederei Hafen (Berlin), vol. 11, no. 17, Sept. 7, 1930, pp. 365-367, 6 figs. Nikuradse's new measurements of pressure loss in pipe are used to develop law of surface friction based on generalization of Karman's calculation of law of Blasius; brief contribution by F. Eisner is appended.

FORGINGS, STEEL

HEAT TREATMENT. Forging and Heat Treating Departments of the Pennsylvania Railroad, C. I. Snowberger and E. Hoenstine. Heat Treating and Forging, vol. 16, no. 9, Sept. 1930, pp. 1140-1144 and 1155, 8 figs. Description of Forging and Heat Treating Department of Pennsylvania Railroad at Altoona, Pa.; sketches show arrangement of furnaces and location of hammers, presses and other equipment.

FOUNDRY EQUIPMENT

SAND BLASTS. Sand Blasts According to Gravity-Pressure System (Sandstrahlgehlaese nach dem Schwerkraft-Drucksystem), W. Kaempfer. Giesserei (Dusseldorf), vol. 17, no. 38, Sept. 19, 1930, pp. 931-933, 4 figs. Advantages and disadvantages of gravity and pressure systems; description of new design which combines both systems avoiding their dsadvantages; application to cleaning of iron and steel castings.

FURNACES

HEAT-TREATING, GASES. Influence of Furnace Atmospheres on Correct Heat Treatment, E. W. Esslinger. Metal Progress, vol. 18, no. 4, Oct. 1930, pp. 60-67, 5 figs. Effect of carbon dioxide, carbon monoxide, free oxygen, water vapour and nitrogen, upon surface of steel: ideal atmosphere for annealing, drawing, box carburization, and preheating is neutral atmosphere, or one which contains trace of free oxygen; scaling effects of gases.

HEAT-TREATING, ROTARY. Rotary Hearth Furnace for Heat Treating, R. E. Barker. Heat Treating and Forging, vol. 16, no. 9, Sept. 1930, pp. 1189-1190, 1 fig. Furnace for annealing, case hardening, etc. for coal firing; performance data and sketches are given.

LABORATORY, HIGH-TEMPERATURE. New High-Temperature Based on Principle of Surface Combustion (Ein neuer Verbrennungsofen fuer hohe Temperaturen nach dem Prinzip der Oberflaechenverbrennung), E. Ryschkewitsch. Feuerungstechnik (Leipzig), vol. 18, no. 17/18, Sept. 15, 1930, pp. 173-176, 2 figs. Nature of surface combustion; technical disadvantages of former furnace designs; description of new system, so-called Roessler furnace, of employing surface combustion; eliminating technical shortcomings; attempt is made to explain catalytic surface action on combustion process; in furnace described temperature of 2,100 deg. cent. can be obtained with coal gas of only 4,200 calories per cu. m.

G

GAUGES

REED INDICATOR. Reed Gauges Guarantee Close Tolerances Under Shop Conditions, C. F. Dreyer. Factory and Indus. Mgmt., vol. 80, no. 4, Oct. 1930, pp. 722-724, 10 figs. Improvement in indicator gauge which will permit its use in control of product tolerances defined in ten-thousandths of inch; limitations of fixed gauges and of usual forms of indicators; construction of fixed gauges and of improved indicator gauge; advantages shown in number of successful applications.

GAS ENGINES

COMBUSTION IN. Influence of Nitrogen in Air Supply on Combustion in Gas Engines, R. Matthews. Power, vol. 72, no. 14, Sept. 30, 1930, pp. 548-549, 1 fig. Recent experiments with gases in bombs show conclusively that nitrogen under some conditions is not neutral constituent during combustion; effects of nitrogen, oxygen and excess carbon monoxide upon engine combustion, with variation in pressure rise with time; rapidity of combustion.

GAS PRODUCERS

TYPES. Producer Gas Practice from the Point of View of the Carbonizing Industries, N. E. Rambush and F. S. Townend. Gas. Jl. (Lond.), vol. 191, no. 3508, Aug. 13, 1930, pp. 369-370. Two types of producers described are brick-built static type and mechanical-grate central producer; brief description of several installations; trend of development in mechanical producers. From paper read before World Power Conference, Berlin.

The Gas Producer—Continuous Producer, J. W. Romig. Am. Gas Jl., vol. 133, nos. 2 and 3, Aug. 1930, pp. 47-48 and Sept., pp. 44-45, 3 figs. Little information available as to actual temperatures in various zones of industrial gas producers; knowledge of reactions existing in distillation zone rather vague; heats of reactions in gas producer; producer gas constituents and percentages for bituminous coal gas; products of combustion of combustible in producer gas.

GASES

SPECIFIC HEATS AT HIGH PRESSURES. Specific Heats of Gases at High Pressures, B. H. Mackey and N. W. Krase. Indus. and Eng. Chem., vol. 22, no. 10, Oct. 1930, pp. 1060-1062, 2 figs. Methods of measurement and calculation of specific heats of gases as function of temperature and pressure have been developed, and results for nitrogen up to 150 deg. cent. and 700 atmos. are presented.

GASOLINE ENGINES

COMPRESSION RATIO. In Influence of Turbulence Upon Highest Useful Compression Ratio in Petrol Engines, T. F. Hurley and R. Cook. Engineering (Lond.), vol. 130, no. 3373, Sept. 5, 1930, pp. 290-293, 10 figs. Account of work being carried out at Fuel Research Station; engine used is E.5 Ricardo variable-compression engine, of 2⅞ in. bore by 3¼ in. stroke; it was found that optimum spark advance at given compression ratio with indiscriminate turbulence was, generally speaking, larger than that necessary with rotational turbulence; theory is advanced which affords explanation of most of observed phenomena, including that in connection with spark advance. Paper read before Brit. Assn. Sept. 4, 1930.

GRINDING MACHINES

SURFACE. Heavy Vertical-spindle Surface Grinder with Reciprocating Table, S. Weil. Eng. Progress (Berlin), vol. 11, no. 10, Oct. 1930, pp. 267-269, 3 figs. Grinder spindle of machine is driven by two 30-hp. motors running at 1,400 r.p.m. and capable of transient overload of 50 per cent; motors are arranged to either side of spindle, which they drive over elastic couplings and geared reductions; segmental abrasive wheel of 4.6 ft. diameter is used; spindle head is pivotally supended at top from two heavy pins, and held at bottom by two special screws.

GYPSUM INDUSTRY

CANADA. The Story of Gypsum in Canada, L. H. Cole. Can. Min. and Met. Bul. (Montreal), No. 221, Sept. 1930, pp. 1206-1224 and (discussion) 1224-1225, 8 figs. on pp. 126-1229. Historical note; gypsum and its varieties; anhydrite; Nova Scotia deposits and industry; New Brunswick; Quebec; Ontario; Manitoba; Saskatchewan, Alberta, and Northwest Territories; British Columbia; marketing; crude gypsum; calcined gypsum; possibilities of industry in Canada; illustrations show results of fire test on building where dry gypsum materials are combined with ordinary framework.

H

HANGARS, CONCRETE

GREAT BRITAIN. A Large Reinforced Concrete Aeroplane Hangar, C. E. Holloway. Structural Engr. (Lond.), vol. 8, no. 9, Sept. 1930, pp. 317-328, 7 figs. Details of design and construction of airplane hangars at Heston Air Park, Middlesex; suitability of reinforced concrete; main ground floor area is 100 ft. wide clear between columns and 80 ft. deep; tied-arch roof principals are 100 ft. clear span, 16 ft. centres, and 20 ft. rise; provision for wind pressure.

HARDNESS TESTING

BRINELL. Offers Some New Hardness Tables, T. N. Holden, Jr. Iron Age, vol. 126, no. 14, Oct. 2, 1930, p. 932. Tables give Brinell hardness number for 5-mm. ball with 750 and 250 kg. load; 10-mm. ball with 3,000, 1,000, and 500-kg. load; data on preparation of surfaces for Brinelling.

HYDRAULIC ACCUMULATORS

USES. Hydraulic Accumulators Charged with Compressed Air (Hydraulische Akkumulatoren mit Druckluftbelastung), R. Sackheim. V.D.I. Zeit. (Berlin), vol. 74, no. 36, Sept. 6, 1930, pp. 1234-1236, 4 figs. Applications and advantages of hydraulic accumulators; types of construction and regulation of high-head and low-head hydraulic accumulator plants.

HYDRAULIC ENGINEERING

EUROPEAN PROGRESS. Hydraulic Engineering Progress in Europe. Engineer (Lond.), vol. 150, no. 3897, Sept. 19, 1930, pp. 313-314. There is quite enough at present time to occupy hydraulic engineer in construction of dams, canals and inland waterways all over Europe; progress of hydraulic engineering is particularly marked in those countries possessing abundance of water power and little solid fuel; hydro-electric enterprise was to have reduced considerably importation of coal but while this has affected foreign coal trade, imports have been growing for some time past; coal has become serious competitor of hydro-electric energy, even in its own domain.

HYDRAULIC LABORATORIES

UNITED STATES. Alden Hydraulic Laboratory—Workshop of Modern Research, F. A. Annett. Power, vol. 72, no. 11, Sept. 9, 1930, pp. 418-422, 7 figs. Adequate hydraulic laboratory facilities in United States have been generally lacking; however, much valuable hydraulic research work has been done in laboratories of manufacturers, power companies, and universities; in his work Alden Hydraulic Laboratory of Worcester Polytechnic Institute has taken pre-eminent part; diagram of laboratory's property is illustrated.

HYDRAULIC TURBINES

DESIGN. Important Points in the Design and Operation of High Speed Hydraulic Turbines (Ueber einige wichtige Punkte beim Bau und beim Betrieb schnellaufender Wasserturbinen), R. Thomann. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 39, Sept. 28, 1930, pp. 889-897, 23 figs. Design principles applying to turbines of which specific rotary speed exceeds 70, i.e., pressure turbines, propeller and Kaplan turbines.

SAND PROTECTION. Keeping Sand Out of Turbines and Forebays, R. P. Waite. Elec. World, vol. 96, no. 12, Sept. 20, 1930, pp. 535-536. Discussion on sand problem in Nebraska hydro-electric plant practice mainly theoretical, because careful engineering study has revealed fact that on account of erratic flow conditions kilowatt-hours produced by Nebraska streams hardly justify extensive improvements involving considerable expenditures; notes on experience. Based on paper presented before Nat. Elec. Light. Assn.

HYDRO-ELECTRIC POWER PLANTS

AUTOMATIC CONTROL. Automatic and Partial Automatic Hydro-Electric Plants. Nat. Elec. Light Assn.—Pub., no. 083, Aug. 1930, 19 pp., 5 figs. Salient features of automatic and partial automatic hydro-electric plants are briefly discussed; tabulations of principal characteristics of 104 such plants are included.

NEWFOUNDLAND. Hydro-Electric Plant at Lawn, Newfoundland, R. J. Murphy. Can. Engr. (Toronto), vol. 59, no. 11, Sept. 9, 1930, pp. 301-302, 4 figs. Report on small initial development by United Towns Electric Co., St. John's, Newfoundland, to supply power to Burin Peninsula; installation of 250-hp. Voith turbine and Westinghouse generator.

ONTARIO. Work Rapidly Proceeding on $23,000,000 Abitibi Job. Contract Rec. (Toronto), vol. 44, no. 37, Sept. 10, 1930, pp. 1083-1085, 3 figs. Features of hydro-electric power project including concrete dam 240 ft. high to develop 330,000 hp.

QUEBEC. Shawinigan Water Power, J. C. Wigham. Elec. Times (Lond.), vol. 78, no. 2029, Sept. 11, 1930, pp. 419-420, 3 figs. Development of Shawinigan Water and Power Co., and projected new developments; Company supplies current to both Montreal and Quebec and many intervening and surrounding places, containing population of over two millions; company has available 803,650 hp. and has control of water powers which can be developed up to two million.

I

ICE

SPECIFIC HEAT. Specific Heats and Latent Heat of Fusion of Ice, W. H. Barnes and O. Maass. Can. Jl. Research (Ottawa), vol. 3, no. 3, Sept. 1930, pp. 205-213, 1 fig. Values for heat capacities of ice and resulting water from initial temperatures of between 0 and 78.5 deg. cent. to final temperature of plus 25.00 deg. are measured to plus 0.05 per cent or better with improved adiabatic calorimeter; specific heats of ice over temperature range; to −80 deg. are found and latent heat of fusion of ice at 0 deg. is obtained from these heat-capacity determinations. Bibliography.

INTERNAL-COMBUSTION ENGINES

AIR FILTERS. The Efficiency of Air Filters for Internal Combustion Engines, W. Alexander. Engineering (Lond.), vol. 130, no. 3373, Sept. 5, 1930, pp. 295-296, 2 figs. Letter to editor referring to article by W. E. Gibbs, A. Brandt and M. L. Nathan, previously indexed from Aug. 22 issue of this journal; only centrifugal separator of which test results are given is old-fashioned cyclone; there are now applied to carburetor inlets vortical separators of through-flow type, which give movement to air much nearer to streamline motion of free or Rankine vortex than is given by cyclone; example of more modern type, called Supreme vortex separator, is illustrated.

AUSTRIA. Internal-Combustion Engines in Power Practice (Die Verbrennungsmotoren in der Energiewirtschaft), L. Richter. Elektrotechnik und Maschinenbau (Vienna), vol. 48, no. 38, Sept. 21, 1930, pp. 874-881, 4 figs. Classification of various types of engines and principal characteristics; fuel, prices and location of operation; comparison of operating costs of electric motors, Diesel engines and gas engines for long distance; paper is entirely based on Austrian conditions. Bibliography.

COMBUSTION. Combustion-Chamber Progress Correlated, A Taub. Soc. Automotive Engrs.—Jl., vol. 27, no. 4, Oct. 1930, pp. 413-443, 42 figs. Analysis of combustion-chamber design based on research of Ricardo, Janeway and whatmough; common principles are cooling last gas to burn by means of shallow clearance space; locating spark plug near exhaust valve; non-compact combustion chambers; volume control for smoothness; controlling acceleration of rise in pressure, to prevent roughness.

INDICATORS. Alterations and Tests of the "Farnboro" Engine Indicator, J. H. Collins, Jr. Nat. Advisory Committee for Aeronautics—Tech. Note No. 348, Sept. 1930, 14 pp., 5 figs. "Farnboro" electro-pneumatic indicator was tested as received from manufacturers and modifications made to improve its operation; modified indicator gives complete record of average cyclic variation in pressure per crank degree for any set of engine operating conditions which can be held constant for period of time required to build up composite card.

VALVE-CLEARANCE MEASUREMENT. A Valve-Clearance Indicator, F. Jehle. Soc. Automotive Engrs.—Jl., vol. 27, no. 4, Oct. 1930, pp. 473-474, 4 figs. Optical arrangement for measuring valve clearance during operation of engine is illustrated by sketch; graphs show changes and clearances of inlet and exhaust valve at three engine speed.

(See also Airplane Engines; Automobile Engines; Diesel Engines; Gas Engines; Gasoline Engines; Oil Engines.)

L

LIQUID OXYGEN CONTAINERS

GERMAN PROCESS. Shipment of Liquid Oxygen and Its Conversion to High-Pressure Gas Without Compressor (Der Versand von verfluessigtem Sauerstoff und seine umwandlung in Druckgas ohne Kompressor), A. Sander. Zeit. fuer kromprimierte und fluessige Gase (Berlin), vol. 28, no. 7, 1929-1930, pp. 65-69, 7 figs. New German process is described for transporting liquid oxygen in heat-insulated copper containers; at receiving point liquid oxygen is pumped into steel cylinder with thin-walled container not in heat contact with steel walls; this has small heat capacity and avoids evaporation losses in transferring oxygen.

LOCOMOTIVES

OIL-ELECTRIC. The Oil-Electric Locomotive, Its Limitations and Value, S. T. Dodd. Motive Power, vol. 1, no. 8, Sept. 1930, pp. 22-23 and 48, 4 figs. Consideration of design and operating characteristics; advantages of oil-electric type over steam locomotives; conclusion may be drawn that oil-electric locomotive presents advantage of highly efficient drive; disadvantage of power output strictly limited to capacity of its engine.

VALVE GEAR, POPPET. Holmes Poppet Valve Gear for Locomotives. Ry. Gaz. (Lond.), vol. 53, no. 12, Sept. 19, 1930, pp. 364-365, 3 figs. Perfect timing of valve events up to 84 per cent cut-off and interchangeability of left- and right-hand cam boxes and cylinders are among advantages claimed for this gear; illustrated diagrams showing general arrangement of valve gear.

LUBRICANTS

GRAPHITE. Lubrication with Graphite. Coloidal Graphite (La lubrification au graphite—le graphite colloiedal), R. Cordebas. Chimie et Industrie (Paris), vol. 23, no. 5, May 1930, pp. 1092-1098, 2 figs. Use and property of graphite for lubrication of various types of machines in dry, semi-fluid and liquid state; oiliness and capillary characteristics; graphite in lubricating oils.

M

MANGANESE STEEL

HEAT TREATMENT. Heat Treatment Determines Manganese Steel Properties, H. P. Evans. Steel, vol. 87, no. 11, Sept. 11, 1930, pp. 66-68. Brief outline of heat-treating method for manganese steel and discussion of reasons for structural changes; data on composition and hardness.

METALS

COLD WORKING. Variations in Hardness of Metals, and Alloys Resulting from Cold Working (Sur les variations de dureté de certains métaux et alliages en fonction de l'écrouissage), Guichard, Clausmann and Billon. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 2, Jan. 13, 1930, pp. 112-114, 1 fig. Increase in hardness caused by cold working of 10 metals and alloys used for coinage was investigated by cold rolling sheets of completely annealed metals and determining relation between deformation and Brinell hardness; results expressed by curves.

ELASTIC HYSTERESIS. Elastic Hysteresis of Materials under Alternating Normal and Shearing Stresses (Die Daempfung der Werkstoffe bei wechselnden Normalspannungen und bei wechselnden Schubspannungen), O. Foeppl. V.D.I. Zeit. (Berlin), vol. 74, no. 40, Oct. 4, 1930, pp. 1391-1394, 8 figs. Classification of elastic hysteresis phenomena; practical value of elastic hysteresis; comparative study of hysteresis curves for normal and shearing stresses.

HEAT CONDUCTIVITY. Determination of Heat Conductivity of Metals, Especially at High Temperatures (Eine Methode zur Bestimmung der Waermeleitfaehigkeit von Metallen, besonders bei hohen Temperaturen), R. Holm. Wissenschaftliche Veroeffentlichungen aus dem Siemens-Konzern (Berlin), vol. 9, no. 2, June 12, 1930, pp. 300-311, 5 figs. Variation of methods of Rohltausch, Diesselhorst and Meissner which is especially suitable for metals of high temperature.

MINERAL RESOURCES

ONTARIO. Minerals of Hastings County, Ontario. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 35, Aug. 29, 1930, pp. 845-846. Notes on actinolite, arsenopynite, barite, clay, copper, corundum, dolomite, feldspar, fluorspar, galena, gold, granite, pyrites, limestone, lithographic stone, marble, mica, molybdenum, peat, silica, sodalite, talc, trap, rock, and iron ore.

MINES AND MINING

CABLEWAYS. Aerial Tramways Construction and Operation, D. L. Pitt. Can. Min. and Met. Bul. (Montreal), no. 221, Sept. 1930, pp. 1132-1174, 20 figs. partly on supp. plates. Notes on construction of Premier and Porter-Idaho tramways of Premier Gold Mining Co. in northern British Columbia; topography; climate; engineering and field work; design; construction; operation; maintenance and repair; performance data.

MINING GEOLOGY

MANITOBA. Leached Outcrops of Northern Manitoba, O. B. Gwilliam. Can. Min. and Met. Bul. (Montreal), no. 220, Aug. 1930, pp. 1039-1049, 3 figs. Comparison between leached outcrops of southwestern United States and those of northern Manitoba; outline of criteria used in southwest; gossans at Flin Flon agree with Locke's description of fine limonite boxworks, correlated with chalcopyrite accompanied by minor pyrite; iron-stained material at surface of Mandy correspond with description of flooded matrix correlated with abundant pyrite; portions of Smith-Pride gossan, and Sherritt-Gordon gossan boxworks, correlated with chalcopyrite and minor pyrite.

MINING LAWS AND LEGISLATION

MANITOBA. Some Notes on the Mining Law of Manitoba, and on the Mines Act of 1930, H. F. Maulson. Can. Min. and Met. Bul. (Montreal), no. 220, Aug. 1930, pp. 996-1011. Historical review of antecedents of Canadian mining laws; Orders-in-Council passed by Dominion, governing natural resources; discussion of Mines Act of 1930.

MOULDING MACHINES

FOUNDRY. Mechanical Handling Methods in Stove Manufacture, H. Magdelenat. Mech. Handling (Lond.), vol. 18, no. 9, Sept. 1930, pp. 297-298, 1 fig. Continuous handling operations embodied in Rosieres-Bachon moulding machine for repetitive production of castings in stove manufacture; a plan and elevation views of continuous moulding machine layout are illustrated. Paper read before Inst. Brit. Foundrymen, previously indexed from Foundry Trade Jl., July 10, 1930.

N

NATURAL GAS STORAGE, UNDERGROUND

ALBERTA. Recharging Old Canadian Gas Field, L. G. E. Bignell. Oil and Gas Jl., vol. 29, no. 19, Sept. 25, 1930, pp. 41 and 151-152, 4 figs. Data covering ground previously indexed from note in Petroleum World, Sept. 1930; maps and tabular records of gas production in wells of Bow Island field and of absorption by wells of waste gas surplus from Turner Valley field; typical well bookup.

NICKEL DEPOSITS

QUEBEC. Nickel-Cobalt Minerals on Calumet Island, Quebec, H. V. Ellsworth. Can. Min. Jl. (Gardenvale, Que.), vol. 51, no. 37, Sept. 12, 1930, pp. 886-888, 1 fig. Deposit of nickeliferous pyrrhotite on lot 11, range IX, in Pontiac County; chief ore mineral is disseminated nickeliferous pyrrhotite; considerable nickeliferous pyrite in some places; chalcopyrite, cobaltiferous gersdorffite and niccolite also occur in small amount; analyses of specimens; concentration, as by oil flotation, of all sulphides and arsenides together would probably yield nickel-cobalt-bearing concentrate of commercial value.

NITRIDATION

CONTINUOUS. Continuous Nitriding a New Development, R. J. Cowan. Metal Progress, vol. 18, no. 4, Oct. 1930, pp. 93-98, 5 figs. Nitridation process for high and low-temperature treatment and furnace equipment developed by Surface Combustion Co., Toledo, O.; sketch shows gas-fired muffle furnace with airlocks and seals at entrance and exit; graph illustrates relations between depth of nitrided case hardness and degree of dissociation and time.

METHODS. Nitriding or Casehardening with Ammonia, V. O. Homerberg and J. P. Walsted. Machy. (N.Y.), vol. 37, no. 2, Oct. 1930, pp. 106-108. Discussion of nitriding methods to produce parts that have tough inner core and surfaces with outstanding wear-resisting qualities; kinds of steel that can be nitrided; temperature required and time of exposure; experiments at temperatures ranging from 900 to 1,300 deg. fahr., inclusive, show that depth of case increases, but hardness decreases with increase in temperature. Abstract of paper read before A.S.M.E., Sept. 22-24, 1930.

RECENT DEVELOPMENTS IN. Recent Developments in Nitriding, R. Sergeson. Iron Age, vol. 126, no. 11, Sept. 11, 1930, pp. 680-682, 6 figs. Outline of types of nitriding analysis now found on commercial market as to many applications in industry; new free machining high-sulphur nitriding steel is reviewed as to its machinability and nitriding qualities; method of protection against nitriding with sodium silicate, chrome ore mixture.

O

OIL ENGINES

COMBUSTION. Ante-chambers and the High-Speed Oil Engine Combustion Problem, R. Matthews. Motive Power, vol. 1, no. 8, Sept. 1930, pp. 19-21 and 46, 5 figs. Questions pertaining to relative merits of ante-chambers and single combustion chamber design; specific reference to above factors are considered.

STARTING. Rapid Starter for Internal-Combustion Engines (Schnellanlasser fuer Verbrennungsmotoren), H. Lang. V.D.I. Zeit. (Berlin), vol. 74, no. 38, Sept. 20, 1930, pp. 1325-1328, 12 figs. Starting methods for low-compression oil engines are illustrated by sketches; rapid burners, electrical, mox, pyrochemical and glow-tube designs.

OPEN-HEARTH FURNACE

PRACTICE. Open-Hearth Furnace Steelworks, H. C. Wood. Iron and Steel of Canada (Gardenvale, Que.), vol. 13, no. 9, Sept. 1930, pp. 194-197, 213 and 215, 4 figs. Comparison of practice followed and results obtained in Great Britain and Germany and other leading Continental steel-producing countries; tables and graphs illustrate production of open-hearth steel according to process and country; typical operation data.

OXYGEN

ELECTROLYTIC MEASUREMENT. Electrolytic Production of Hydrogen and Oxygen, E. F. Evenden. Elec. Times (Lond.), vol. 78, no. 2028, Sept. 4, 1930, pp. 389-392, 6 figs. Advantages and disadvantages of filter press and bell-type electrolytic cells are discussed; Knowles plant at Bussi, Italy, is described in detail.

P

PHOTO-ELECTRIC CELLS

INDUSTRIAL APPLICATIONS. Applications of Photo-Electric Cells, E. H. Vedder. Elec. Jl., vol. 27, no. 6, June 1930, pp. 335-339, 9 figs. Uses for cell have been found in many different industries, and many more suggested applications are awaiting development; cell can be applied to three different types of work; indicating and recording, automatic control and relaying, and sorting, grading and matching; various applications are discussed.

PILE DRIVERS

HEAVY FLOATING. Heavy Floating Pile Driver (Schwimmramme schwerster Bauart), H. Nauhardt. Bauingenieur (Berlin), vol. 11, no. 18, May 2, 1930, pp. 318-319, 2 figs. Pile driver, having monkey weight of 6 tons, and designed to drive reinforced-concrete piles 14 m. long and weighing 10 tons, built by Maschinen-und Kranbay A.G. for Belgian Congo.

PIPE

HEAT TRANSMISSION. Relation of Mean Heat Transfer Coefficient of Length of Pipe (Die Abhaengigkeit der Mittleren Waermeuehergangszahl von der Rohrlaenge), W. Stender. Wissenschaftluchungen aus dem Siemens-Konzern (Berlin), vol. 9, no. 2, June 12, 1930, pp. 88-98, 5 figs. New equation is developed for temperature relations and heat transfer in heated pipes; new equation is applied to experiments by Nusselt, Rietschel, Stanton and Stander for verification of their constants derived for gases and water.

PROTECTIVE COATINGS. Simple Method for Quantitative Analysis of Atmospheric Corrosion of Protected Metal Pipe (Ein einfaches Verfahren zur quantitativen Verfolgung der atmosphaerischen Korrosion geschuetzter Metallrohre), W. Beck. Korrosion und Metallschutz (Berlin), vol. 6, no. 9, Sept. 1930, pp. 201-204, 4 figs. Results of study carried out at Kaiser Wilhelm Institut fuer Physikalische Chemie und Elektrochemie; tests were made with aid of gas-volumetric method; results of observations of Schade tube protective bandage show that this bandage possesses excellent anti-corrosive properties.

PIPE LINES

DESIGN. Calculation of Pipe Lines for Viscous Fluids (Berechnung von Rohrleitungen fuer Zaehe Fluessigkeiten), W. Guntermann and H. Kroessin. Waerme (Berlin), vol. 53, no. 38, Sept. 20, 1930, pp. 704-706, 6 figs. Simple values are given for relation between friction coefficient and Reynolds coefficient in dependence upon nature of flow; influence of temperature on viscosity and, therefore, on Reynolds coefficient and flow conditions; by applying this calculation to flow of tar, limit values are obtained for temperature, diameter and speed as basis for economic design of pipe lines.

POLES

CONCRETE. Study of Cross-Sectional Shapes to be Adopted for Concrete Poles (Etude des formes à adopter pour les sections des pylones en béton), H. Claude. Revue Générale de l'Electricité (Paris), vol. 28, no. 9, Aug. 30, 1930, pp. 326-330, 2 figs. Author points out that disregarding of forces acting on intermediate poles parallel to direction of line is erroneous as stresses in that direction can be quite appreciable; adoption of T-shape on this basis in England is discussed, and correctness of this practice is proven by mathematical analysis.

POWER PLANTS

TIDAL. The Shishkoff Hydro-Thermal Tidal Power System. Engineer (Lond.), vol. 150, no. 3898, Sept. 26, 1930, pp. 330-33, 10 figs. Experimental plant erected at Old Lock, Avonmouth Docks; Shishkoff system makes use of thermal storage; vertical shaft of water turbine is coupled directly to Heenan and Froude brake and to vertical alternator; energy delivered by water turbine is in part directly converted into electricity for immediate consumption and in part converted into heat; water which receives heat generated inside brake is circulated by pump in closed circuit between brake and Ruths steam accumulator.

STANDBY. Hydro-Electric and Thermal Plants. Can. Engr. (Toronto), vol. 59, no. 14, Sept. 30, 1930, pp. 511-512. Abstracts of papers from general report presented in symposium on electrical energy produced thermally, and its joint use with hydro-electric power, at World Power Conference, Tokyo; economy of thermal station serving as standby for hydro-electric plant.

PRESSES

HYDRAULIC. Piping Engineers Need Information on Hydraulic Equipment, F. G. Schranz and W. L. DeLaney. Heat., Piping and Air Conditioning, vol. 2, no. 9, Sept. 1930, pp. 776-788, 2 figs. Design and operation of hydraulic press; table giving capacities of hydraulic rams in tons for various diameters and pressures; list of industries that are used in hydraulic press equipment are given.

PRESSURE GAUGES

MERCURY. The Measurement of Pressures in Mercury, P. A. Redford. Mech. World (Lond.), vol. 88, no. 2279, Sept. 5, 1930, pp. 226-227, 3 figs. In contrast to column of water, level of which rises in consequence of capillary attraction in narrow pipes, column of mercury is reduced in height due to surface tension of mercury; depressions, which depend on pipe diameter and height of mercury column, must be taken into consideration in determining pressure to be measured; table giving depression in millimeters of mercury, and water column, for different internal diameters of glass tubes.

PRESSURE VESSELS

DESIGN. Correlating Theory and Practice in Pressure-Vessel Design, N. W. Krase. Chem. and Met. Eng., vol. 37, no. 9, Sept. 1930, pp. 540-543, 11 figs. Review of fundamentals of design of pressure vessels; difficulties encountered when very high pressures and temperatures are involved.

WELDING. The Strength and Design of Fusion Welds for Unfired Pressure Vessels, L. W. Schuster. Instn. Mech. Engrs.—Proc. (Lond.), no. 2, Mar. 1930, pp. 319-377 and (discussion) 378-422, 26 figs. Object, scope and need of investigation; conclusions reached on mechanical construction of welded vessels; various tables and figures are given illustrating extent of investigation; appendix of provisional rules for fusion-welded non-fired pressure vessels. Paper previously indexed from various sources.

PUMPS, CENTRIFUGAL

SELF-PRIMING. Self-Priming Centrifugal Pump of Unusual Pumping Lift (Ungewoehnliche Foerderhoehe einer selbstansaugenden Kreiselpumpe), C. Ritter. V.D.I. Zeit. (Berlin), vol. 74, no. 37, Sept. 13, 1930, pp. 1257-1258, 5 figs. Abstract of report on construction and tests of so-called Sihi pump manufactured by Siemen & Hinch m.b.H.; by means of special channels, nearly concentric with casing, pump is enabled to acquire multi-stage effect equivalent to 5 times lift expected of ordinary pump rotor of equal speed.

TURBINE. Experimental Researches on Turbine Pumps, M. Yendo. Yokohama Technological College—Reports (Yokohama), no. 1, June 1930, 96 pp., 293 figs. partly on plates. Experiments to determine mainly pressure, velocity, and direction of flow of water just after leaving impeller and entering diffusor ring; also diffusor efficiency and entrance conditions by aid of subsidiary measurements. (In English.)

R

RAIL MOTOR CARS

FUTURE. The Probable Rail-Motor Equipment of the Future, E. Wanamaker. Can. Ry. and Mar. World (Toronto), vol. 390, Sept. 1930, pp. 575-576. Discussion treating of study of commodities and passengers moved today, routes over which they are moved, form of transportation, and other features; part played by rail motor car in branch line transportation; discussion of transportation situation during next decade; historical review of rail motor car development. Paper read before Am. Ry. Assn., Motor Transport Division.

GASOLINE-ELECTRIC. Gas-Electric Motor Rail Cars, Canadian Pacific Railway. Can Ry. and Mar. World (Toronto), no. 390, Aug. 1930, p. 495, 1 fig. Design and constructional features of two gas-electric rail motor cars recently received for passenger service on branch line; list of principal dimensions is given; power plant consists of 400-hp. engine, 8-cylinder, 8-in. bore, 10-in. stroke, model 148, Winton Engine Co.

RAILROAD OPERATION STATISTICS

CANADA. A Decade's Progress in the Canadian Railway Industry, E. Winfield. Can. Ry. and Mar. World (Toronto), no. 390, Sept. 1930, pp. 549-552, 5 figs. Statistical review of financial results, all Canadian Railways, 1920-1929; discussion of operating progress illustrated with tables and curves.

RAILROAD TERMINALS

MONTREAL. Operation of Montreal Terminals, Canadian Pacific Railway, T. Collins. Can. Ry. and Mar. World (Toronto), no. 390, Aug. 1930, pp. 493-495. Discussion of operations of five distinct departments; handling of passenger and freight trains. Paper read before Eng. Inst. of Canada.

RESERVOIRS, STORAGE

CANADA. Water Storage Reservoirs in Canada, O. Lefebvre. Can. Engr. (Toronto), vol. 59, no. 12, Sept. 16, 1930, pp. 321-327, 6 figs. Water available for power generation; location and capacity of principal storage reservoirs in Canada; storage reservoirs built by Quebec Streams Commission. Paper presented at Second World Power Conference, Berlin.

ROAD CONSTRUCTION

ONTARIO. Highway Construction in Ontario, R. M. Smith. Can. Engr. (Toronto), vol. 59, no. 13, Sept. 23, 1930, pp. 143-145 and (discussion) 127 and 132, 4 figs.: see also Contract Rec. (Toronto), vol. 44. no. 39, Sept. 24, 1930, pp. 1162-1166, 2 figs. Highway widths, strengths, grades, curves and alignment; construction on highways; culverts and drainage; low-cost road surfaces; concrete roads.

ROAD MATERIALS

BITUMINOUS. Construction and Maintenance of Modern Roads, etc. (La construction et l'entretien des routes modernes—Le rôle du goudron), G. Coret. Jl. des Usines à Gaz (Paris), vol. 54, nos. 10, 11 and 12, May 20, 1930, pp. 219-229, June 5, pp. 246-258 and June 20, pp. 269-275, 6 figs. See also Génie Civil (Paris), vol. 97, no. 8, Aug. 23, 1930, pp. 187-188. General discussion of highway design and financing; types of roads; manufacture and use of tar products for road construction with special reference to coal-tar products derived from gas plants; cost data on bituminous surface treatment; treatment of roads.

ROADS, ASPHALT

CONSTRUCTION. Trend of Practice in Asphalt Paving, E. H. Scott. Can. Engr. (Toronto), vol. 59, no. 13, Sept. 23, 1930, pp. 257-258D and 258J, 6 figs. Construction and maintenance of sheet asphalt, mixed macadam, penetration and retread pavements; temperature stresses; resurfacing old roads; maintenance of secondary roads; types compared; asphaltic mixed macadam; reasons for methods used; rolling hot mixture; surface treated mixed macadam; asphalt plant inspectors and road inspector's duties; sheet asphalt and asphaltic concrete; correcting hair checking.

ROCK DRILLS

HOLLOW STEEL. Machine Simplifies Cleaning of Clogged Drills. Eng. and Min. Jl., vol. 130, no. 5, Sept. 8, 1930, p. 220, 1 fig. Brief note on machine constructed and installed at central drill-sharpening shop of Copper Queen Branch of Phelps Dodge Corporation, at Bisbee, Ariz.; driven by 5 hp. electric motor; average of 80 drills cleaned per hour.

ROLLING MILLS

DESIGN. Energy Required and Forces Developed in Rolling Mills, A. W. Knight. Mech. World (Lond.), vol. 88, nos. 2280, 2281, Sept. 12, 1930, pp. 248-251, Sept. 19, pp. 263-265, 10 figs., Sept. 26, pp. 290-294, 2 figs. Phenomena in rolling of hot and plastic steel; formulae for forces exerted on housings or rolls, torque on rolls, energy required for pass, horsepower necessary, and total amount of deforming energy required to roll from ingot or billet to finished section; frictional losses in roll journals; differences in efficiency of these journals explain why mills having small-diameter rolls absorb less energy to produce certain deformations than mills having large rolls. Values of plastic stress "f" and experimental verification of formulae on six different rolling-mills, all electrically driven; effect of rate of deformation on value of "f"; total amount of energy required to roll from ingot or billet to finished section.

ROLLER BEARING. Power Consumption Tests on the Timken Steel and Tube Company Blooming and Bar Mills, F. Waldorf. Iron and Steel Engr., vol. 7, no. 9, Sept. 1930, pp. 442-460 and 466-468, 23 figs. Discussion of test results with particular regard to effects of roller bearings; graphs illustrate data on rolling pressures, temperatures, reductions and elongations.

Results Obtained with Roller Bearings in Rolling Mills, G. E. Palmgren. Iron Age, vol. 126, no. 12 and 13, Sept. 18, 1930, pp. 778-781 and Sept. 25, pp. 855-859, 18 figs. Sept. 18: Discussion of design and application of roller bearings particularly to rolling mills, based on experience of SKF industries; two-bearing design for ordinary hot rolling mills; sketches show distribution of pressure and methods of absorbing actual trust. Sept. 25: Tables give data on power economy measurements in wire rolling mill and rolling of steel strips in medium mill.

ROLLS

FAILURES. Sheet and Tinplate Rolls, J. S. Caswell. Iron and Coal Trades Rev. (Lond.), vol. 121, no. 3259, Aug. 15, 1930, pp. 217-218. Roll-breakage records; loads set up by deformation of iron; roll temperature; thermal variations with falling face temperature; discussion. Extracts from paper read before South Wales Inst. of Engrs.

S

SCREW THREADS

DARDELET SELF-LOCKING. The Dardelet Self-Locking Screw Thread. Engineering (Lond.), vol. 130, no. 3372, Aug. 29, 1930, p. 282, 3 figs. In this device forms of threads for nut and bolt are somewhat different; portion of bolt between threads is made slightly tapered, with parts of smaller diameter nearer head, i.e., toward left in figures, while crests of threads in nut are tapered to same angle in both directions.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Guiding Principles of the Activated Sludge Process, T. C. Hatton. Civil Eng., vol. 1, no. 1, Oct. 1930, pp. 31-36 and (discussion) p. 45, 4 figs. History of activated sludge process with special reference to work done in United States; outline of experimental work done at Milwaukee and other laboratories; air requirement; depth of aerating tanks; precipitation of activated sludge; grit removal and screening; screen tests; dewatering of sludge; filters and sludge driers; plant and operation costs; sale of sludge. Paper presented before Summer School for Engineering Teachers at Yale University.

SEWER TUNNELS

CONSTRUCTION. Shield Tunnelling Under Stony Creek, Melbourne, J. C. Coldham. Commonwealth Engr. (Melbourne), vol. 17, no. 12, July 1930, pp. 433-438, 4 figs. Report on driving of concrete sewer tunnels, 8 ft. 6 in. interior diam., 1,892 ft. long, mostly through soft silt; shield consists of mild steel cylinder 11 ft. 9⅝ in. in diam. and 8 ft. 8 in. long, constructed of ⅞-in. plate with electrically-welded joints; tunnel lining is constructed of fabricated timber rings.

SHEET-METAL TESTING

METHODS AND APPARATUS. Method and Apparatus Giving Extension Coefficient and Breaking Load of Metallurgical Products in Thin Sheets (Méthode et appareil d'essai donnant le coefficient d'extension et la charge de rupture des produits métallurgiques en feuilles), C. Jovignot. Académie des Sciences—Comptes Rendus (Paris), vol. 190, no. 22, June 2, 1930, pp. 1299-1302, 2 figs.; see also brief translated abstract in Chem. and Industry (Lond.), vol. 49, no. 34, Aug. 22, 1930, p. 772. Test piece is pressed tightly between two circular jaws, and measured hydraulic pressure is applied through reservoir below it till rupture of leather sphere occurs; nature of break furnishes indication of homogeneity of test piece.

Testing Method and Apparatus Giving Coefficient of Expansion and Breaking Load of Metallurgical Sheet Products (Méthode et appareil d'essai donnant le coefficient d'extension et la charge de rupture des produits métallurgiques en feuilles), C. Jovignot. Revue de Métallurgie (Paris), vol. 27, no. 8, Aug. 1930, pp. 443-448, 10 figs. Method described consists of submitting specimen sheet clamped between circular jaws to direct action of liquid; advantages of method are set forth.

Testing of Thin Sheets with Deep Drawing Hole-Widening Test (Die Pruefung von Feinblechen durch den Tiefzieh-Weitungsversuch), E. Siebel and A. Pomp. Mitteilungen aus dem Kaiser-Whilhelm-Institut fuer Eisenforschung zu Duesseldorf (Duesseldorf), vol. 12, no. 9, 1930, pp. 115-125, 15 figs. partly on supp. plate. Authors' previously indexed paper in vol. 11, no. 8, 1929 issue, described cupping test using disc test piece in which central hole was cut: stretch of material during cupping occurs by radial flow outward from central circular hole, which gradually widens; tests on sheet and strip steel and non-ferrous metals and on coarse-grained recrystallized metal.

The Testing of Sheet Metal. Metallurgist (Supp. to Engineer, Lond.), Sept. 1930, pp. 139-141. Attempts have been made both in England and France to overcome defects of existing types of cupping tests and to develop it into reliable quantitative method of measuring certain important properties of sheet metal; idea underlying these attempts, is to replace plunger which produces cup by pressure of liquid, thus eliminating friction between plunger and sample; machine of this kind is described by C. Jovignot in August number of Revue de Métallurgie, previously indexed.

SHEET-METAL WORKING

STAMPING. Effects Economies in Small Stampings Production, A. H. Allen. Steel, vol. 87, no. 14, Oct. 2, 1930, pp. 60, 62, and 64, 6 figs. Production methods and equipment at plant of Detroit Stamping Co., making washers, small drawn shells, flanges, and shims; seamless sleeves.

SMELTING PLANTS

NATURAL GAS FUEL. Natural Gas Firing at El Paso Smelting Works, E. R. Marble. Min. and Met., vol. 11, no. 286, Oct. 1930, pp. 466-467, 1 fig. Successful smelting with new fuel; temperature, high rate of heat transfer and length of flame.

SMOKE ABATEMENT

PROGRESS IN. Smoke Abatement Progress, V. J. Azbe. Power Plant Eng., vol. 34, no. 19, Oct. 1, 1930, pp. 1102-1104, 5 figs. Improved methods for domestic and industrial firing; fundamentals for smoke elimination; performance curves for steam heating boiler with and without down-draft baffle; arrangement of down draft baffle in firebox of heating boiler. Paper presented before World Power Conference, Berlin, June 1930.

SOUND INSULATION

MEASUREMENT OF. Measurement and Calculation of Sound-Insulation, V. O. Kundsen. Acoustical Soc. of America—Jl., vol. 2, no. 1, July 1930, pp. 129-140, 3 figs. Author has made some insulation measurements by three different typical methods now in use at different laboratories, and obtains good agreement for coefficients of transmission by all three methods; by assigning reasonable properties to test rooms at Riverbank Laboratories it is shown that Sabine's results on insulation of rigid partitions are in essential agreement with Chrisler's results; simple formula is suggested for calculating insulation properties of rooms.

SPILLWAYS

GATES. Large Spillway Gates at Hume Dam. Commonwealth Engr. (Melbourne), vol. 17, no. 12, July 1930, pp. 439-442, 4 figs. Description of series of 29 gates of overshot type, 15 ft. 8 in. deep and 22 ft. wide, built of heavy rolled steel joists with mild steel plates riveted on downstream side and vertical tie plates attached on reverse side; continuous caterpillar roller trains running in grooved facings at each side of gate; staunching device for preventing leakage at each side of gate consists of length of 2-in. brass tubing floating in machined groove casting attached to gate and bearing against machined facing on groove casting attached to pier.

STEAM

DISTRIBUTION IN INDUSTRIAL PLANTS. Economical Production and Distribution of Steam in Large Factories, F. Carnegie. Instn. Mech. Engrs.—Proc. (Lond.), no. 2, Mar. 1930, pp. 473-526 and (discussion), 527-552, 22 figs. Factors involved in steam generation in English industrial power plants; survey of existing conditions; economical distribution or conveyance of steam from generating centre to user centre; system of accounting which would accurately reflect unit cost of steam at each generating and user centre; checking consumption and accounting for steam used; results of steam investigation at Woolwich Arsenal. Paper previously indexed from various sources.

HIGH-PRESSURE. High-Pressure Steam—A Money Saver in Process Plants, P. W. Swain. Chem. and Met. Eng., vol. 37, no. 9, Sept. 1930, pp. 568-569, 1 fig. Examples of wide application of high-pressure steam both in United States and abroad.

STEAM CONDENSERS

MAINTENANCE AND REPAIR. Improving Plant Operation by Condenser Maintenance. Power Plant Eng., vol. 36, no. 18, Sept. 15, 1930, pp. 1035-1038, 11 figs. Clean tubes, air and water leakage form important factors in successful condenser performance; typical condenser layout of modern power plant is illustrated.

SURFACE. Principles of Surface Condenser Design. Mech. World (Lond.), vol. 88, no. 2281, Sept. 19, 1930, pp. 274-278, 7 figs. Outline of fundamental thermodynamic relations and formulae; critical investigation of influence of various factors upon which performance of condenser depends; effect of limited conductivity; influence of pressure drop over tube nest.

STEAM-ELECTRIC POWER PLANTS

DESIGN AND OPERATION. Design and Operation of Super Power Plants (Bau und Betrieb von Energie-Grossanlagen), H. Gleichmann. Archiv fuer Waermewirtschaft (Berlin), vol. 11, no. 9, Sept. 1930, pp. 299-300. Interchange of energy between states; planning of large electric works; most economic steam pressure; intermediate superheating; peak-load power plants; momentary reserve. Paper read before World Power Conference, Berlin.

SWITCHGEAR. Switchgear at the 250,000-kw. Steam Generating Plant at Stalingrad, U.S.S.R., A. J. Cowan. Gen. Elec. Rev., vol. 33, no. 10, Oct. 1930, pp. 577-580, 9 figs. Power station, now in course of construction, will have steam-turbine-generator capacity of 50,000 kva. with provision for increase in near future to 170,000 kva. and ultimately to 250,000 kva.; power will be generated at 11,000 volts, 50 cycles by two generators and stepped up by their individual transformers to 115,000 volts for transmission some 130 miles to factories and municipalities; plant switching equipment is illustrated and described.

TESTING. Power-Plant Testing, P. H. Hardie. Engineering (Lond.), vol. 130, no. 3374, Sept. 12, 1930, p. 324. Letter to editor referring to article by Guy and Lamb, on Operating Results with Recent Extensions of Barton Power Station, previously indexed from May 9 and 16 issues of this journal; under classification Steam-Electric Power Plant—Great Britain, present writer, who is test engineer of Brooklyn Edison Co., criticizes fact that test heat consumption was reported only to number of significant figures; he believes that accuracy of plus or minus 0.5 per cent is best than can be obtained consistently on turbo-generator units tested in operation in power station.

STEAM PIPE LINES

RISERS. Capacity of Return Risers for Steam and Vapour Heating Systems, F. C. Houghten. Heat., Piping and Air Conditioning, vol. 2, no. 10, Oct. 1930, pp. 859-865, 9 figs. Paper marks completion of general investigation of capacity of pipe for carrying steam, condensate, and air in various parts of steam heating systems, as outlined by Technical Advisory Committee on pipe sizes for heating systems, and as carried on by Research Laboratory in co-operation with Carnegie Institute of Technology; test set-up and operation of experiments to determine capacity of return rises; graphic analysis of experimental results.

STEAM POWER PLANTS

EQUIPMENT. Boilers, Superheaters, and Economizers. Nat. Elec. Light Assn.—Pub., no. 0-1, Aug. 1930, 34 pp., 61 figs. In 1929 boiler which produced 1,250,000 lbs. of steam per hr. was used; steam pressure and temperature have increased; there are more than 15 boilers operating at 1,400 lbs. or more and steam temperature in large number of stations is 750 deg. fahr. knowledge of control of caustic embrittlement has been greatly extended; use of water-cooled furnace walls, particularly on large units, is almost standard practice; methods of welding have progressed.

Steam and Gas Turbines and Reciprocating Engines (Dampf und Gasturbinen und Kolbenmaschinen), A. E. Kraft. Archiv. fuer Waermewirtschaft (Berlin), vol. 11, no. 10, Oct. 1930, pp. 325-328. Generation of power steam; intermediate superheating; back-pressure and bleeder turbines; operating costs and statistics; high-pressure reciprocating engines; economic limits between reciprocating steam engines and turbines; gas engines and gas turbines; binary-vapour processes; it is believed that no other prime mover will replace steam turbine in some time to come, and that steam power plants will remain in ascendency. Paper read before World Power Conference. Berlin.

HIGH PRESSURE. High-Pressure Steam and Economic Steam Pressure (Hochdruckdampf und wirtschaftlichter Dampfdruck), G. Frantz. Warme (Berlin), vol. 53, no. 39, Sept. 27, 1930, pp. 740-745, 1 fig. Properties of high-pressure steam and its most important feature as compared with low-pressure steam; based on examples it is shown that most economic pressure can be determined only individually, and after careful calculation taking all special conditions into consideration.

STEAM TURBINES

EFFICIENCY CHARTS. A Steam Turbine Efficiency Chart, F. C. Martin. Australasian Elec. Times (Melbourne), vol. 9, no. 8, Aug. 27, 1930, pp. 499-500, 1 fig. Chart incorporates all steam properties and data required by turbo-electric plant engineer to check up on efficiency of his plant, and thus detect deterioration therein, mismanagement, mud in condenser tubes, air leakage to condenser, etc. Presented at World Power Conference, Tokyo, 1929.

OVERLOADING. Steam Turbine Overloads, C. A. Parsons and R. Dowson. Elec. Rev. (Lond.), vol. 107, no. 2755, pp. 435-437, 3 figs. Case for use in power stations of steam turbines having larger emergency ratings than are at present usually specified; steam-turbine design for wide ranges of load; alternators with artificially increased ratings; comparative costs. Abstract of paper presented before World Power Conference.

STEEL

COLD WORKING. Cold Rolling Raises Fatigue or Endurance Limit, G. S. von Heydekampf. Iron Age, vol. 126, no. 12, Sept. 18, 1930, pp. 775-777 and 829, 4 figs. Investigation of endurance limits and elastic behaviour with special attention to mechanical hysteresis effect for ranges of stress within elastic and fatigue limits; influence of surface and surface damage on fatigue strength; by cold rolling surface of machine parts fatigue or endurance limit can be raised about 15 per cent.

HARDNESS TESTING. Hardness Tests of Steel Strip, G. A. Hankins. Engineering (Lond.), vol. 130, no. 3374, Sept. 12, 1930, p. 324. Letter to editor containing remarks and results of tests carried out at National Physical Laboratory; typical series of tests in Vickers machine are given in table, material being steel strip 0.0152 in. in thickness.

HEAT TREATMENT. Steel and Its Heat Treatment for Parts That Must Resist Wear, H. W. McQuaid. Heat Treating and Forging, vol. 16, no. 9, Sept. 1930, pp. 1159-1162 and 1164, 5 figs. Relative status and economy of different steels and treatments which can be used where hard surface is required; curves showing depth hardness relation of various steels and treatments; notes on nitriding; use of low carbon steel and low carbon alloy steel.

STEEL CASTINGS

SPECIFICATIONS. Revised Edition of DIN 1681 (Cast Steel) [Die Neuauflage des Normblattes DIN 1681 (Stahlguss)], L. Schmid. Maschinenbau (Berlin), vol. 9, no. 17, Sept. 4, 1930, pp. 565-571, 6 figs. German cast-steel specification revised from standpoint of manufacturer and consumer of cast steel; production methods, physical properties, composition and heat treatment.

STEEL FOUNDRY PRACTICE

SAND MOULDS. Notes on Behaviour of Sand Moulds in Steel Foundries, P. L. Goodale. Am. Foundry Men's Assn.—Trans., vol. 1, no. 9, Sept. 1930, pp. 471-477 and (discussion) 477-480, 4 figs. Characteristics and properties of core surfaces when casting steel against them; surface of casting burns in contact with air, forming oxide slag which forms some iron silicate by action with sand; ideas to overcome this objectionable feature of slag formation.

STREET RAILROADS

SUBSTATIONS. Montreal's Third Automatic Mercury Arc Railway Sub-Station, M. L. de Angelis. Elec. News (Toronto), vol. 39, no. 18, Sept. 15, 1930, pp. 53-56, 5 figs. Montreal Tramways Co. started operation of their third automatic mercury-arc rectifier station; electric equipment supplied by Canadian General Electric Co., comprises two 1,500-kw., 600-volt, 12-phase mercury-arc rectifiers capable of 50 per cent overload for two hours; two 13,000/935-volt, 60-cycle, three-phase delta/12-phase quadruple zig-zag transformers; 5,000-amp. reactor, bake-out transformer, water-cooling and circulating system, etc.

STRUCTURAL STEEL

OXYACETYLENE WELDING. Application of Gas Welding to Steel Construction (Anwendung der Gasschmelzschweissung fuer Stahlbauten), R. Cajar. Stahlbau (Supp. to Bautechnik) (Berlin), vol. 3, no. 7, Apr. 4, 1930, pp. 80-81, 14 figs.; see also translated abstract in Bldg. Science Abstracts (Lond.), vol. 3, no. 8/9, Aug./Sept. 1930, pp. 329-330. Possibility of using acetylene welding in construction of steel buildings and engineering structures is demonstrated, but its ability to compete with arc welding is questioned.

WELDING. Welding Steel Structures. Eng. News-Rec., vol. 105, no. 12, Sept. 18, 1930, pp. 442-449, 5 figs. Symposium of six articles: Highest All-Welded Office Building Erected in Dallas; Inspecting Field-Welding of Structural Steel, W. F. Carson; Rational Method of Welded Connection Design, A. Vogel; Large Area of Welded Steel Floor in Pittsfield, Mass., Garage, E. N. Adams; Welding Field Joints on 14-Storey Office Building, J. T. Whitney; Arc-Welding Facts That Should be Common Knowledge.

T

TEMPERATURE SCALE

INTERNATIONAL. Experimental Bases of International Temperature Scale in Low-Temperature Range (Die experimentellen Grundlagen der internationalen Temperaturskala, etc.), F. Henning. Zeit. fuer die Gesamte Kaelte-Industrie (Berlin), vol. 37, no. 9, Sept. 1930, pp. 169-174. Following points have been established: within measuring accuracy of plus or minus 0.03 deg., internationally accepted relation between resistance of platinum wire and gas-thermometrically determined temperature holds true within range of minus 190 to 0 deg.; platinum resistance thermometers of varying platinum purity calibrated according to international regulations give temperature values agreeing within plus or minus 0.01 deg.

TUNGSTEN CARBIDE

ALLOYS. Hard Metal Carbides and Cemented Tungsten Carbide, S. L. Hoyt. Am. Inst. of Min. and Met. Engrs.—Trans., Inst. of Metals Div., 1930, pp. 9-57, 22 figs. Broad review and correlation of literature on hard metal carbides and cemented tungsten carbide; metallography; preparation; physical properties; cutting efficiency; hot press process of preparing cemented tungsten carbide, yielding harder product. Bibliography.

TUNNELS

CONSTRUCTION. How to Secure Speed in Rock Tunneling, C. S. Hurter. Contractors and Engrs. Monthly, vol. 21, no. 3, Sept. 1930, pp. 98-100, 3 figs. Advantages of Rogers pass system; economy of drilling time; ventilating; suction vs. blowing on single headings; choice of explosives; co-ordinating drilling, blasting and removal of broken rock.

ELECTRIC CABLE. Concrete Cable Tunnels Show Economy, R. A. Cole. Elec. World, vol. 96, no. 13, Sept. 27, 1930, pp. 586-588, 6 figs. Monolithic tunnel structures with ducts in side walls used by Detroit Edison Co. to provide path for cables where streets of Detroit are so congested with various underground structures as to make usual conduit outlets impossible or impracticable can be built at distinct savings over usual bricked construction; main tunnel is nearly 1,100 ft. long, with about 400 ft. of smaller tunnel, at average depth of 67 ft.

VEHICULAR—VENTILATION. Development of the Ventilation System of the Holland Tunnel, A. C. Davis. Heat. Piping and Air Conditioning, vol. 2, no. 10, Oct. 1930, pp. 866-874, 14 figs. Ventilation problems confronting design engineers; exhaust gases from automobile engines; summary of important results; effect of automobile exhaust gases on animal life; power required to ventilate tunnel; characteristics of ventilation system.

TURBINES

SPIRAL CASINGS. Theory and Design of Spiral Casings (Theorie und Konstruktion von Spiralgehaeusen), B. Eck. Werft-Reederei-Hafen (Berlin), vol. 11, no. 14, July 22, 1930, pp. 309-318, 17 figs. Hydrodynamic principles of design of spirals for turbo-machinery are developed; for spirals with parallel and conical lateral walls with circular and rectangular cross-sections, exact formulae are derived, which permit recording of spirals; influence of wall friction on spiral itself and on rotor; theoretical treatment and practical experiments show that practice of disregarding friction in spiral, in case of single-stage turbo-machinery, often leads to faulty design.

W

WATER PIPE LINES

RIVETED STEEL. Building a Steel Water Supply Conduit under Usual Conditions, S. M. Van Loan. Water Works Eng., vol. 83, no. 19, Sept. 10, 1930, pp. 1356 and 1403-1404, 5 figs. Report on construction of 20,000 ft. of 93-in. x 9/16 in. riveted-steel pipe, from Torresdale filter plant to pumping units of Torresdale Station, Philadelphia Water Supply; types of construction; specification for pipe; construction of piers in marshland.

WATER TOWERS

CONCRETE-STEEL. Harpenden Water Tower—An Improved Method of Construction. Water and Water Eng. (Lond.), vol. 32, no. 381, Sept. 20, 1930, pp. 419-421, 4 figs. Report on construction of concrete-steel water tower, 83 ft. high, having capacity of 350,000 gals.

WELDING

IRON AND STEEL PLANTS. Welding in Steel Plants (Schweissen in Huettenwerken), Adran. V.D.I. Zeit. (Berlin), vol. 74, no. 19, May 10, 1930, pp. 610-611. Abstract of following papers, presented at meeting of Welding Committee of Society of German Engineers: Acetylene or Arc Welding in Steel Works, Drescher; Water-gas Welding for Manufacture of Containers, Boilers and Pipes, Pohl; Progress in Development of Weld Metals, Hoffmann; Transfer of Metal in Arc Weldings, Hilpert.

STRESSES IN. Distribution of Stress in Parallel Welding Fillets, H. M. MacKay and A. M. Bain. Can. Jl. Research (Ottawa), vol. 3, no. 3, Sept. 1930, pp. 260-271, 11 figs. Mathematical theory is developed for distribution of stress in welded joints with parallel fillets, in case where each of members connected by weld is of uniform cross-section; theory is verified by strain measurements on two specimens of type of joint considered.

TESTING. Classification and Physical Tests for Various Types of Welded Plate Joints, G. R. Exley. Gen. Elec. Rev., vol. 33, no. 10, Oct. 1930, pp. 581-591, 8 figs. Variables affecting classification; comparison of rolled steel and deposited steel; effects of ductile extensibility; test specimens; test results; comparison of characteristics.

Fatigue and Impact Tests for Welds, C. H. Jennings. Am. Welding Soc.—Jl., vol. 9, no. 9, Sept. 1930, pp. 90-104, 13 figs. Need of fatigue tests and problems encountered in making them; information obtained by author on impact strength of arc welds.

Magnetic Testing of Butt Welds, T. R. Watts. Am. Welding Soc.—Jl., vol. 9, no. 9, Sept. 1930, pp. 49-68, 17 figs. Magnetographic method has been employed experimentally by Research Laboratories, Westinghouse Electric and Manufacturing Co., for nearly two years; several minor variations and improvements developed during this time are described.

WIND TUNNELS

DESIGN OF CORNERS. The Design of Corners in Fluid Channels, G. J. Klein, K. F. Tupper and J. J. Green. Can. Jl. Research (Ottawa), vol. 3, no. 3, Sept. 1930, pp. 272-285, 25 figs. Results of detailed investigation of characteristics of variety of modified corners in wind tunnel; report includes data on vane shape, spacing and incidence, on variation of accompanying air flow, and on resulting influence on corner resistance; variety of methods have been employed to analyse conditions existing in air stream at vanes and, from information so obtained, it is possible to select vane section and method of use which will lead to most desirable features in flow at corner.

WIRE GALVANIZING

PROCESS OF. The Process of Zinc Coating Steel Wires, A. D. Turnbull. Eng. Jl. (Montreal), vol. 13, no. 9, Sept. 1930, pp. 553-558, 2 figs. Factors which influence rate of corrosion of wire; uses of galvanized steel wire; process of galvanizing; advantages of wire drawing power block; tests of quality of galvanized wire.

WIRE ROPE

MINE HOISTS. Wire-Rope Failures (Bemerkenswerte Brueche von Foerderseilen), H. Herbst. Glueckauf (Essen), vol. 66, no. 33, Aug. 16, 1930, pp. 1091-1096, 9 figs. Account of two rather unusual failures of hoist cables, showing effect of dynamic stresses of end section of rope; suggestions for timely detection of internal damages and for their prevention.